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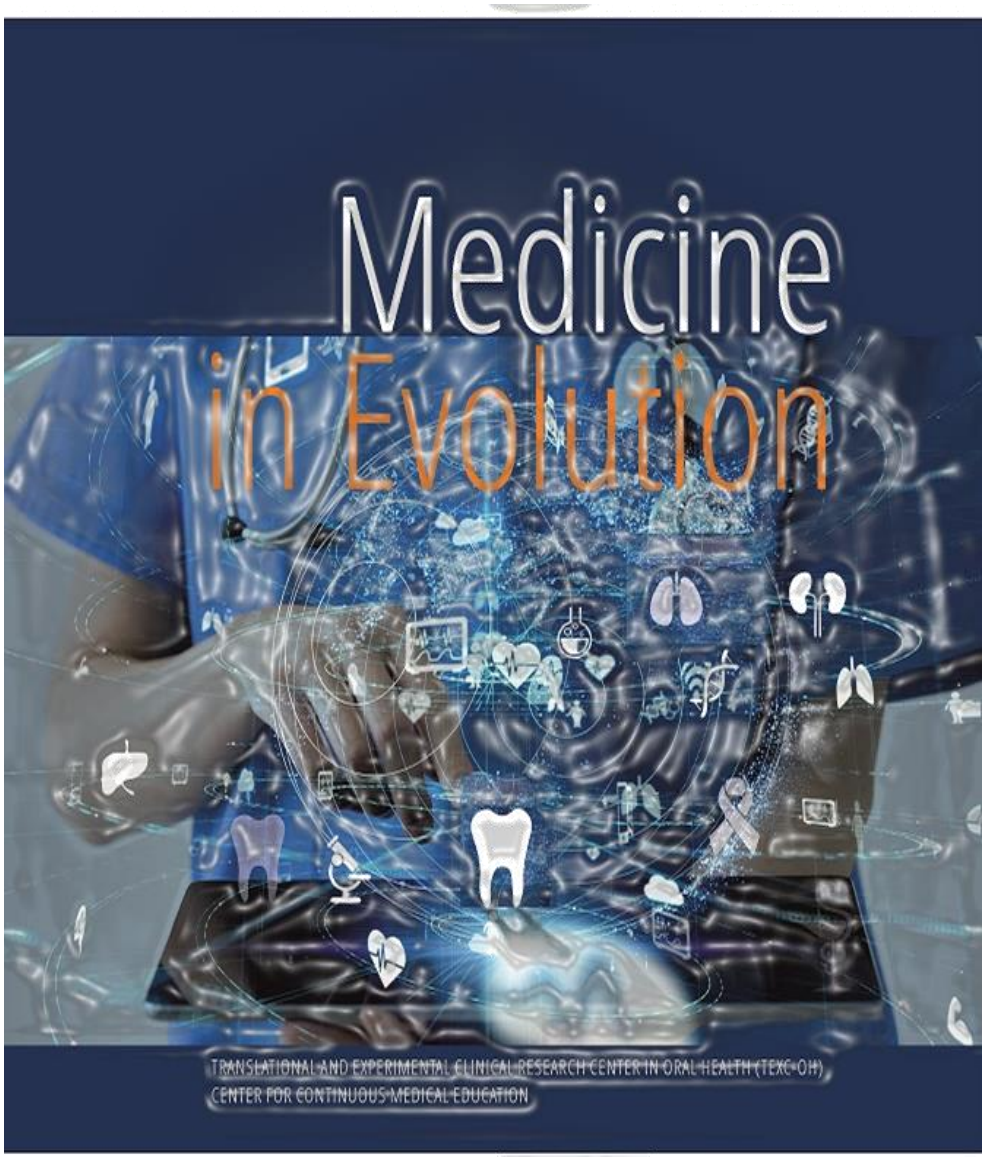
# MEDICINE IN EVOLUTION

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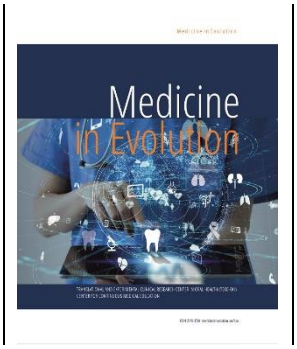

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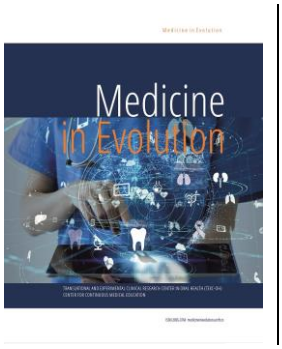
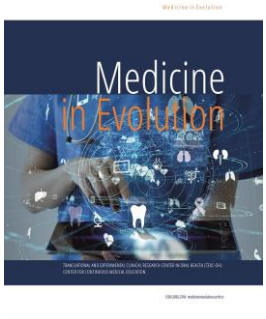


# Review: The tumor microenvironment of melanoma

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## Abstract

**Aim and objectives:** Melanoma is one of the most complex skin cancers based on its numerous somatic mutations and chromosomal instability. Besides the traditional causative factors, such as ultraviolet radiation, or genetic factors, recent studies showed that melanoma highly depends on its adjacent microenvironment. A malignant tumor, like melanoma, is composed of oncogenic cells, regular cells (melanocytes, macrophages, mast cells, keratinocytes, and others), the supporting stroma, which includes fibroblasts, endothelial cells, immune cells, soluble molecules, and the extracellular matrix (ECM). This article aims to present the tumor microenvironment's main functions in the development or progression of melanoma. **Material and methods:** we have studied some of the most recent 30 articles based on the role of the microenvironment in melanoma. **Results:** After analyzing the most recent articles regarding melanoma's tumor microenvironment (TME) and its impact, we have found that the cells that comprise the TME can affect melanoma's onset or progression. TME's cells actively interact with each other and have many functions, from tumor-suppressing roles to the initiation or progression of melanoma. **Conclusions:** Understanding the complex interplay between tumor cells, and systemic mediators of disease progression is critical for the rational development of effective melanoma treatments. Each cell involved in the TME can play an important role either in the onset or advancement of melanoma with the help of certain mutagenic factors.

**Keywords:** melanoma, microenvironment, mast cells, mutations

## INTRODUCTION

Melanoma develops through the oncogenic transformation of melanocytes, under the influence of various mutagenic factors, these cells being derived from the neural crest [1], [2]. The malignant transformation of melanocytes begins with a proliferative stage in which the formation of common nevi occurs, then an abnormal and dysplastic growth of melanocytes takes place, with the onset of atypical nevi [2]. Subsequently, the tumor will grow radially, with the intraepidermal development of the tumor, then a vertical growth would occur, with the invasion of the dermis and subcutaneous tissue. Finally, the cancerous cells acquire the ability to metastasize to other organs [2]. When atypical melanocytes cross from the epidermis into the dermis a "trigger reaction" takes place where an inflammatory infiltrate appears, formed of macrophages, histiocytes, and lymphocytes and this could be considered the first step of the immune system in trying to block the migration of atypical cells [3]. In this process, many atypical melanocytes are destroyed, but some manage to continue their path in melanoma development and the metastasizing process [3].

The onset of melanoma is also associated, both through direct or indirect interactions, with the tumor microenvironment formed by various cells (mast cells, macrophages, keratinocytes, or other immune system cells, and cells that form the cutaneous blood vessels) that interact with each other through signaling proteins and cytokines [1]. Recent studies have shown that the cells mentioned above could be involved in all stages of melanoma: initiation, 0enhance the migration of cancerous cells and therefore could be involved in melanoma progression and the metastatic process [1].

All this considered melanoma may also arise "de novo" (de novo melanoma / DNM) under certain mutational factors, and not only on preexisting lesions (nevus-associated melanoma/NAM) [1].

### *Aim and objectives*

This article aims to present the microenvironment's main roles in the appearance, or progression of melanoma. Some of the TME cells will be presented for their role in melanoma's initiation or progress.

## MATERIALS AND METHODS

We have studied over 30 of the most recent articles regarding the role of the tumor microenvironment in melanoma, to provide a review of the possible causes of the initiation and progression of this neoplasia and the importance of the TME.

## RESULTS

The present study will be categorized into 3 sections, as follows: 1. The role of the tumor microenvironment in melanoma, 2. Immune system cells, 4. Vascular cells - angiogenesis and melanoma. After analyzing the latest articles on the topic of the tumor microenvironment in melanoma the following facts were found:

1. The role of the tumor microenvironment in melanoma

The tumor microenvironment (TME) composition differs from tumor to tumor, but the most frequently encountered features include immune cells, stromal cells, blood vessels, and extracellular matrix (ECM) [4]. Some studies attest that TME could be an active promoter of cancer progression, as in tumor growth there is a relationship that develops between the oncogenic cells and the components of the TME to support the survival of neoplastic cells, the local invasion and metastatic dissemination [4].

Therefore, melanoma's onset and progression are based on a complex evolution from a common nevus, at first through a radial superficial growth phase, then a vertical invasive phase that leads to an eventual metastatic process [5]. Epidermal melanocytes are attached to the basement membrane, and their migration is controlled mostly by the surrounding keratinocytes [5]. Thus, the epidermis represents the first microenvironment responsible for melanoma progression [5]. This process involves cell-to-cell interactions and the secretion of a broad range of bioactive molecules [5]. At first, there is a breakdown of the dermo-epidermal basement membrane followed by the migration of oncogenic melanocytes into the dermis [5]. Then, the microenvironment must support the multiplication and survival of melanocytes outside the normal epidermal–melanin units [5].

When atypical melanocytes cross from the epidermis into the dermis a "trigger reaction" occurs where an inflammatory infiltrate takes place, formed of macrophages, histiocytes, and lymphocytes and this may be the first step of the immune system in trying to block the migration of atypical cells [3]. In this process, many atypical melanocytes end up being destroyed, but some manage to continue their path in melanoma development [3].

The tumor microenvironment is formed of various immune cells, fibroblasts, endothelial cells, and the extracellular matrix (ECM), among others [6]. The normal tissue microenvironment can block cancer outgrowth through the suppressive functions of immune cells, fibroblasts, and the ECM [6]. However, for cancer to progress, it must evade these functions and influence cells in the TME to become tumor-promoting, resulting in increased multiplication, and local invasion [6]. TME also plays an important role in the metastatic process, stimulating cancer cell survival in the circulation, and promoting extravasation [6]. During the metastatic stages, the TME helps to control metastatic cell dormancy, and subsequent metastatic outgrowth [6].

1.1. Keratinocytes

Primary melanomas, originating from melanocytes, appear in close interaction with keratinocytes, which are known for their role in melanoma initiation, progression, and immune escape [7].

The first signs of oncogenic transformation include increased melanocyte density, changes in cellular features, and migration from the dermal-epidermal junction [7].

At first, melanoma in situ can be formed through a pagetoid growth with superficial spreading for BRAFV600E cells or through a lentiginous growth with confluent individual melanocytes along the dermo-epidermal junction for BRAFnonV600E cells, leading to the radial growth phase [7]. Later, the vertical growth phase can occur and is associated with an epithelial-to-mesenchymal-like transition or phenotypic switching of oncogenic cells triggered by certain genetic events and microenvironmental factors [7]. Therefore, some studies attest that keratinocytes are involved in melanoma initiation (through the BRAFV600E mutation), invasion/progression (eventually through activating melanoma cell Notch signaling) and may be involved in melanoma-associated inflammation (melanoma initiation, progression, and metastasis have long been associated with chronic inflammation) [7].

2. Immune system cells

Immune cells are a very important component of the TME, as immune cells can either inhibit tumor growth or initiate it [4]. The immune system is mostly known for having two main functions: non-specific and acquired immunity [8].

Adaptive immunity is activated by exposure to certain antigens and is involved in "evaluating" threats through immunological memory and in enhancing immune responses [4]. T-cells, B-cells, and NK (natural killer) cells belong to the adaptive immune response [4]. In general, macrophages and natural killer (NK) cells recognize and eliminate oncogenic cells. Innate immunity can be considered a non-specific defense mechanism that appears hours

after a foreign antigen enters the body [4]. Cells that carry out an innate immune response include macrophages, neutrophils, and dendritic cells [4]. Also, along with the dendritic cells, some studies confirm that macrophages are involved both in innate and acquired immunity [8].

2.1. Macrophages

Macrophages are noted in some studies as an important part of the tumor microenvironment in melanoma, as they are considered to have multiple effects on this neoplasm [9]. Macrophages may also have an important role in the immune system and their presence in a tumor could be associated with a poor prognosis [9].

Phenotypically, macrophages can be classified into two categories: classically activated (M1) and alternatively activated (M2) macrophages [9]. M1 macrophages can activate the adaptive immune system and may have antitumor abilities due to their pro-inflammatory response and the production of pro-inflammatory factors such as IL-6, IL-12, tumor necrosis factor (TNF), etc. As opposed to the M1 macrophages, alternatively activated (M2) macrophages have pro-tumor abilities and are associated with poor survival [9], see Table 1. Moreover, some studies show that macrophages may participate in tumor progression and immunosuppression, and can also promote tumor proliferation, lymphangiogenesis, therapy resistance, immune evasion/invasion, and metastasis [6], [9].

Table 1. M1 and M2 macrophages effects on melanoma [9]

| **Classically activated (M1) macrophages** | **Alternatively activated (M2) macrophages** |
|---|---|
| Inhibits the invasion and migration of tumoral cells in melanoma | Promotes the invasion and migration of tumoral cells in melanoma |
| Decreasing the metastatic ability of tumoral cells | Increasing the metastatic ability of tumoral cells |
| Both types of macrophages may inhibit the growth of melanoma | |
| Triggers immune responses and normalizes irregular tumor vascular network | Promotes angiogenesis |
| Improves the efficacy of PD-1 immunotherapy and of the doxorubicin chemotherapy | Induces melanoma resistance to PD-1 inhibitors - resulting in anti-PD-1/PD-L1 therapy resistance |

2.2. Mast cells

Mast cells originate from the bone marrow and possess many properties that enable them to participate in a diverse range of biological activities [10], [11]. They phagocytose, process antigens, produce cytokines, and release preformed (histamine, proteoglycans, proteases) and newly formed (leukotrienes, prostaglandins) mediators [11].

Mast cells (MC) are granulocytes that are involved in mediating the host defense and in the maintenance of homeostasis by degranulating histamines, cytokines, and chemokines [6]. They are known for their role in allergies and autoimmunity, but they can also infiltrate tumors [6], [10]. MC can exert both pro- and anti-tumorigenic activities depending on the microenvironmental stimuli [6], [10]. They can directly target tumor cells, but they mainly regulate the recruitment and activity of other immune populations and the endothelium [6]. From our research, regarding melanoma, mast cells can be present in lymph node metastases, in the vicinity of vessels in the intratumoral area (known for their role in promoting angiogenesis), and in the areas bordering the melanoma.

It seems that the tumor microenvironment can be either an ally or an enemy in cancer development, as MC infiltration could be critical in remodeling the TME by regulating immune and inflammatory reactions [10].

MC degranulation might be determined by tumor hypoxia and thus MCs can produce reactive oxygen species that are functionally correlated with their activation [10]. MCs can release not only pro-angiogenic factors, such as bFGF, VEGF, transforming growth factor β, TNF-α, and IL8, but also heparin and proteases that liberate pro-angiogenic factors [10].

Therefore, the importance of MCs lies in the genesis, growth, and metastasis of skin cancer [10]. Their wide biological characteristics and distribution (strategic locations near blood vessels, nerves, inflamed tissues, and neoplastic foci) enable them to play a crucial role in a multitude of pathologic processes [11].

3. Vascular cells - angiogenesis and melanoma

Angiogenesis, the process of developing new blood vessels, is essential for the formation of tumors and once a tumor grows beyond 1–2 mm, it must establish its vascular supply of oxygen and nutrients [6]

Endothelial cells (ECs) form a single cell layer that lines all blood vessels and display a remarkable heterogeneity and plasticity, as they control the passage of proteins, cells, oxygen, and fluid into the surrounding tissue [6]. Still, ECs that line tumor blood vessels differ from normal ECs [6]. Tumor ECs express low levels of adhesion molecules, which causes an impaired barrier function, and they express increased levels of inhibitory immune checkpoint molecules, which contributes to immunosuppression [6].

Lymphatic ECs (LECs) form the walls of lymphatic vessels and in the TME, they provide a dissemination route for cancer cells in addition to blood vessels [6]. Some studies note that LECs have recently been recognized as direct regulators of anti-tumor immunity and immunotherapy response, as LECs can present tumor antigens but also immune checkpoint molecules [6].

As the malignant tumor develops, new vessels need to be formed to maintain an adequate local supply of nutrients and oxygen, a process driven by the imbalance between pro- and anti-angiogenic mediators [10]. Developing a rich vascular network seems vital for melanoma cells during the vertical growth phase, as melanoma cells require nutrients and oxygen to sustain their vertical growth [12]. Therefore, angiogenesis is essential for the occurrence and development of melanoma.

Hypoxia, the lack of oxygen in tissue, is a major trigger for angiogenesis [6]. Many molecules that respond to hypoxia can promote angiogenesis, of which vascular endothelial growth factor (VEGF) and its downstream signaling pathway are the predominant drivers [6]. In melanoma patients, high intratumoral and systemic VEGF levels correlate with poor disease outcomes across cancer types [6].

Generally, in a normal state, pro-angiogenic and anti-angiogenic factors should be in a dynamic balance [12]. However, this balance of angiogenesis is often out of control in melanoma, therefore, large amounts of pro-angiogenic factors are released which play a dominant role in angiogenesis, leading to the formation of new blood vessels [12]. Then, with an adequate supply of nutrients, tumor cells can increase rapidly without control and become more invasive, ultimately leading to metastasis [12]. Pro-angiogenic factors are released by melanoma cells and can bind receptors expressed on endothelial cells, which determines the initiation of the downstream signaling effects to stimulate melanoma proliferation, metastasis, and differentiation [12].

Similarly, tumor lymphatics also have important immunoregulatory properties [6]. Like blood ECs, lymphatic ECs can suppress T cell responses through various mechanisms, including expression of immune checkpoint molecules and antigen presentation in the absence of co-stimulatory molecules [6]. High levels of VEGF-C, the predominant driver of lymphangiogenesis, are associated with increased metastasis and reduced survival [6].

## DISCUSSIONS

Melanoma can be considered a complex ecosystem comprised of tumor cells and a multitude of non-cancerous cells, embedded in an altered extracellular matrix [6]. The tumor

microenvironment (TME) is formed of a multitude of immune cell types, endothelial cells, pericytes, and other tissue-resident cell types [6]. Primary melanoma tumors can develop on pre-existing nevi ("nevus-associated melanoma") or spontaneously ("de novo").

Melanocytes are specialized cells that synthesize and distribute melanin, a pigment with a role in the pigmentation of the skin, hair, eyes, and inner ear. Approximately 128 genes are involved in skin pigmentation and ensure this process through a complex mechanism. The disruption of the functions of these genes can cause the onset of pigmentary pathologies, affecting development (specification, migration, survival, proliferation), and melanocyte differentiation. Differentiated melanocytes produce melanosomes, organelles specialized in melanin synthesis. Melanosomes are distributed by melanocytes, at the level of suprabasal keratinocytes, which multiply towards the surface of the skin, where they form a protective barrier of the skin against various environmental factors (especially ultraviolet radiation). The density and differentiation of melanocytes are influenced by the environment, respectively by ultraviolet radiation, and by the factors secreted by keratinocytes and fibroblasts. Thus, melanoma has a heterogenous pathophysiology, caused by genetic mutations that imply cell multiplication, differentiation, and survivance.

The immune system is important for protection against various pathogens, for wound healing, and for the elimination of damaged cells [6]. To execute these roles, the immune system is incredibly diverse and adaptable, but despite the ability of adaptive immune cells to recognize and eliminate pathogens, cancer cells can escape destruction and form tumors [6]. At the earliest stages of tumor initiation, cancer cells could be targeted for destruction by the immune system [6]. Fibroblasts and macrophages may help inhibit tumor growth initially, but they can be influenced by the developing cancer to gain pro-tumorigenic functions [6]. For example, macrophages can support angiogenesis and invasion by secreting growth factors, cytokines, and proteases [6].

Once tumors have established the reinforcing connections between angiogenesis, inflammation, and fibrosis, they can develop local invasion [6]. Invasion is a complex, multi-step process that involves cancer cells detaching from each other, migrating from the primary tumor, and invading the surrounding stroma [6].

The next step in the metastatic process is the intravasation of cancer cells into the blood or lymphatic stream. The mechanisms by which cancer cells cross enter the circulation are complex, and influenced by cancer cell-intrinsic characteristics, the physical properties of the ECM and type of vessels, microenvironmental factors, and hypoxia [6]. The integrity of the blood vessels in tumors is often impaired, which cancer cell intravasation [6]. Lymphatic intravasation is another route that cancer cells may choose to disseminate, although the underlying mechanisms are not fully understood [6].

Regarding angiogenesis and melanoma, the main mechanisms of blood vessel formation described in this cancer are the formation of new blood vessels, the movement of cells along the surface of blood vessels, vasculogenic mimicry (melanoma cells remodel and form patterns of loops and channels that mimic vascularization) and vasculogenesis (the formation of blood vessels from endothelial progenitor cells). Similarly, it seems that tumor lymphatics may also have important immunoregulatory properties as they can suppress T cell responses through various mechanisms, including expression of immune checkpoint molecules and antigen presentation in the absence of co-stimulatory molecules [6]. For example, a high level of VEGF-C is associated with increased metastasis and reduced survival [6].

The literature is more focused on the study of tumoral cells, but recently, studies related to the importance of the tumor microenvironment have been published. The interrelationships between melanoma and the tumor microenvironment include cancer-associated fibroblasts, myeloid-derived suppressor cells, tumor-associated macrophages,

clustered differentiation of lymphocytes, dendritic, endothelial, lymphatic cells, and mast cells (MC). Mast cells play one of the most important roles in melanoma as they can be involved in the development, progression, and metastasis of this neoplasm through the secretion of proteases, and pro-angiogenic factors - both pro-inflammatory and immunoinhibitory mediators. The role of mast cells as an important player in angiogenesis is well known. This is due to the release of pro-angiogenic mediators such as IL-8, NGF, TNF-alpha, TGF-beta, urokinase-like plasminogen activator, promotion of endothelial cell proliferation, breakdown of connective tissue matrix, histamine, and release of VEGF-A, VEGF-B, VEGF-C, VEGF-D [6]. Similar to MC, other cells such as keratinocytes and macrophages can also promote angiogenesis, promote the invasion/migration of melanoma cells, and play a role in metastasis.

From our research, it seems that each cell involved in the TME can play an important part in either the onset or advancement of melanoma and later on in metastatic melanoma.

## CONCLUSIONS

Melanoma is a type of skin cancer that develops from the cancerous transformation of the melanin-producing cells located in the basal layer of the epidermis. At first, the unrestrained multiplication of melanocytes can form a nevus, but over time, that nevus can turn into melanoma, under the influence of various mutagenic factors. Still, some tumors can develop in a spontaneous way (de novo melanoma) more often than on pre-existing nevi (nevus-associated melanoma).

The pathophysiology of melanoma is not known in its entirety, but several factors may develop or stimulate this malignant process. The tumor microenvironment (TME) seems to play a crucial role in melanoma, and it is formed of diverse immune cells, fibroblasts, endothelial cells, pericytes, and various other tissue-resident cell types. Each cell involved in the TME can play an important part in either the onset or advancement of melanoma with the help of certain mutagenic factors.

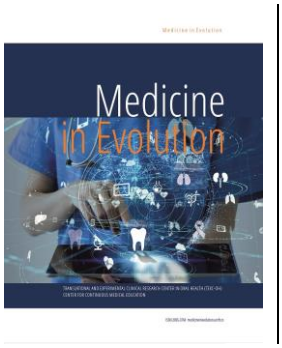
All this considered, this study aimed to present a review of the most recent articles on the tumor microenvironment and to observe the role of each TME cell in the onset, or progression of melanoma. In the future, the various functions of TME might be exploited to develop antitumoral therapeutic strategies.

## REFERENCES

1. Mihulecea C-R, Rotaru M. Review: The Key Factors to Melanomagenesis. Life. 2023; 13(1):181. https://doi.org/10.3390/life13010181
2. Villanueva J, Herlyn M. Melanoma and the tumor microenvironment. Curr Oncol Rep. 2008 Sep;10(5):439-46. doi: 10.1007/s11912-008-0067-y. PMID: 18706274; PMCID: PMC5662003.
3. Botti, G., Cerrone, M., Scognamiglio, G., Anniciello, A., Ascierto, P. A., & Cantile, M. (2012). Microenvironment and tumor progression of melanoma: New therapeutic prospectives. Journal of Immunotoxicology, 10(3), 235–252. https://doi.org/10.3109/1547691X.2012.723767
4. Anderson NM, Simon MC. The tumor microenvironment. Curr Biol. 2020 Aug 17;30(16):R921-R925. doi: 10.1016/j.cub.2020.06.081. PMID: 32810447; PMCID: PMC8194051.
5. Marrapodi R, Bellei B. The Keratinocyte in the Picture Cutaneous Melanoma Microenvironment. Cancers (Basel). 2024 Feb 23;16(5):913. doi: 10.3390/cancers16050913. PMID: 38473275; PMCID: PMC10930874.
6. De Visser KE, Joyce JA, The evolving tumor microenvironment: From cancer initiation to metastatic outgrowth, Cancer Cell 41, March 13, 2023 [a] 2023 Elsevier Inc.

7. Dainese-Marque O, Garcia V, Andrieu-Abadie N, Riond J. Contribution of Keratinocytes in Skin Cancer Initiation and Progression. International Journal of Molecular Sciences. 2024; 25(16):8813. https://doi.org/10.3390/ijms25168813
8. Hussein MR. Tumour-associated macrophages and melanoma tumourigenesis: integrating the complexity. Int J Exp Pathol. 2006 Jun;87(3):163-76. doi: 10.1111/j.1365-2613.2006.00478.x. PMID: 16709225; PMCID: PMC2517364.
9. Zhou Q, Fang T, Wei S, Chai S, Yang H, Tao M, Cao Y. Macrophages in melanoma: A double-edged sword and targeted therapy strategies (Review). Exp Ther Med. 2022 Aug 26;24(4):640. doi: 10.3892/etm.2022.11577. PMID: 36160877; PMCID: PMC9468802.
10. Alda S, Ceausu RA, Gaje PN, Raica M, Cosoroaba RM, Mast Cell: A Mysterious Character in Skin Cancer, In Vivo Jan 2024, 38 (1) 58-68; DOI: 10.21873/invivo.13410.
11. Ch'ng S, Wallis RA, Yuan L, Davis PF, Tan ST, Mast cells and cutaneous malignancies, Modern Pathology, Volume 19, Issue 1, 2006, Pages 149-159, ISSN 0893-3952, https://doi.org/10.1038/modpathol.3800474.
12. Cazzato G, Ingravallo G, Ribatti D. Angiogenesis Still Plays a Crucial Role in Human Melanoma Progression. Cancers. 2024; 16(10):1794. https://doi.org/10.3390/cancers16101794

# Colorectal cancer: Population aspects in Bihor County, Romania

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## Abstract

**Aim and objectives:** The main purpose of our study is to establish prevalence and distribution of colorectal malignancies among people of Bihor County, Romania and to identify the survival according to TNM classification;

**Material and methods:** We included 100 patientes collected in a time interval between January 1st 2022 and July 1st 2024 who presented in the County Clinical Emergency Hospital Bihor, who had histopathologic evidence of colorectal cancer.

**Results:** From the total number of 100 patients included in the study 57 were males and 43 were females and the the mean age at diagnosis of colorectal cancer was between 61-70 years old (41%).

**Conclusions:** This study aims to provide valuable insights into how sex, age, environment, the histopathological result, TNM classification and survival interact to influence colorectal cancer characteristics and outcomes in Bihor County, Romania.

**Keywords:** colorectal cancer, population, TNM classification, stage of diseases, survival

## INTRODUCTION

Colorectal cancer is one of the most common cancers both worldwide and in our country. This pathology ranks 3rd in the ranking of the most common oncologic diagnoses, being the third most common cancer among men, after bronchopulmonary and prostate cancer and the second most common cancer among women, after breast cancer both at the World and national levels [1–3]. The number of new cases reported in 2020 at the World level was 1.9 million, and in our country in 2020 about 98,886 new oncological cases were diagnosed, of which about 13,000 cases were due to colorectal tumors [1,2].Thus, this type of cancer accounts for 13.1% of all cancers in Romania, according to statistics from the International Agency for the Fight Against Cancer cited by the Coalition of Organizations of Patients with Chronic Diseases in Romania (COPAC) [2,4].Colorectal cancer mortality is also high, Romania occupying the 9th place at the World level, mainly among males [1].

Most studies have shown that the incidence of colorectal cancer is higher after the age of 50, and in terms of gender, men are more commonly affected than women [1,3–6]. This is thought to be due to men's unhealthier lifestyles, with a diet rich in red meat, more alcohol consumption, more smoking, a sedentary lifestyle and, last but not least, abdominal fat storage [1,7–9].

Histopathologically, the most common types of colorectal tumors are adenocarcinomas, which account for about 98% of all cases detected at this level [10]. The remaining 2% are represented by: low-grade tubuloglandular adenocarcinoma, neuroendocrine tumors and large cell and small cell neuroendocrine carcinomas [10].

Regarding the location of the tumor, apparently those located in the rectum are more common than those in the colon [4,11,12].

### *Aim and objectives*

The main purpose of our study is to establish prevalence and distribution of colorectal malignancies among people of Bihor County, Romania and to identify the survival according to TNM classification, respectively the stage of disease.

## MATERIAL AND METHODS

We aimed for analytical, observational, retrospective study. We included 100 patientes collected in a time interval between January 1st 2022 and July 1st 2024 who presented in the, County Clinical Emergency Hospital Bihor, who had histopathologic evidence of colorectal cancer and who presented to 4 specific doctor of oncology and radiotherapy specialisation. For each patient we collected demographic data as: age, gender, residence, localization of the tumor, histopathological type, tumoral grading, TNM classification and survivel. The Research Ethical Approval for the study conducted was granted by the Ethics Comitee of Clinical Emergency Hospital County Bihor, Nr 39653/15.11.2023. We also with the help of Cancer Registry of the above- mentioned Hospital we noticed a downward trend regarding the number of new cases of colorectal cancer in all the Hospitals in Bihor County, namely in 2022 there were 2445 new cases and in 2023- 2280 new cases.

All the data, were introduced in Microsoft Excel, quantitative and categoricale variables (nominal and ordinal) and then with Statistical Package for Social Sciences (SPSS), version 26 we obtained all the results. For categorical variable crosstabulation tables, Chi-square test, Pearson Coefficent Correlation, Fiecher test, Eta Coefficient, frequency tables were applied and for quantitative variable, mean, median, standard derivations, One way Anova were calculated. Cut off value $p<0.05$, at a confidence interval of 95% (numerical variables).

## RESULTS

From the total number of 100 patients included in the study 57 were males and 43 were females and the the mean age at diagnosis of colorectal cancer was between 61-70 years old (41%) (Table I and Table II). For 55 patients living environment was the urban place and 45 was rural place (Tabel 2). Regarding to the localization of colorectal tumors, we classified into: cecum, ascending colon, transverse colon, descending colon, sigmoid, upper rectum, middler rectum and lower rectum and the most affected part was the middle rectum (17%).

Table I. Absolute and percentage distribution by age

| Age | N% |
|---|---|
| 31-40 | 2(2%) |
| 41-50 | 4(4%) |
| 51-60 | 17(17%) |
| 61-70 | 41(41%) |
| 71-80 | 30(30%) |
| 81-90 | 6(6%) |

Table II. Absolute and percentage distribution by sex, environmental and survival of colorectal cancer

| Sex | N% | Environmental | N% | Survival | N% |
|---|---|---|---|---|---|
| Male | 57(57%) | Urban | 55(55%) | Yes | 89(89%) |
| Female | 43(43%) | Rural | 45(45%) | No | 11(11%) |

In terms of histopathologic finding, adenocarcinomas were the most frequently reported representing 95% of all cases. According to TNM classification, the stage of colorectal cancers most common diagnosed in our study was IIA. From the point of view of of patient survival 89% of patients survived and 11% died (Tabel 2).

We tried to highlight a link between tumor location and sex, so that among females the lower rectal cancer was more common compared to males where the middle rectal cancer was more common, but without a p statistically significant (p= 0.382) (Table III).

Table III. Absolute and percentage distribution by sex and localization of colorectal cancer. p-values refer to the chi-square test for between-group differences. P value =0.382

| Sex | Male | Female |
|---|---|---|
| Localization | N % | N % |
| Cecum | 4(4%) | 3(3%) |
| Ascending colon | 3(3%) | 3(3%) |
| Transverse colon, | 10(10%) | 5(5%) |
| Descending colon, | 8(8%) | 3(3%) |
| Sigmoid | 8(8%) | 5(5%) |
| Upper rectum, | 5(5%) | 10(10%) |
| Middler rectum | 12(12%) | 5(5%) |
| Lower rectum | 3(3%) | 2(2%) |

We sought to examine the relationship between sex and age at the time of colorectal cancer diagnosis. Our findings indicated that both sexes were affected within the 61-70 age range. However, the results were not statistically significant, with a p-value of 0.809 (Table IV).

Table IV. Absolute and percentage distribution by sex and age of colorectal cancer. p-values refer to the chi-square test for between-group differences. P value = 0.809

| Age | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-90 |
|---|---|---|---|---|---|---|
| Sex | | | | | | |
| Male | 1(1.8%) | 1(1.8%) | 11(19.3%) | 24(42.1%) | 17(29.8%) | 3(5.3%) |
| Female | 1(2.3%) | 3(7%) | 6(14%) | 17(39.5%) | 13(30.2%) | 3(7%) |

Table V. One way Anova test: the survival is link to age.

| Survival | | | | | |
|---|---|---|---|---|---|
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 4.834 | 38 | 0.127 | 1.566 | ***0.058*** |
| Within Groups | 4.956 | 61 | 0.081 | - | - |
| Total | 9.790 | 99 | - | - | - |

We also wanted to find a link between survival and patient's age (Table V), respectively TNM classification, the stage of diseases. The relation between age and survival of patients according to the tests performed is confirmed by a statistically significant p (p=0.058). We have demonstrated that histopathologic type is related to survival, better said adenocarcinomas have a higher survival rate than other histopathological types of colorectal cancer (Tabel 6). We also observed a link between survival and disease stage, in other words the lower the disease stage, the higher the survival rate is (Table 7).

Table VI. Absolute and percentage distribution by survival and histopathological type of colorectal cancer. p-values refer to the chi-square test for between-group differences. P value =0.072

| | Histopathologic type | | | |
|---|---|---|---|---|
| Survive | Adenocarcinoma | GIST | Malign Melanoma | Neuroendocrin tumor with big cell |
| No | 10 (10%) | 0 (0%) | 0 (0%) | 1 (1%) |
| Yes | 87 (87%) | 1 (1%) | 1 (1%) | 0 (0%) |

Table VII. Absolute and percentage distribution by survival and stage of colorectal cancer. p-values refer to the chi-square test for between-group differences. P value =0.004

| | Stage of colorectal cancer | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Survival | I | II A | II B | II C | III A | III B | III C | IV A | IV C |
| No | 1 (1%) | 0 (0%) | 1 (1%) | 1 (1%) | 0 (0%) | 1 (1%) | 3 (3%) | 3 (3%) | 1 (1%) |
| Yes | 11 (11%) | 28 (28%) | 3 (3%) | 3 (3%) | 2 (2%) | 24 (24%) | 15 (15%) | 3 (3%) | 1 (1%) |

## DISCUSSIONS

Colorectal cancer is one of the most common cancers both worldwide and in our country. This pathology ranks 3rd in the ranking of the most common oncologic diagnoses, being the third most common cancer among men, and the second most common cancer among women, both at the World and national levels [1,10,13]. Men are slightly more likely to develop colorectal cancer than women. This was also noted in our study, where males were more frequently affected than females in percentages of 57% versus 43%.

In our study it was also noted that the diagnosis of colorectal cancer was significantly more frequently diagnosed in patients aged between 61-70 years (41%), so, similar to the studies presented so far in the literature, the age over 50 years is more predisposed to the development of this oncologic pathology [1,9]. On the other hand, we also noted an earlier predisposition among young people, 6% of all our cases were in the 30-50 age group and paradoxically at the opposite pole of age, 6% of all patients included in the study were aged between 81-90 years.

Higher incidence rates are observed in high-income countries, including the United States, Australia, and parts of Europe, largely due to lifestyle factors [1,5,6,8,9]. Lower rates are generally seen in Africa and South-Central Asia, but these regions are experiencing an increase in incidence due to lifestyle changes [8,9]. From this point of view we have also noted a higher incidence of this pathology among patients from urban areas (55%) compared to rural areas (45%).

Referring to the histopathologic type of the tumor, adenocarcinomas are the most common representing in the literature about 98%, the rest being represented by neuroendocrine tumors, gastrointestinal stromal tumors and Non-Hodgkin tumors [11]. Of note, 97% of all colorectal cancers in our study were adenocarcinomas and the rest were represented by large cell neuroendocrine tumor, GIST and malignant melanoma.

According to studies in the literature, colorectal cancer can occur in any region, but a predisposition has been noted for the sigmoid and rectum [11]. In line with the above, a predisposition for colorectal tumors in the rectum of about 43% and 13% for sigmoid tumors was also noted in our data.

The stage of disease at diagnosis according to literature sources is over 60% in locally advanced and metastasized stages [11,14]. We note a proportion of 56% of all cases included in our data in these stages (III-IV) and 44% in early stages (I-II).

The prognosis of this oncologic pathology is not good, about 5 year survival is 40% - 60%, and most recurrences occur are within 2 years [9,10]. Similarly at 2 years, 1 year and 6 months respectively, from diagnosis 89% of patients survive, only 11% are deceased.

In our study we tried to show, that also in In Bihor County, Romania, especially in County Clinical Emergency Hospital Bihor, the data from colorectal cancer have a statistically significant relationship and agreement with the data in the literature. The most obvious and important finding was the link between stage of the disease and survival rate with significant statistically impact ($p < 0.04$). The stage of the disease is inversely proportional to the survival rate, early stages of colorectal cancer have a higher survival rate than locally advanced or metastasized stages.

Our study also has demonstrated a significant correlation between histopathologic type and survival in colorectal cancer patients, particularly noting that adenocarcinomas are associated with a higher survival rate compared to other histopathological types. Additionally, we observed a strong link between survival and disease stage, confirming that the lower the stage at diagnosis, the higher the survival rate. These findings emphasize the importance of early detection and accurate histopathological assessment in improving patient outcomes.

## CONCLUSIONS

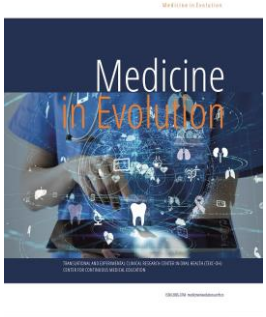
This study aims to provide valuable insights into how sex, age, environment, the histopathological result, TNM classification and survival interact to influence colorectal cancer characteristics and outcomes in Bihor County, Romania. By understanding these relationships, healthcare providers can tailor screening and prevention strategies to better meet the needs of specific populations. These findings could also contribute to Romania country and to the global understanding of colorectal cancer epidemiology, ultimately improving patient care and survival outcomes.

## REFERENCES

1. World Health Organization Available online: https://www.who.int/news-room/fact-sheets/detail/cancer (accessed on Aug 1, 2024).
2. Medichub Available online: https://www.medichub.ro/stiri/cancerul-colorectal-cel-mai-frecvent-tip-de-neoplasm-din-romania-id-4940-cmsid-2 (accessed on Aug 1, 2024).
3. Cancer.Net Available online: https://www.cancer.net/cancer-types/colorectal-cancer/risk-factors-and-prevention (accessed on Aug 2, 2024).
4. Cancer-plan.ro Available online: https://cancer-plan.ro/copac-cancerul-colorectal-peste-13-din-totalul-cancerelor-in-romania/ (accessed on Aug 1, 2024).

5. Factors, R. Colorectal Cancer: Epidemiology, Risk Factors, and Prevention. 2024.
6. Perotti, V.; Fabiano, S.; Contiero, P.; Michiara, M.; Musolino, A.; Boschetti, L.; Cascone, G.; Castelli, M.; Tagliabue, G. Influence of Sex and Age on Site of Onset, Morphology, and Site of Metastasis in Colorectal Cancer: A Population-Based Study on Data from Four Italian Cancer Registries. Cancers (Basel). 2023, 15, doi:10.3390/cancers15030803.
7. Rezaei, F.; Mazidimoradi, A.; Rayatinejad, A.; Allahqoli, L.; Salehiniya, H. Temporal Trends of Colon and Rectum Cancer Between 2010 and 2019 in Asian Countries By Geographical Region and Socio-Demographic Index: a Comparison With Global Data. World Cancer Res. J. 2024, 11, 1–20, doi:10.32113/wcrj_20244_2783.
8. Zeller, J.L.; Lynm, C.; Glass, R.M. Colon cancer - NCCN. Jama 2006, 296, 1552, doi:10.1001/jama.296.12.1552.
9. Shaib, Y.; Doughan, S. Rectal Cancer- NCCN. Diagnosis Manag. Guid. Anorectal Dis. A Clin. Ref. 2024, 161–172, doi:10.1201/9781003523826-19.
10. PathologyOutlines.com Available online: https://www.pathologyoutlines.com/topic/colontumorcarcinomageneral.html (accessed on Aug 2, 2024).
11. Tsiaoussis, J.; Vassilopoulou, L.; Nikolouzakis, T.; Rakitskii, V.N.; Vakonaki, E.; Fragiadaki, P.; Stivaktakis, P.; Tsatsakis, A.M. Biomolecular profile of colorectal cancer - The role of telomerase as a potent biomarker. Farmacia 2017, 65, 643–659.
12. Malki, A.; Elruz, R.A.; Gupta, I.; Allouch, A.; Vranic, S.; Al Moustafa, A.E. Molecular mechanisms of colon cancer progression and metastasis: Recent insights and advancements. Int. J. Mol. Sci. 2021, 22, 1–24, doi:10.3390/ijms22010130.
13. Duan, B.; Zhao, Y.; Bai, J.; Wang, J. Colorectal Cancer: An Overview. 2022, 1–12.
14. Zender, C.; Ledgerwood, L.; Ryan, J.; Tang, A.; Yarlagadda, B.; Cervenka, B. AJCC Cancer Stanging Manual; 2022; 268-270; ISBN 9781119775973.

# Psychological well-being and satisfaction with life in relation to stress, anxiety, and depression among final-year medical students

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## Abstract

University medical degree programs are physically and mentally demanding, requiring continuous focus and hard work. Under these conditions, medical students tend to develop mental health problems during their studies. **Aim and objectives:** The study aimed to evaluate the inter-relationships between psychological well-being (PWB) and satisfaction with life (SWL) in connection to stress, anxiety and depression, in final-year medical students. **Material and methods:** The present work is an observational study carried out on 82 subjects. The data collection was cross-sectional, carried out using 3 tests, delivered in the form of online questionnaires. Spearman rank correlation coefficient was applied, with a significance level of 5% (95% confidence interval). **Results:** The results highlighted statistically significant negative corelations between stress, anxiety and depression with multiple dimensions of PWB, and a statistically significant positive corelation between PWB and SWL. In addition, female students reported significantly higher levels of stress, anxiety and depression compared to male students. **Conclusions:** Psychological comfort and satisfaction with life show a positive correlation, a fact that supports the integrative approach of the two concepts. Stress, anxiety and depression negatively influence of SWL and PWB, in the population of final year medical students.

**Keywords:** medical students, psychological well-being, stress, anxiety, depression

## INTRODUCTION

In the recent years, taking into account the SarsCov-2 pandemic, symptomatology of anxiety and depression has been frequently reported in studies conducted all over the world, with a predilection for people who activated in the field of healthcare, both professionals [ 1] and medical students [2]. In this context, the medical student population is in a risk group in terms of exposure to stress, anxiety and depression [3], which leads to increased prevalence of mental health problems, a fact that should not be ignored.

Psychological profiles represent a very important factor for choosing a medical profession and include a strong assessment of the humanistic aspects of medicine: openness to new experiences, a critical need for fulfilment in their career, and the conscious and unconscious desire to help people [4]. Medical degree programs in public and private universities aim to train and produce competent doctors and very good professionals for the benefit of the health system. Such programs are physically and mentally demanding, requiring continuous focus and hard work for a course of five or six years. Under these conditions, medical students tend to develop mental health problems during their studies [5], which include psychological stress, anxiety, depression, sleep disorders, exhaustion, eating disorders, and potentially hazardous alcohol use [6].

Psychological well-being (PWB) is a vast concept, representing a subjective perception for each individual and directly influencing the quality of personal life. PWB analyses the extent to which a person is prosperous in regard to the existential problems of life (for example, fulfilling meaningful goals, growing and developing as a person, establishing quality relationships with others) [7]. Well-being of an individual is closely related to his mental health. From a psychological point of view, there are two distinct dimensions of mental health: a positive dimension, corresponding to PWB, and a negative dimension, which includes psychological distress and mental disorders. Therefore, the assessment of subjects' mental health should investigate both dimensions. However, most studies on student mental health have only examined psychological distress, typically assessed in terms of depression, anxiety, and stress.

Contrary to the initial theories which stated that well-being is defined by the absence of psychopathological symptoms, the WHO (World Health Organization) has reconsidered mental health as an international health and development priority, and is now defining mental health as "a state of well-being in which an individual is aware of his or her own abilities, can cope with the daily stresses of life, can work productively and is able to make a contribution to his community" [8]. Starting with 1969, the study of PWB has been carried out in accordance with two primary concepts on the positive functioning of the individual [9]. According to the first concept, the PWB of a person is considered the result of individual position in relation to two independent dimensions, one of positive affects and the other of negative affects. The second primary concept claims that satisfaction with life (SWL) is the key indicator of well-being. These concepts have evolved and shaped differently, over time, but currently, the integrative approach of the two states of well-being is emphasized.

Therefore, assessment of student mental health should investigate both dimensions - psychological distress and psychological well-being. However, most studies of student mental health have only examined psychological distress, typically assessed in terms of stress, anxiety, and depression.

### *Aim and objectives*

The main purpose of this study was to evaluate the relationships that exist between psychological well-being and satisfaction with life in connection to stress, anxiety and depression, within the final year medical students population.

## MATERIALS AND METHODS

The target population of the study was represented by sixth year students from the Faculty of Medicine, "Victor Babeş" University of Medicine and Pharmacy in Timişoara. The criterion for inclusion in the study was the voluntary and full completion of the questionnaires distributed online. There were 82 subjects, 64 female and 18 male, aged between 23 and 34 years, who participated in this study.

The procedure for constituting the representative sample was carried out by simple randomization, of the random selection type, following the on-line completion of the questionnaires. The subjects come from urban and/or rural areas and are students in their last year of studies at the Faculty of Medicine. All participants were informed about the purpose and manner of conducting the study, and completing the questionnaires represented their voluntary consent to participate in the study.

### *Study design*

The present work is an observational, correlational, non-experimental and transversal study that has tracked the relationships between the following variables: *anxiety*, *depression*, *stress*, *satisfaction with life (SWL)*, *psychological well-being (PWB)* - including the six dimensions: *autonomy (A)*, *control over the environment (E)*, *personal development (G)*, *positive relationships with others (R)*, *purpose in life (P)*, *self-acceptance (S)*.

The data collection was cross-sectional, and it was carried out using three tests, which were delivered online, using the Google Forms application. No special training of the examiner was required for their delivery, scoring or interpretation.

For data collection, the following psychological tests were used:

- *Psychological Well-Being Scale (PWBS – Psychological Well-Being Scale), developed by Ryff, C.D. (1989) evaluated and validated by Abbott et al., 2006.*
- *Diener E.'s Satisfaction with Life Scale (SWLS); 1985*
- *DASS-21 (Depression Anxiety Stress Scale) developed by Lovibond and Lovibond, 1995.*

Statistical processing was performed with IBM SPSS v.20 statistical software. Correlation between scores was investigated by applying the Spearman rank correlation coefficient, calculating the Spearman correlation coefficient (rho) between the variables considered in the study. The statistical significance level was 5% (corresponding to a 95% confidence interval).

## RESULTS

The comparative analysis between male and female, and the correlational analysis of the data (for the variables considered in the study) were carried out, with the following results:

• The comparative analysis of the scores obtained for the recorded variables, depending on the gender of the participants, can be seen in Table 1.

Table 1. Results of the score comparison, by gender, for the study variables

| Score | Total (N=82) | Female (N=64) | Male (N=18) | P value |
|---|---|---|---|---|
| **PWBS**_ A_E_G_R_P_S | 4.35 ± 0.783 | 4.275 ± 0.772 | 4.619 ± 0.784 | 0.49 |

| | | | | |
|---|---|---|---|---|
| | 4.357 (3.81 – 5.048) | 4.214 (3.774 – 4.881) | 4.75 (3.929 – 5.309) | |
| **SWLS** | 4.834 ± 1.322<br>5 (3.8 – 6) | 4.788 ± 1.343<br>5 (3.8 – 5.8) | 5 ± 1.267<br>5.2 (4.4 – 6) | 0.114 |
| DASS_**STRESS** | 1.232 ± 0.632<br>1.143 (0.857 – 1.571) | 1.337 ± 0.611<br>1.286 (1 – 1.643) | 0.857 ± 0.576<br>0.857 (0.429 – 1.286) | **0.006**** |
| DASS_**ANXIETY** | 0.831 ± 0.633<br>0.714 (0.286 – 1.286) | 0.949 ± 0.624<br>0.857 (5 – 1.286) | 0.413 ± 0.482<br>0.214 (0 – 0.714) | **0.001**** |
| DASS_**DEPRESSION** | 0.852 ± 0.646<br>0.714 (0.286 – 1.286) | 0.951 ± 0.659<br>0.857 (0.429 – 1.357) | 5 ± 0.458<br>0.429 (0.143 – 0.714) | **0.006**** |
| ** highly statistically significant differences | | | | |

The results obtained show statistically significant differences between female and male participants for stress, anxiety and depression.

Regarding psychological well-being and satisfaction with life, no statistically significant differences were observed between subjects of different genders.

• For the correlational analysis, the bivariate correlation was used, calculating the Spearman coefficient (rs) between stress, anxiety, depression and each dimension of psychological well-being. For a unified view, Table 2 lists the values of the Spearman correlation coefficient for all the variables evaluated in the present study (satisfaction with life, psychological well-being, stress, anxiety and depression), correlated two by two.

Table 1. Spearman's coefficient (rho) values for all variables assessed in the study (SWLS, PWBS, Stress, Anxiety and Depression), pairwise correlated

| | | SWLS | PWBS_ A_E_G_R_P_S | DASS_STRESS | DASS_ANXIETY | DASS_DEPRESSION |
|---|---|---|---|---|---|---|
| SWLS | Correlation coefficient R (Spearman) | 1.000 | .722** | -.520** | -.459** | -.620** |
| | p (bidirectional test) | . | <0.001 | <0.001 | <0.001 | <0.001 |
| | N | 82 | 82 | 82 | 82 | 82 |
| PWBS_ A_E_G_R_P_S | Correlation coefficient R (Spearman) | 0.722** | 1.000 | -.580** | -.564** | -.668** |
| | p (bidirectional test) | <0.001 | . | <0.001 | <0.001 | <0.001 |
| | N | 82 | 82 | 82 | 82 | 82 |
| DASS_STRESS | Correlation coefficient R (Spearman) | -.520** | -.580** | 1.000 | .767** | .739** |
| | p (bidirectional test) | <0.001 | <0.001 | . | <0.001 | <0.001 |
| | N | 82 | 82 | 82 | 82 | 82 |
| DASS_ANXIETY | Correlation coefficient R (Spearman) | -.459** | -.564** | .767** | 1.000 | .747** |
| | p (bidirectional test) | <0.001 | <0.001 | <0.001 | . | <0.001 |
| | N | 82 | 82 | 82 | 82 | 82 |
| DASS_DEPRESSION | Correlation coefficient R (Spearman) | -.620** | -.668** | .739** | .747** | 1.000 |
| | p (bidirectional test) | <0.001 | <0.001 | <0.001 | <0.001 | . |
| | N | 82 | 82 | 82 | 82 | 82 |
| **. The correlation is statistically significant | | | | | | |

Graphical representations of the linearity and direction of the point cloud for the correlated variables in the study, in the form of scatter-plot diagrams, are summarized in Figure 1.

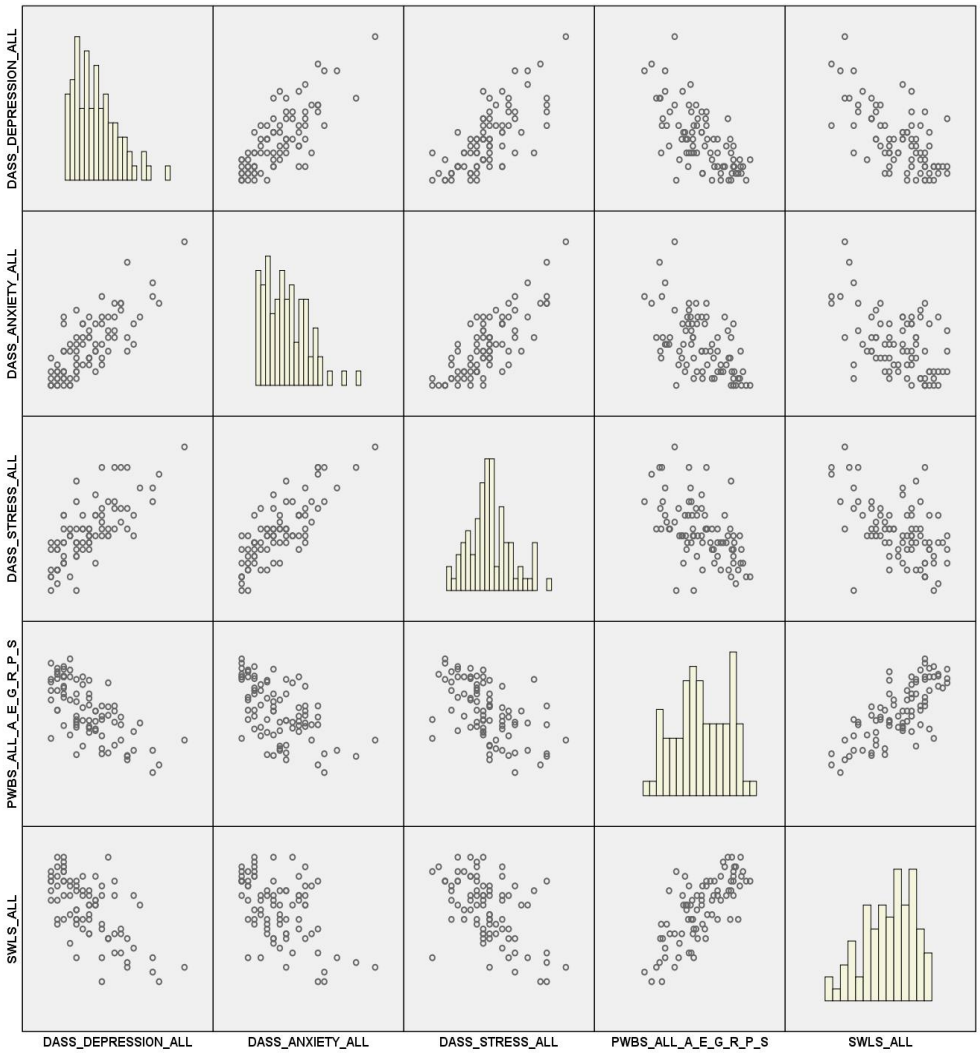



Figure 1. Scatter plot diagrams for the correlations between the pairs of studied variables

## DISCUSSIONS

The results obtained by statistical processing of the data, according to the established methodology, shows that stress seems to have a stronger negative influence on: control over the environment (rho =.631), autonomy (rho =.595) and self-acceptance (rho =.580), at a significance threshold of $p < 0.01$. Anxiety correlates significantly negative with the following dimensions: control over the environment (rho = -.586), autonomy (rho = -.585) and self-acceptance (rho = -.517). In addition, the results showed negative values of the correlation coefficient, highly statistically significant, at a significance threshold of $p < 0.01$, for the associations between depression and all six dimensions of psychological well-being. The correlation coefficient values between depression and the following dimensions are noted: control over the environment (rho = -.732), self-acceptance (rho = -.661), purpose in life (rho = -.600) and autonomy (rho = -.586), showing the highly statistically significant negative influence that depression has on the four dimensions of the state of PWB.

The results obtained in the present study, regarding the level of corelation between stress, anxiety and depression with psychological well-being, in medical students, coincide with those obtained by other researchers, in similar studies [10, 11]. Tran et al. [10] conducted a study in 2019-2020 on medical students at the University of Geneva and found that final-year students reported lower academic satisfaction, and were significantly more stressed,

anxious, and depressed than their first-year counterparts. In addition, female students reported significantly higher levels of stress and anxiety than male students. These data are supported by the results of the present study, in which highly statistically significant differences were obtained between female and male participants for stress, anxiety and depression.

Our results showed a positive correlation between psychological well-being and satisfaction with life. The very high positive values of the correlation coefficient, for the relationship between satisfaction with life and the dimensions of PWB: self-acceptance (rho =.816), control over the environment (rho =.726) and positive relationships with others (rho =.613), at a $p < 0.01$ level (2-tailed). The results obtained in the present study are consistent with those of other authors who approach subjective well-being (SWB) and psychological comfort as a unitary approach. Thus, Ryff and Keyes [12], as early as 1995, analysed data from several studies that investigated the associations between PWB and SWB. According to these authors, moderate associations were found between two SWB scales (self-acceptance and control over the environment) and measures of happiness and life satisfaction. Rivas et al. cited by Mamani-Benito et al. [13], found significant relationships between the dimensions of psychological well-being and life satisfaction, highlighting that the dimensions of self-acceptance and environmental control predict satisfaction in young adults. On the other hand, positive relationships with others have a highly significant positive correlation when entering a new social group, and life purpose appears to be a significant predictor in the last year of studies. The results of the present study support this integrative approach of the two aspects of well-being. All dimensions of PWB correlate positively with satisfaction with life. In particular, individuals who have the ability to manage their own lives as well as those around them, who display a clear understanding of the purpose of life, a sense of meaning and intentionality, with a positive attitude and self-acceptance and good interpersonal skills, are happier. This fact suggests that subjects who tend to report higher levels of psychological comfort also tend to report feeling more positive affect and less negative affect, and to rate their life satisfaction more positively.

The results of this study are consistent with those of other authors. Serin et al. [14], reported for the student population in Cyprus that the higher the depressive and anxious manifestations, the more they tend to self-assess their life as unsatisfactory. Samaranayake and Fernando [15] observed that, among medical students in New Zealand, depression was associated with low levels of life satisfaction and psychological well-being, with the presence of depression being more common in students of female gender. Sahin and Tuna [16], obtained negative correlations between depression and anxiety with the variable satisfaction in life, and Duong [17], observed that fear and anxiety reduced the level of life satisfaction among students.

Moreover, compared to non-medical students, stress levels have been observed to be higher in medical students than non-medical students, as reported in multiple studies [28-20]. In a systematic review that analysed 40 selected articles, Dyrbye et al. [21] highlighted that they found a very high prevalence of stress, anxiety and depression in medical students compared to the general population, which considerably reduced the level of psychological well-being and life satisfaction.

***Research limitations and practical implications***

One of the limitations of the present study is the relatively small size of the sample (82 subjects). Being a self-administered test, it is likely to provide subjective data or desirable answers. Moreover, the structure of the sample was unbalanced, in terms of the gender of the participants - the sample included 64 female and 18 male subjects.

Another direction of investigation could be to study the differences regarding the relationship between the variables, for the participants who come from the urban

environment compared to those who come from the rural environment. In addition, the presence of chronic general conditions or recent unpleasant events, with great emotional impact, can constitute third variables that can influence the relationships between the analysed variables.

As practical implications, medical academic institutions should develop and implement stress, anxiety and depression management programs developed for medical and nursing students. Such programs may include, for example, self-hypnosis, meditation, mindfulness-based stress reduction, feedback on various health habits, educational discussions, changes in the length and type of curriculum, changes in the grading system, or music and muscle relaxation therapy before exams to improve academic performance.

## CONCLUSIONS

The present study aimed to identify and evaluate the existing relationships between psychological well-being, satisfaction with life and stress, anxiety and depression in medical students in their last year of studies. Following the analysis and interpretation of the data, for the formulated study hypotheses, the main conclusions that can be drawn from this research are the following:

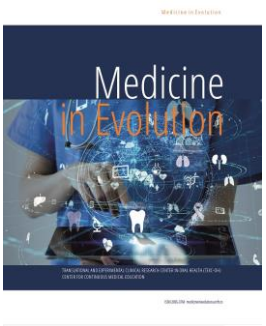
- Psychological comfort and satisfaction with life are facets of well-being, in a very significant positive correlation, a fact that supports the integrative approach of the two concepts;
- Stress, anxiety and depression negatively influence the level of life satisfaction and psychological well-being, in the population of final year medical students.

## REFERENCES

1. Motahedi S, Aghdam NF, Khajeh M, et al. Anxiety and depression among healthcare workers during COVID-19 pandemic: A cross-sectional study. Heliyon. 2021 Dec;7(12):e08570. doi: 10.1016/j.heliyon.2021.e08570. Epub 2021 Dec 8. PMID: 34901484; PMCID: PMC8653403.
2. Aloufi MA, Jarden RJ, Gerdtz MF, Kapp S. Reducing stress, anxiety and depression in undergraduate nursing students: Systematic review. Nurse Educ Today. 2021 Jul;102:104877. doi: 10.1016/j.nedt.2021.104877. Epub 2021 Mar 18. PMID: 33905898.
3. Deng Y, Ye B, Yang Q. COVID-19 Related Emotional Stress and Bedtime Procrastination Among College Students in China: A Moderated Mediation Model. Nat Sci Sleep. 2022 Aug 22;14:1437-1447. doi: 10.2147/NSS.S371292. PMID: 36033906; PMCID: PMC9416325.
4. Vlad R, Golu F, Toma A, et al. Depression And Anxiety In Romanian Medical Students: Prevalence And Associations With Personality, FARMACIA, 2020;68(5):944-949 https://doi.org/10.31925/farmacia.2020.5.24
5. Dendle C, Baulch J, Pellicano R, Hay M, Lichtwark I, Ayoub S, Clarke DM, Morand EF, Kumar A, Leech M, Horne K. Medical student psychological distress and academic performance. Med Teach. 2018;40(12):1257-1263. doi: 10.1080/0142159X.2018.1427222. Epub 2018 Jan 21. PMID: 29355074.
6. Pacheco JP, Giacomin HT, Tam WW, Ribeiro TB, Arab C, Bezerra IM, Pinasco GC. Mental health problems among medical students in Brazil: a systematic review and meta-analysis. Braz J Psychiatry. 2017;39(4):369-378. doi: 10.1590/1516-4446-2017-2223. Epub 2017 Aug 31. PMID: 28876408; PMCID: PMC7111407.
7. Greenfield EA, Vaillant GE, Marks NF. Do formal religious participation and spiritual perceptions have independent linkages with diverse dimensions of psychological well-being? J Health Soc Behav. 2009;50(2):196-212. doi: 10.1177/002214650905000206. PMID: 19537460; PMCID: PMC2723716.

8. World Health Organization. Depression and Other Common Mental Disorders: Global Health Estimates; World Health Organization: Geneva, Switzerland, 2017 Licence:CC BY-NC-SA 3.0 IGO. https://apps.who.int/iris/bitstream/handle/10665/254610/WHO-MSD-MER-2017.2-eng.pdf?sequence=1&isAllowed=y
9. Sandvik E, Diene, E, Seidlitz L. Subjective well-being: The convergence and stability of self-report and non-self-report measures. Journal of Personality, 1993;61(3):317-342.
10. Tran NT, Franzen J, Jermann F, et al. Psychological distress and well-being among students of health disciplines in Geneva, Switzerland: The importance of academic satisfaction in the context of academic year-end and COVID-19 stress on their learning experience. PLOS ONE, 2022;17(4): e0266612. https://doi.org/10.1371/journal.pone.0266612
11. Franzen J, Jermann F, Ghisletta P, et al. Psychological Distress and Well-Being among Students of Health Disciplines: The Importance of Academic Satisfaction. International Journal of Environmental Research and Public Health. 2021;18(4):2151. https://doi.org/10.3390/ijerph18042151
12. Ryff CD, Keyes CL. The structure of psychological well-being revisited. J Pers Soc Psychol. 1995 Oct;69(4):719-27. doi: 10.1037//0022-3514.69.4.719. PMID: 7473027.
13. Mamani-Benito O, Carranza Esteban RF, Castillo-Blanco R, et al. Anxiety and depression as predictors of life satisfaction during pre-professional health internships in COVID-19 times: the mediating role of psychological well-being. A Cell Press journal, Heliyon, 2022;8(10):e11025 https://doi.org/10.1016/j.heliyon.2022.e11025
14. Serin NB, Serin O, Özbaş FL. Predicting University Students' Life Satisfaction by Their Anxiety and Depression Level. Procedia-Social and Behavioral Sciences, 2010;9,579-582. https://doi.org/10.1016/j.sbspro.2010.12.200
15. Samaranayake C., Fernando A. Satisfaction with life and depression among medical students in Auckland, New Zealand. The New Zealand MJ 2011, 124.12-7.
16. Sahin S, Tuna R. The effect of anxiety on thriving levels of university students during the COVID-19 pandemic. Collegian. 2022;29(3):263-70.
17. Duong CD. The impact of fear and anxiety of Covid-19 on life satisfaction: Psychological distress and sleep disturbance as mediators. Personality and Individual Differences, 2021, 178, 110869. doi:10.1016/j.paid.2021.110869
18. Moreira de Sousa J, Moreira CA, Telles-Correia D. Anxiety, Depression and Academic Performance: A Study Amongst Portuguese Medical Students Versus Non-Medical Students. Acta Med Port. 2018;31(9):454-462. doi: 10.20344/amp.9996. PMID: 30332368.
19. Sheldon E, Simmonds-Buckley M, Bone C, et al. Prevalence and risk factors for mental health problems in university undergraduate students: A systematic review with meta-analysis. Journal of Affective Disorders,2021;287, 282–292. https://doi.org/10.1016/j.jad.2021.03.054
20. AlShamlan NA, AlOmar RS, Al Shammari MA, et al. Anxiety and Its Association with Preparation for Future Specialty: A Cross-Sectional Study Among Medical Students, Saudi Arabia. J Multidiscip Healthc. 2020;13:581-591. doi: 10.2147/JMDH.S259905. PMID: 32753877; PMCID: PMC7351973.
21. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. Acad Med. 2006 Apr;81(4):354-73. doi: 10.1097/00001888-200604000-00009. PMID: 16565188.

# Comparison between the size of PRF clot obtained through horizontal centrifugation vs. fixed-angle centrifugation

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## Abstract

**Introduction:** Over the years, centrifugation systems have undergone significant transformations, adapting in shape to facilitate their application in dental clinics and advancing in operational technology. While centrifuge designs may vary in numerous ways, one critical distinction between the centrifuge is the angle at which centrifugation takes place. **Aim of the Study:** The objective of this experimental study is to assess and measure the volume of the end product, specifically the PRF clot obtained using horizontal centrifugation and fixed-angle centrifugation to ascertain which method produces a larger quantity of PRF clot. **Material and Methods:** The study was conducted on a cohort of 6 male and female patients. Blood was drawn from each patient into two 10ml glass tubes without anticoagulants or additives, destined for centrifugation in the two centrifugation systems. The tubes were split into two sets of six tubes each, labeled with the letters H (for tubes to be centrifuged horizontally) and L (for tubes to be centrifuged at a fixed angle), along with numbers from 1 to 6 for each tube pair corresponding to a patient. **Results and Discussions:** It has been proven that horizontal centrifugation produces a bigger PRF clot. Considering the insights gained from this study alongside the ANOVA test results, we conclude that horizontal centrifugation using the Bio-PRF system results in a larger PRF clot compared to fixed-angle centrifugation. One possible explanation is the variance in g-force distribution between fixed-angle and horizontal centrifugation. This variance led to marginally smaller quantities of PRF clots in the second tube batch, albeit not significantly so. **Conclusions:** In conclusion, the appearance and methodology of the two types of PRF we obtained are highly similar but not identical, with disparities in PRF clot quantity and consequently, in cellular properties. Notably, H-PRF exhibited a greater clot quantity compared to L-PRF.

**Keywords:** PRF clot, fixed-angle centrifugation, horizontal centrifugation, L-PRF, H-PRF

## INTRODUCTION

Platelet-Rich Fibrin (PRF) is a fibrin matrix in which platelet cytokines, growth factors, and cells are trapped and can be released over time, serving as a resorbable membrane. Choukroun and his associates were among the pioneers in using the PRF protocol in oral and maxillofacial surgery to enhance healing in dentistry. PRF is considered a healing biomaterial, and studies have shown its application in various dental disciplines [1][2].

The history of these products illustrates the evolving trends in research over the years. It began with an interest in fibrin matrix alone as a healing material, then shifted to the healing properties of platelets, and finally focused on growth factors (both circulating and from platelets) for tissue regeneration. Among all these elements, which can be considered the most important? Given our general understanding of coagulation and healing—and a certain degree of common sense—it is now considered that all these elements are important and should be properly combined to achieve the best clinical outcomes. Fibrin, platelets, growth factors with slow release, leukocytes, and other cells are the key players in the natural healing process, and together they form a kind of processed tissue derived from blood. This complex combination is key to optimal performance. For this reason, PRF has often been described as an "optimized blood clot" that can be surgically manipulated and used. This description is actually true (more or less) for all well-designed platelet concentrate products [3][4][5].

Platelet concentrate therapy was developed to naturally enhance the regenerative potential of platelets present in the blood. PRF is achieved by centrifuging blood into various components, including red blood cells, plasma, white blood cells, and platelets. The final PRF clot is a concentrate of white blood cells, platelets, and fibrin [6][7].

It is important to understand that inflammation and wound healing are regulated by a series of growth factors. These growth factors can stimulate or inhibit cellular migration, adhesion, proliferation, and differentiation. While growth factors are present in all tissues, it is important to note that blood serves as the primary reservoir for numerous growth factors and cytokines responsible for angiogenesis and tissue regeneration. Growth factors typically exist as inactive or partially active precursors that require proteolytic activation [8][9][10].

Over time, centrifugation systems have undergone numerous changes, both in terms of their shape to facilitate their use in dental clinics and in terms of their operating technology. The design differences between centrifuges can be numerous, but this aspect is not very important. One crucial aspect between the two types of centrifuges used in this experiment is the angle at which centrifugation occurs [11][12][13].

In horizontal centrifugation, as in the Bio-PRF centrifuge, the tube radius is larger, the RCF (Relative Centrifugal Force) is higher, and the forces are more efficient. Therefore, the time required for complete centrifugation is only 2/3 of the time required for centrifugation in the Duo Quattro Advanced PRF centrifuge by Choukroun, where the angle is fixed at 33 degrees and the tube radius is smaller [14][15].

### *Aim and objectives*

The aim of the experimental study is to evaluate and quantify the amount of the final product, namely the PRF clot obtained through horizontal centrifugation (a newer technique) and fixed-angle centrifugation (a well-established technique in the market), in order to determine which method yields a greater quantity of PRF clot.

## MATERIAL AND METHODS

The study was conducted on a cohort of 6 male and female patients who presented to a private clinic in Timişoara in the year 2021. Inclusion criteria for the study included ages between 25 and 30 years old, with patients not having chronic health issues. Blood was collected from each patient in two 10ml glass tubes without anticoagulant or additives, to be centrifuged in the two centrifugation systems. The tubes were divided into 2 sets of 6 tubes each, and each set was labeled with the letters H (for tubes to be centrifuged horizontally) and L (for tubes to be centrifuged at a fixed angle), along with numbers from 1 to 6 for each pair of tubes corresponding to a patient.

For the preparation of H-PRF, blood was collected from each donor in 10 ml glass tubes without additives and anticoagulant, and these were centrifuged at 700 RCF for 8 minutes in a centrifuge where centrifugation is performed horizontally (Bio-PRF system).

The time required for horizontal centrifugation is 2/3 of that for fixed-angle centrifugation. Therefore, the 12-minute protocol used in this study on a fixed-angle centrifuge perfectly equates to an 8-minute protocol used on a horizontal centrifuge, both set at 700g.

For the preparation of L-PRF, blood was collected from each donor in 10 ml glass tubes without additives and anticoagulant, and these were centrifuged at 2700 RPM for 12 minutes in a fixed-angle centrifuge (Duo Quattro Advanced PRF by Choukroun).

After centrifugation, the tubes were placed in a rack with a linear attachment to measure the size of the PRF clots. This allowed us to compare the quantity of PRF clots obtained through the two centrifugation techniques.

Figure 1. The tubes to be centrifuged horizontally are labeled with the letter H and numbers from 1 to 6, while their counterparts are found in the batch of tubes marked with L

## RESULTS

To analyze the results obtained through the two techniques, after centrifuging the blood tubes, we photographed all the tubes. Using a ruler attached to the metal stand, we measured each PRF clot in centimeters.

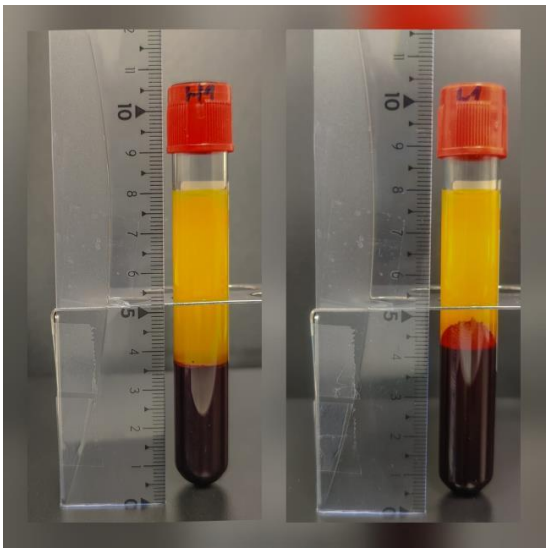


Figure 2. Comparative measurement of the two clots

To better observe and compare the results obtained, we created three charts. In Chart 1, we displayed the measurements in centimeters for each test tube from the two batches. At first glance, the graphical representation shows the difference between the H tubes (horizontally centrifuged) shown in blue and the L tubes (vertically centrifuged) shown in red.

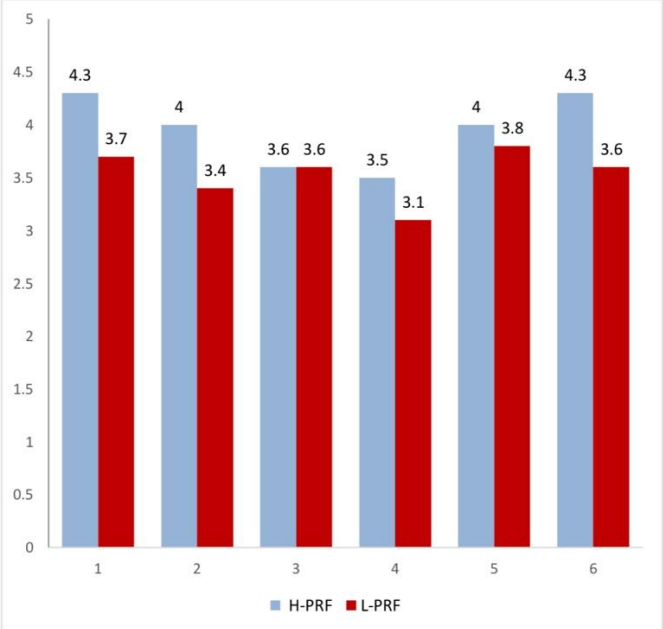



Chart 1. Quantity of PRF clots measured in centimeters

In Chart 2, we displayed the average measurements in centimeters: the H tubes (horizontally centrifuged) are shown in blue, and the L tubes (vertically centrifuged) are shown in red.

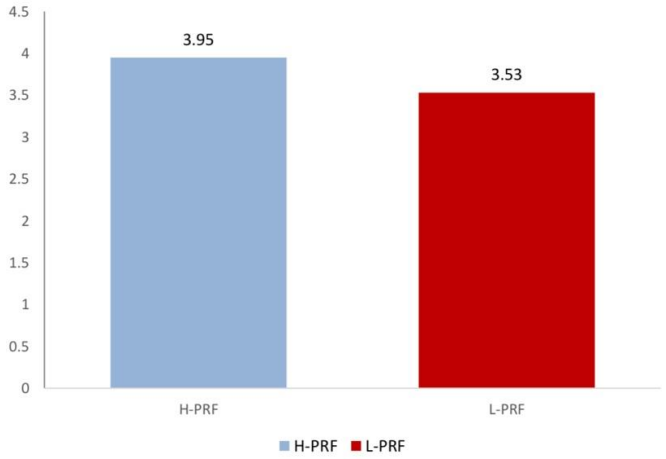



Chart 2. Average clots of H-PRF vs. L-PRF in centimeters

In Chart 3, we displayed the difference in centimeters between the clots of H-PRF and L-PRF for each pair of test tubes.

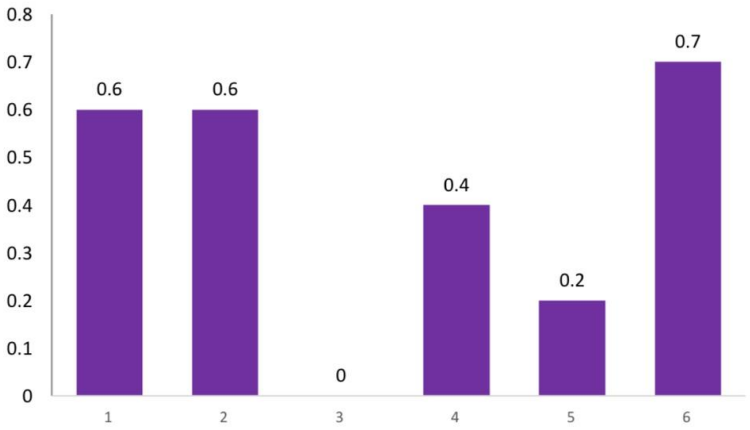



Chart 3. Difference between H-PRF and L-PRF clots for each pair of tubes, measured in centimeters

From Table 1, the following observations can be made: the smallest values belong to the L-PRF tubes, while the largest values belong to the H-PRF tubes.

Table 1. ANOVA test results for PRF clot measurements

| SUMMARY | | | | | | |
|---|---|---|---|---|---|---|
| *Groups* | *Count* | *Sum* | *Average* | *Variance* | | |
| H PRF | 6 | 23.7 | 3.95 | 0.115 | | |
| L PRF | 6 | 21.2 | 3.533333 | 0.062667 | | |
| ANOVA | | | | | | |
| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
| Between Groups | 0.520833 | 1 | 0.520833 | 5.863039 | 0.035977 | 4.964603 |
| Within Groups | 0.888333 | 10 | 0.088833 | | | |
| | | | | | | |
| Total | 1.409167 | 11 | | | | |

Thus, it has been demonstrated that horizontal centrifugation produces a larger PRF clot. Combining the experience gained from this experiment with the data obtained from the ANOVA test in Table 1, we can state that horizontal centrifugation using the Bio-PRF system results in a larger PRF clot compared to a PRF clot obtained through fixed-angle centrifugation.

## DISCUSSIONS

In the experimental study we conducted, we analyzed the amount of PRF clot obtained based on the centrifugation system used. The Choukroun Duo Quattro Advanced PRF system has stood the test of time, and the benefits of PRF obtained with this system are indisputable. However, as technology evolves over the years, new approaches emerge offering additional benefits and advantages. The Bio PRF system promises these new benefits and advantages through horizontal centrifugation.

Choosing the best centrifugation system to obtain the optimal PRF clot can be challenging and requires extensive knowledge in this field. Since the Bio-PRF system is relatively new, there are not many studies on this system that uses horizontal centrifugation, making it difficult for clinicians to choose the best system currently available on the market. To assist clinicians in making an informed decision, we decided to conduct this study. Based on our findings, we can state the following [16].

By measuring the PRF clots, we demonstrated that the clots obtained with the Bio PRF system through horizontal centrifugation have a larger volume and better cellular properties compared to those obtained with the Choukroun Duo Quattro Advanced PRF system using fixed-angle centrifugation. Since the Bio PRF system is relatively new to the market, there are not many studies that clarify this precisely. One explanation is that the distribution of g-forces differs between fixed-angle and horizontal centrifugation, as explained in more detail by Richard J. Miron in his book. This difference resulted in slightly smaller PRF clot quantities from the second batch of tubes, but not significantly.

We emphasize that the statements about the superior cellular properties of H-PRF clots from batch 1 are based on recent studies by Masako Fujioka-Kobayashi, Michihide Kono, and Richard J. Miron, without us conducting these histological and microscopic studies in this paper. [17]

This study highlights the quantitative difference between PRF obtained using a fixed-angle centrifugation system and PRF obtained using a horizontal centrifugation system. By correlating the amounts of PRF clots, we can assert that PRF clots obtained through horizontal centrifugation provide clinicians with a larger and higher-quality PRF membrane in terms of cellular properties, resulting in a significantly improved treatment. The advantages of this technique are not only related to the clot but also to shorter working times, which enhance treatment efficiency. Reducing working times is always advantageous for clinicians as it saves time, allowing for the treatment of more patients and offering them shorter waiting times.

The results of this study align with our expectations based on an in-depth review of the specialized literature.

The Choukroun Duo Quattro Advanced PRF system, which has been long established in the market, may lose ground to these new horizontal centrifugation systems due to their technique yielding a superior final product in all respects. [18][19]

In conclusion, while the Choukroun Duo Quattro Advanced PRF system has successfully stood the test of time and its benefits cannot be contested, the advantages offered by the Bio-PRF system through horizontal centrifugation cannot be overlooked. This system can be considered essential for current clinical situations. [20][21]

## CONCLUSIONS

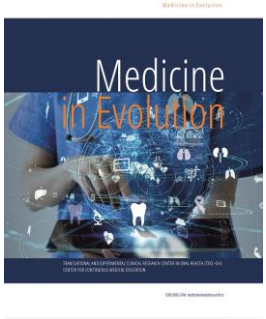
In conclusion, the appearance and technique of the two types of PRF we obtained are very similar but not identical, with a difference in the quantity of the PRF clot and, consequently, in the cellular properties. H-PRF was found to have a larger clot quantity than L-PRF. The specialized literature lacks sufficient data on this aspect; however, a study by Fujioka-Kobayashi and collaborators in 2020 demonstrated that H-PRF obtained through horizontal centrifugation has better separation and a larger PRF clot quantity, as well as better cellular properties compared to PRF obtained through fixed-angle centrifugation. These properties need to be studied more deeply, and a comparison between horizontal and fixed-angle centrifugation in terms of both clot quantity and cellular properties would bring many advantages to clinical dental practice.

## REFERENCES


1. Naik B, Karunakar P, Jayadev M, et al. Role of Platelet rich fibrin in wound healing: A critical review. Journal of conservative dentistry. 2013 August; 16(4): p. 284-293.
2. Dohan Ehrenfest David M, Isabel Andia, Matthias A. Zumstein et al. Classification of platelet concentrates (Platelet-Rich Plasma-PRP, Platelet-Rich Fibrin-PRF) for topical and infiltrative use in orthopedic and sports medicine: current consensus, clinical implications and perspectives. Muscles, ligaments and tendons journal. 2014 May; 4(1): p. 3-9.
3. Kawase T, Tanaka T. An updated proposal for terminology and classification of platelet-rich fibrin. Regenerative Therapy. 2017 June; 7: p. 80-81.
4. Kawase T. Platelet-rich plasma and its derivatives as promising bioactive materials for regenerative medicine: basic principles and concepts underlying recent advances. Odontology. 2015 May 16; 103(2): p. 126-135.
5. Peck M, Hiss D, Stephen L. Factors affecting the preparation. South African Dental Journal. 2016 August; 71(7): p. 298-302.
6. Isobe K, Watanebe T, Kawabata H, et al. Mechanical and degradation properties of advanced platelet-rich fibrin (A-PRF), concentrated growth factors (CGF), and platelet-poor plasma-derived fibrin (PPTF). International Journal of Implant Dentistry. 2017 December; 3(1): p. 2-6.
7. Richard J. Miron. Understanding Platelet Rich Fibrin. 1st ed. Huffman L, editor. USA: Quintessence Publishing USA; 2021 Cap. 1: 1-4.
8. Miron RJ, Bosshardt DD. OsteoMasc: Key players around bone biomaterials. Biomaterials. Biomaterials. 2016; 82(1-19).
9. Tsirogianni AK, Moutsopoulos NM, Moutsopoulos HM. Wound healing: Immunological aspects. Injury; 2016 Cap. 37: S5-S12.
10. Davis VL, Abukabda AB, Radio NM et al. Platelet-rich preparations to improve healing. Part I: Workable options for every size practice. J. Oral Implantology. 2014; 40(4): p. 500-510.
11. Davis VL, Abukabda AB, Radio NM et. al. Platelet-rich preparations to improve healing. Part II: Platelet activatios and enrichment, leukocyte inclusion, and other selection criteria. J. Oral Implantology. 2014; 40(4): p. 511-521.
12. Kulkarni MR, Thomas BS, Varghese JM, et al. Platelet-rich fibrin as an adjunct to palatal wound healing after harvesting a free gingival graft: A case series. Journal of Indian Socienty of Periodontology. 2014 May; 18(3): p. 399-404.
13. Borie E, Oliví DG, Orsi IA, et al. Platelet-rich fibrin application in dentistry: a literature review. International journal of clinical and experimental medicine. 2015 August; 8(5).

14. Richard J. Miron, Joseph Choukroun. Platelet Rich Fibrin In Regenerative Dentistry: biological background and clinical indications. 1st ed. Richard J. Miron JC, editor.: Wiley Blackwell; 2017, Cap.2: 16-20.
15. Ghanaati S, Booms P, Orlowska A, et. al. Advanced platelet-rich fibrin: a new concept for cell-based tissue engineering by means of inflammatory cells. The Journal of oral implantology. 2014; 40(6): p. 679-689.
16. Kobayashi E, Fluckiger L, Fujioka-Kobayashi M, et al. Comparative release of growth factors from PRP, PRF, and advanced-PRF. Clinical Oral Investigation. 2016 January 11; 20(9): p. 2353-2360.
17. Masako Fujioka-Kobayashi, Richard J. Miron, Maria Hernandez, et al. Optimized Platelet-Rich Fibrin With the Low-Speed Concept: Growth Factor Release, Biocompatibility, and Cellular Response. Journal of periodontology. 2017; 88(1): p. 112-121.
18. Effect of centrifugation time on growth factor and MMP release of an experimental platelet- rich fibrin-type product. Platelets. 2016 February 1; 27(5): p. 427-432.
19. Masako Fujioka-Kobayashi, Michihide Kono, Hiroki Katagiri, et al. Histological comparison of Platelet rich fibrin clots prepared by fixed-angle versus horizontal centrifugation. Platelets. 2020 April 18; p. 1-7.
20. Richard J. Miron. Understanding Platelet-Rich Fibrin. 1st ed. Huffman L, editor.: Quintessence Publishing USA; 2021 Cap. 3: 51-70.
21. Richard J. Miron. Understanding Platelet-Rich Fibrin. 1st ed. Huffman L, editor.: Quintessence Publishing USA; 2021 Cap. 4: 71-81.
22. Olariu I., Buzatu R., Azar R.R., Luca M., Buzatu B.L.R., Azar I., Azar E.R., Ardelean V.A., Leretter M. PRF in modern dentistry: An innovative approach to oro-dental tissue regeneration, Medicine in Evolution Volume XXIX, No. 3, 2023

# The role of communication in the success of therapeutic interventions in dental practice

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## Abstract

The professional relationship between dentists and patients encompasses the provision of medical care and needs to be completed by an ethical and accurate communication. This highlights the significant emphasis placed on the interaction between medical staff and patients in medical practice. The success of dental treatments also hinges on the dentist's ability to establish a connection through communication with patients, paying attention to their needs, and demonstrating empathy and care towards them. **Materials and Methods:** For this observational-prospective study it was developed a questionnaire consisting of 10 closed-ended questions. The aim is to assess patients' opinions regarding the role and impact of communication in their relationship with dentists and on the success of medical treatment. **Results and Discussions:** The results indicate that the majority of patients evaluate their collaboration with dentists from a medical perspective but also through the way of communication and interaction quality. There is a strong emphasis on how healthcare providers are aware by their patient's needs, demonstrating empathy and skills in their professional collaborations. **Conclusions:** The primary conclusion of this study centers on the development of communication skills among dentists to achieve successful therapeutic outcomes, given the increasing needs of patients in the present context.

**Keywords:** communication, dentist, pacient, empathy, non-verbal communication, dental treatment

## INTRODUCTION

In the past three decades, communication has become an effective tool for improved outcomes in our society and moreover in medical field. Communication improves health, medical education and influence the social and behavioral changes that aime patient health. Population's behavior regarding oral health may change through an effective transmission of medical information being dependent on the dentist's communication skills and a strategic approach in communication [1,2].

In the context of health issues, most patients feel helpless and vulnerable but gaining their trust is essential for their confort and complaince. It is important that each interaction to be viewed as an opportunity for bidirectional information exchange and as a chance to establish a partnership with the shared goal of healing or safeguarding health [3,4]. Communication skills ensure the efficient time management, comprehension of recommendations and treatments, optimal health outcomes, and a high level of patient satisfaction [5].

For effective communication between dentist and patient, it is crucial to analyze the interaction process from the perspective of both parties involved. The patients' perspective on their interaction with the dentist will be influenced by how they understand and internalize their health issue, how they manage the uncertainty regarding the progression of their condition, and the extent to which they are involved in decision-making and complaince with the medical staff [6,7].

Patients' perspectives on communication are influenced, on one hand, by the content of the interaction and, on the other hand, by variables related to their perception of health [8]. It is challenging to determine which variables are most crucial for improving communication between dentists and patients. None of the investigations, dental treatments, or technology cannot be use to its maximum potential for patient if it is not accompanied by effective information exchange, coordination, and collaboration between patients and healthcare providers [9,10]. Studies show that dentists and patients attribute different meanings to the concept of "competent medical personnel." While dentists consider that a key criteria for a competent dentist is the ability to accurately diagnose. Patients prioritize how well their health needs are met through effective communication, which is grounded in empathy [11, 12]. The information and explanations provided by dentists form the core of the communication in their relationship with patients. Through the communicated information, the dentist clarifies various aspects related to the patient's health status, thereby reducing their level of uncertainty and anxiety regarding the medical procedure [13].

It is evident that the provision of information holds significant importance, and studies indicate that patients who receive clear and relevant information through effective communication exhibit higher levels of treatment adherence, thereby achieving the anticipated medical outcomes [14,15].

### *Aim and objectives*

The aim of this study is to highlight the benefits of effective communication in the patient relationship, which can ensure optimal therapeutic compliance in the medical field characterized by numerous diagnostic and therapeutic manoeuvres.

## MATERIAL AND METHODS

The research of the role of communication in dental medical practice focuses on conducting an observational-prospective study, which involves a questionnaire composed of

10 closed-ended questions. The questionnaire evaluate patients' opinions regarding the role and implications of communication in their relationship with dentists and its impact on the success of therapeutical dental procedures.

The time allocated for responding to the questionnaire was one week, and it was distributed to 50 patients from various dental practices in Timiș County. The responses were compiled and analyzed statistically and the questionnaire was distributed in both printed and electronic formats via different social media platforms.

Patients completed an appendix to the questionnaire, which included their consent to participate in the study, after being informed about the purpose of the research. They had the right to ask any questions they considered necessary regarding the study and were informed that they could withdraw from the study at any time without facing any adverse consequences.

The questionnaire developed began with a section providing general information about the patients' background (Urban/Rural). The first question aimed to assess patients' opinions about the benefits of integrating the three forms of communication—verbal, non-verbal, and para-verbal—during their interaction with the dentist in medical practice. We sought to examine if patients use not only verbal communication but also non-verbal and para-verbal communication when interacting with their dentist, and how these forms of communication have assisted them in the interaction.

The second question in the questionnaire was based on the premise of language barriers in medical communication, considering that most patients lack specialized medical knowledge. We aimed to evaluate their opinions on the extent to which dentists should be attentive and strive to simplify the terminology used when conveying messages, so that the information communicated is understood correctly.

The third question in the questionnaire addresses a crucial element of the communication process: active listening. We aimed to evaluate if patients understand the concept of active listening and to gauge how this understanding contributes to improving the communication process in their relationship with the dentist.

The fourth question analyzed the implications of effective communication in dental medical practice concerning the increase in patients' trust in the healthcare system. We aimed to assess if patients feel more confident in collaborating with dentists when their interactions are effective and free from communication barriers.

For question number five, patients were asked about the role of empathy in communication. Specifically, they were inquired if they believe a dentist who demonstrates empathy can develop a closer connection with them, thereby fostering cohesion. The aim was to explore whether dentists should exhibit empathy in their relationship with all patients or whether it should be more pronounced when interacting with minor or elderly patients.

The sixth question aims to analyze potential dysfunctions that may arise in the communication process between dental practitioners and patients when using closed-ended questions. It is based on the existence of two types of questions that can be posed during an interaction: closed-ended and open-ended questions, each serving its specific purpose. We seek to explore from the patients' perspective whether open-ended questions are preferable in interactions with dentists, as they might allow for more effective communication. Additionally, we aim to investigate whether closed-ended questions are more suitable for interactions with emotionally distressed patients or if, in these cases as well, open-ended questions would be more beneficial.

Question number seven was included to analyze the extent to which a dentist should adapt and individualize their communication style for each patient, given that each patient is unique. We aim to investigate whether the communication rules in medical practice can be universally applied to all patients or if it is beneficial for the dentist to adjust their

communication style to meet the needs of each individual patient. Additionally, we seek to explore whether patients consider it beneficial for them to take into account the type of dentist they are interacting with during the course of their professional relationship.

Question number eight in the questionnaire addresses a highly relevant and current topic in dental medical practice: the usefulness of organizing professional training courses in medical communication sciences. Given that the dental profession today requires not only medical knowledge but also the development of communication skills, we analyzed how beneficial it would be for dentists to receive training and guidance from specialists in communication regarding the rules and techniques they should consider when interacting with patients.

Question number nine examines one of the most important elements of non-verbal communication: eye contact. We aim to evaluate the extent to which dentists use eye contact as a form of non-verbal communication when interacting with patients and how this contributes to conveying a sense of security in the medical encounter.

Question number ten aims to analyze the feedback in the communication between dentists and patients. We determined whether providing feedback from patients at the end of the conversation contributes to enhancing communication in medical practice and if is helping the dentist to understand whether the information conveyed was correctly understood by the patient or not.

## RESULTS

The collected data were analyzed based on the patients' background. For question 1, according to the results, out of 50 patients, 12 from rural areas and 34 from urban areas believe that using verbal, non-verbal, and para-verbal communication is effective during the medical procedure in interactions with the dentist. They hold the view that integrating these three forms of communication is much more beneficial for accurately conveying messages. Two patients from rural areas and two from urban areas, believe that this approach is beneficial in communication with the dentist, but not in all cases. None of patients rejected the usefulness of employing these three forms of communication.

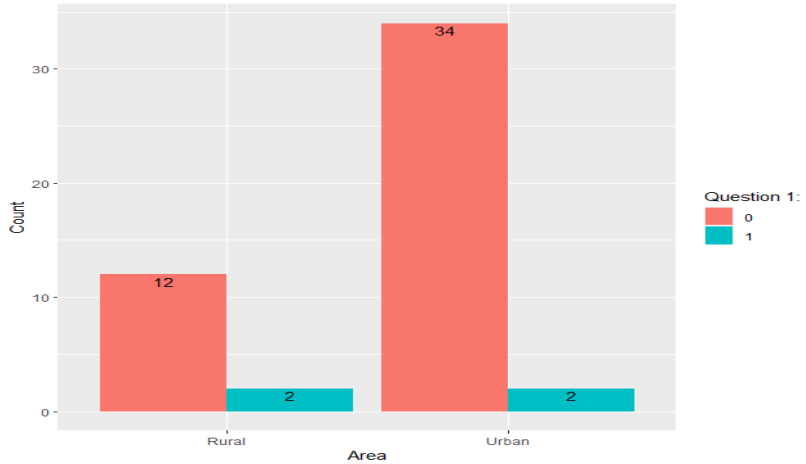



Figure 1. Statistical results for question 1 acording to urban and rural environment

Question 2, upon compiling the questionnaires, it was found that 13 from rural and 32 from urban areas believe it is very important for the dentist to minimize specialized language, particularly when dealing with patients who lack specialized medical knowledge or education. This practice helps facilitate a correct understanding of the conveyed information

and removes potential communication barriers. Only 1 patient, one from rural and 4 from urban areas, stated that minimizing specialized language does not always eliminate communication barriers, but only in certain situations, thus not allowing for a general conclusion. It is notable that no patient considered this measure to be unhelpful, indicating that all patients prefer medical staff to communicate information in a clear, coherent manner, avoiding ambiguities caused by complex terminology.

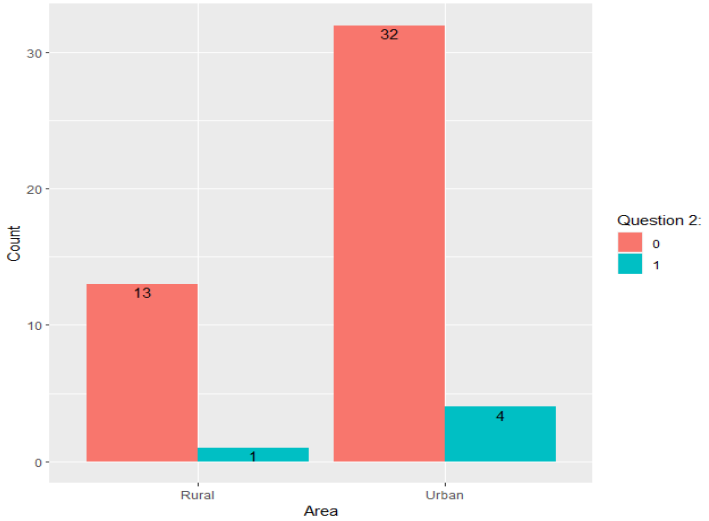



Figure 2. Statistical results for question 2 acording to urban and rural environment

Question 3: Do you believe that active listening represents one of the most important rules in the communication process between the dentist and patients? 0 – Yes; 1 – I lack knowledge about what active listening represents in the communication process, and therefore cannot provide a pertinent opinion on this subject; 2 – No. Among the 50 patients surveyed, 13 from rural areas and 32 from urban areas consider active listening to be one of the most important rules in the communication process between the dentist and patients. Three patients from urban areas did not provide an opinion on this matter due to their lack of understanding of what active listening entails in communication. Additionally, two patients—one from rural areas and one from urban areas—do not believe that active listening improves the relationship in dental medical practice.

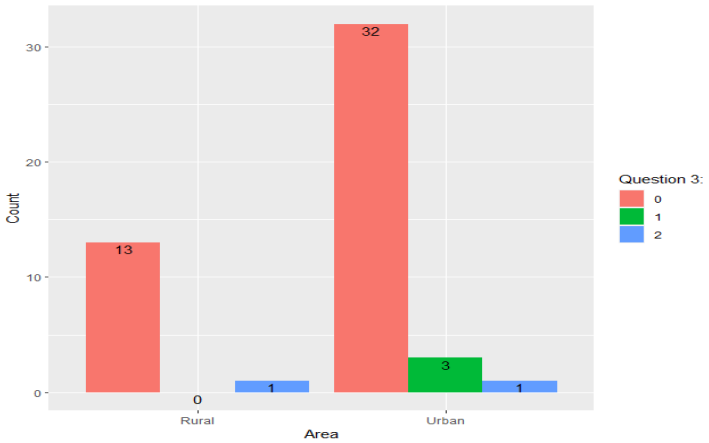



Figure 3. Statistical results for question 3 acording to urban and rural environment

Question 4: Do you believe that effective communication between medical staff and patients will increase the patients' trust in the healthcare system? 0 – Yes, in all situations; 1 – Yes, but not in all situations; 2 – No. 10 subjects from rural and 31 from urban areas stated that effective communication in medical practice with all medical staff would increase their trust in the healthcare system. Patients would approach specialists with greater opening. A small number of patients (4 from rural and 3 from urban areas) believe that effective communication with medical staff does not automatically lead to increased trust in the healthcare system in all cases. Additionally, only 2 patients from urban areas responded negatively to this question.

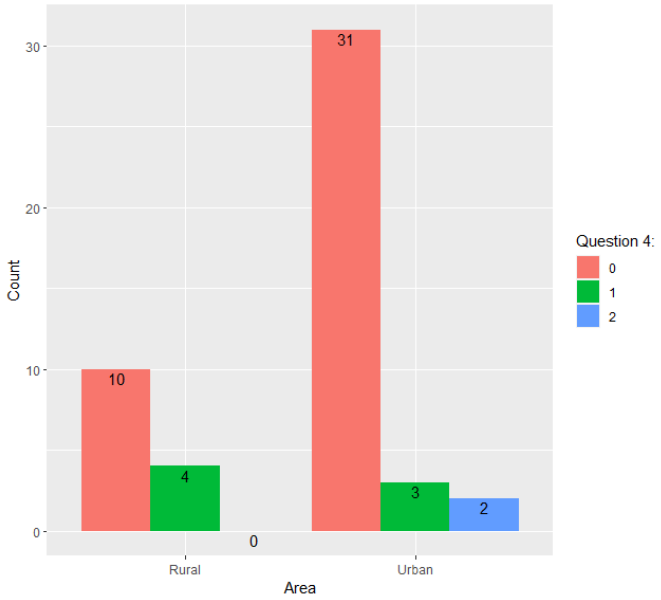



Figure 4. Statistical results for question 4 acording to urban and rural environment

The results for question 5 show that out of the 50 patients surveyed, 4 from rural areas and 19 from urban areas believe that it is very important for the dentist to show empathy during communication, particularly when dealing with elderly patients or minor patients accompanied by their guardians. They feel that an empathetic approach facilitates communication. Nine patients from rural and 16 from urban areas consider empathy to be very important in the communication process, regardless of the patients' age. Only 2 participants in the study (one from rural and one from urban areas) do not believe that empathetic dentists will interact and communicate more effectively in practice.

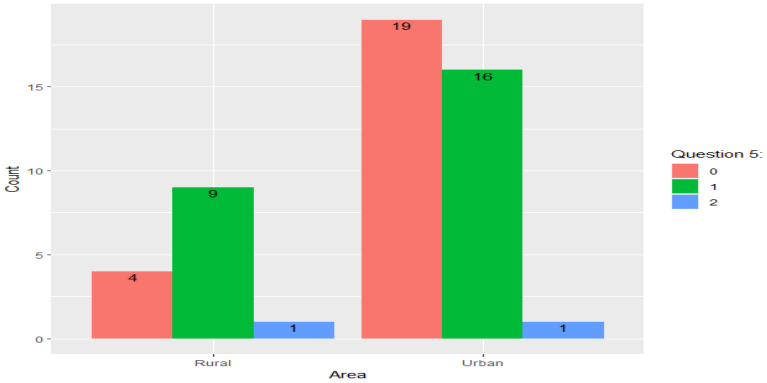



Figure 5. Statistical results for question 5 acording to urban and rural environment

Question 6: Do you believe that asking closed-ended questions by the dentist during communication with patients somewhat hinders interaction by limiting patients' ability to express their ideas and feelings? Out of the 50 patients surveyed, 9 from rural areas and 22 from urban areas believe that asking closed-ended questions by the dentist can somewhat hinder interaction by restricting patients' ability to express their ideas and emotions. A smaller number of patients (4 from rural areas and 14 from urban areas) stated that closed-ended questions can be useful when the dentist is dealing with emotionally expressive patients. Only one patient from rural areas felt that closed-ended questions do not create any dysfunctions in the communication process.

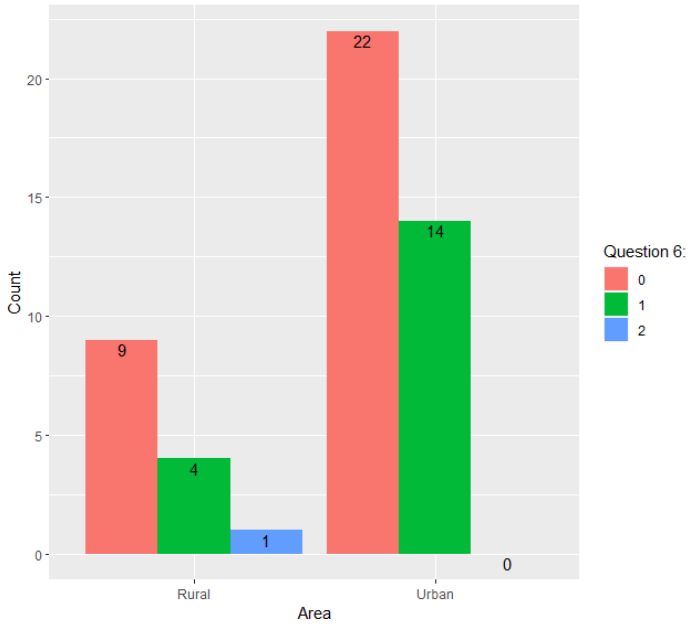



Figure 6. Statistical results for question 6 acording to urban and rural environment

Question 7: Do you believe that for effective collaboration, communication should be adapted to each type of patient? Regarding the importance of adapting communication in dental practice depending by each patient, 10 from rural and 26 from urban areas believe that the dentist should adapt their communication style to the needs of each patient for effective interaction. Three patients from rural and 10 from urban areas felt that not only should the dentist adapt their communication style, but patients should also adjust their communication approach based on the type of dentist they are interacting with. Only one patient from rural area did not consider this aspect important in their interaction with the dentist.

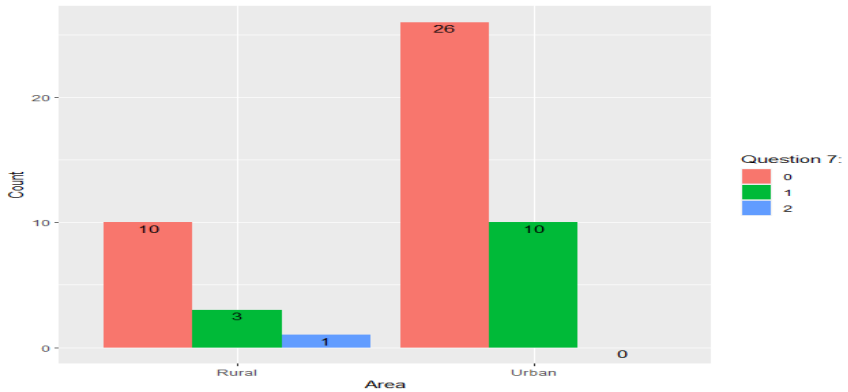



Figure 7. Statistical results for question 7 acording to urban and rural environment

Question 8: Do you consider professional training courses in communication useful in medical practice? Eleven patients from rural areas and 36 from urban believe that professional training courses focused on communication in medical practice, conducted by specialists in the field, are extremely useful. One patient from rural areas consider that these courses are useful, but not in all situations. Additionally, 2 patients from rural area do not believe that participating in these courses adds value to medical communication.

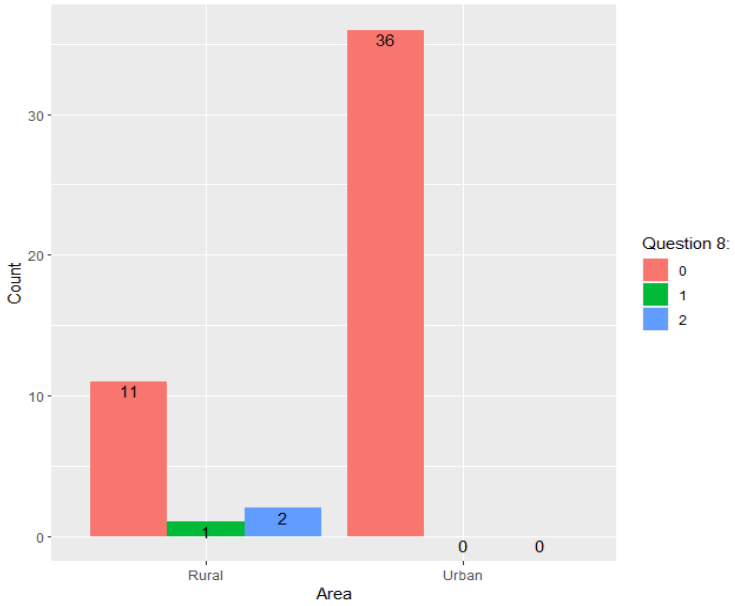



Figure 8. Statistical results for question 8 acording to urban and rural environment

Question 9: Does eye contact during the communication of information by the dentist capture the patient's attention regarding the message being conveyed and simultaneously convey a greater sense of security about the medical procedure? Regarding this question, 12 subjects from rural areas and 34 from urban areas consider that eye contact during the communication of information by the dentist effectively captures the patient's attention to the conveyed message and conveys a greater sense of security about the medical procedure. Only three patients, 2 from rural areas and 1 from urban areas, believe that this aspect of non-verbal communication is not beneficial in all situations, particularly with emotionally sensitive patients. Additionally, one patient from urban areas answered negatively to this question.

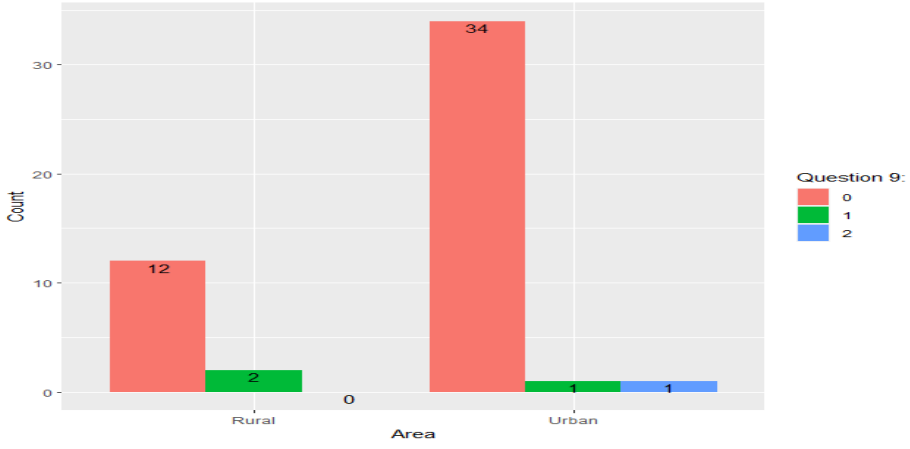



Figure 9. Statistical results for question 9 acording to urban and rural environment

Question 10: Do you consider that feedback provided by patients at the end of the consultation is an important element in communication with dentists? According to the last question of the questionnaire, 12 subjects from rural areas and 36 from urban areas believe that feedback is extremely important and should be provided by patients at the end of the interaction with the dentist. This allows the dentist to see if the information given was understood and perceived correctly by the patients. Only one patient from the rural area does not think that feedback ensures effective communication in all situations, and one patient from the rural area also gave a negative response to this question.

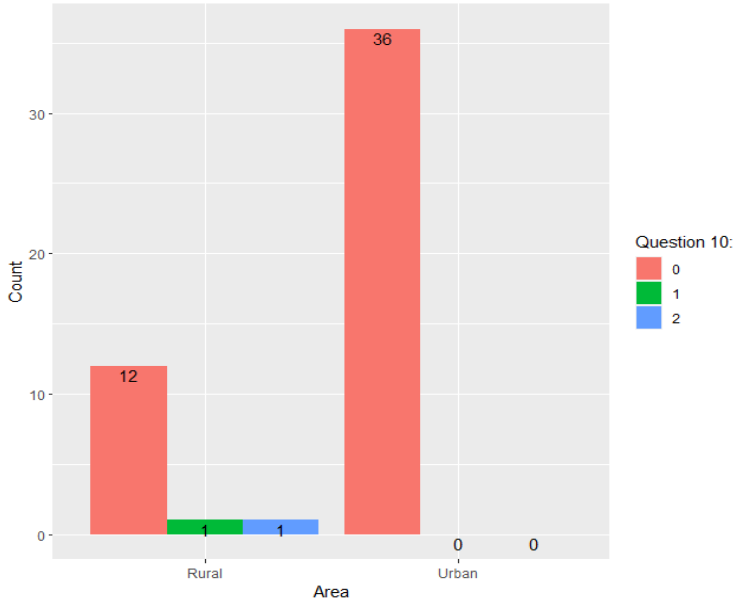



Figure 10. Statistical results for question 10 acording to urban and rural environment

## DISCUSSIONS

In recent years, there has been a decline in patients' trust in the healthcare system in Romania. This is not only because some dentists may lack the competence and knowledge but because, in many cases, they fail to give time and importance to the relational needs of patients, often downplaying their importance. This is precisely what should be avoided in dental practice, and it can be achieved when dentists are aware of the need for effective communication with patients [16,17].

In the medical field, communication has its own specific characteristics, determined by the needs of patients. Medical professionals must develop a range of relational skills [18].

It is crucial for dentists to realize that most of the time, patients coming to the clinic are unfamiliar with the field, having various concerns and uncertainties. Minimizing the use of specialized terminology will positively influence their anxiety about dental procedures [19,20].

## CONCLUSIONS

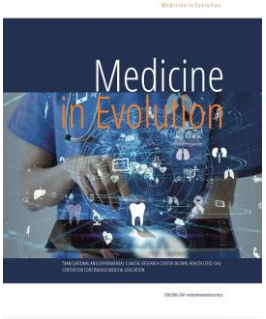
In recent years, there has been a decline in patients' trust in the healthcare system in Romania. This is not only because some dentists may lack the necessary competence and knowledge but also because, in many cases, they fail to address the relational needs of patients, often downplaying their importance. This is precisely what should be avoided in dental practice, and it can be achieved when dentists are aware of the need for effective communication with patients [16,17].

In the medical field, communication has its own specific characteristics, determined by the needs of patients. Medical professionals must develop a range of relational skills [18]. It is crucial for dentists to realize that most of the time, patients coming to the clinic are unfamiliar with the field, having various concerns and uncertainties. Minimizing the use of specialized terminology will positively contribute to the control of their anxiety about dental procedures [19,20].

**REFERENCES**


1. Barbos MC: Comunicarea în domeniul sănătăţii. Teorii, modele explicative, aplicaţii, Editura Universităţii Alexandru Ioan Cuza, Iaşi, 2020: 67
2. Sinadinović D, Hajduković IA, Mijomanović S. Doctor-patient communication in medicine and dental medicine, Serbian Dental Journal, 2020; 1 (67): 50-54
3. Hasson G: Cum să-ţi dezvolţi abilităţile de comunicare: ce ştiu, fac şi spun experţii în comunicare, Editura Polirom, Iaşi, 2012: 34
4. Smith AJE. Communication in the dental practice. Building a good dentist-patient relationship with communication, Ned Tijdschr Tandheelkd, 2019; 126(1): 37-44
5. Dinu G: Strategii ale comunicării în cabinetul stomatologic. Un model cultural şi organizatoric, Editura Eikon, Bucureşti, 2021: 31
6. Josan L: Relaţionarea medic-pacient. Modelul medicului formator, Institutul European, Iaşi, 2018: 60
7. Gasparik AI: Aspecte teoretice ale comunicării medic-pacient, Ed. University Press, Bucureşti, 2020:80
8. Nastasiu S, Eşanu-Dumnazev D. Elemente structurale în comunicarea interpersonală medic-pacient, Revista Acta et Commentationes, Sciences of Education, 2019; 2(16): 54-55
9. Iorgulescu G: Elemente de ştiinţe comportamentale şi neuroştiinţe în medicina dentară, Ediţia I, Editura Medicală, 2017: 102
10. Popa-Velea O: Comunicare. Comunicare medicală, Editura Universitară Carol Davila, Bucureşti, 2023: 230
11. Mahler B: Comunicarea medic-pacient în cuvinte şi dincolo de ele, Editura Humanitas, Bucureşti, 2023:70
12. Fathima SA. Communication – An Effective and Efficient Tool in Dentistry, Acta Scientific Dental Sciences, 2019; 8 (3): 74-76
13. Kadanakuppe S. Effective Communication and Empathy Skills in Dentistry for Better Dentist-Patient Relationships, Journal of Dental Problems and Solutions, 2015; 2 (3): 58
14. Easson E. Communicating effectively with patients, British Dental Association, 2020; 7 (21): 50
15. Nariţa I: Comunicare şi comportament, Editura de Vest, Timişoara, 2019: 76
16. Drăcsineanu C. Reconsidering the role of language to improve the doctor-patient communication, Romanian Journal of Oral Rehabilitation, 2020; 2(12): 229-234
17. Oană SC: Relaţia medic-pacient în practica medicală, Editura All, Bucureşti, 2021: 119-120
18. Popescu CA, Armean SM: Curs de comunicare medicală pentru studenţii de la Medicină Generală, Editura Medicală Universitară Iuliu Haţieganu, Cluj-Napoca, 2019: 25
19. Sabika Saeed HS, Muraikhi A, Khalid Esmael MER, "et al". Attitudes Of Dentist Towards Communication Skills Learning, International Journal of Dentistry and Oral Science (IJDOS), 2020; 7(12): 1187-1192
20. Popovici RA, Levai MC, Podariu AC, Rusu L.C., Faur A.: Particularităţi ale comunicării în medicină, Editura Mirton, Timişoara, 2016: 50-53
21. Pop D. M., Negruțiu M. L., Tănase A. D., Crăciunescu E. L., Novac A. C., Bojoga D. E., Miok K., Popa M. Importance of Communication for the Dental Treatment of ASD Patients, Medicine in Evolution Volume XXX, No. 1, 2024

# Dental care for the institutionalized elderly population – A literature review

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## Abstract

The current article is meant to be a literature review based on our findings regarding the dental care issues in the geriatric community.

The purpose was the focus to finding out information about what communities from around the world are doing in terms of dealing with the issue of an aging population and how to deal with the dental problems associated with aging and other comorbidities, thus involving a cardio/ general medicine diagnosis and a legal one when the patient is no longer able to tend to themselves or is institutionalized.

The material taken in this study was a full literature review based on pub med indexed articles from different parts of the world dealing with the same issues and corroborating the results and findings into categories of interest.

**Keywords:** geriatrics, institutionalized elderly, dental care for the elderly, dental geriatric care, cardio dental issues

## INTRODUCTION

This literature study came to its fruition after a personal struggle with the subject of geriatric dental care the authors have experienced when observing the elderly and their dental care needs. As clinical dentists, general practitioners, lawyers, cardiologist and university affiliates, we have underlined the need for a better management of the aging populations worldwide. This review is aimed to identify the role of geriatric dentistry in end-of-life palliative care, in the institutionalized elderly and the home-based older population by synthesizing the published scientific literature on the topic and analysing its significance and contributions. The lack of national oral health care / prevention and palliation for the institutionalized patients had us thinking of solutions to better this situation in terms of nationwide organization. It was rewarding to find that other countries struggle with the lack of dental care for this demographic as well and to research further their solutions and future. The issues of law and ethics, development of public and community oral health programs for the geriatric population and plans as well as trends for the future will also be discussed. Material and method used was researching the literature on diverse topics regarding geriatric dental care and issues. We have looked at worldwide publications and original research on the topics surround our interests. The results have shown considerable need for this issue and in conclusion we are on the brink of a much wider research and potential for this topic. Romania has a fertility rate of under 1,8 births per woman according to the national centre of statistic while the death rate is skyrocketing. After closely considering this information, we are bound to understand that in terms of dental, legal and cardio/ general medicine care we need to be prepared for an influx of elderly issues in our patients for the upcoming years as the population in our country is aging at a fast rate and we need to cater to its medical needs. Therefore, the dental issues we need to focus on are directly related to the patient's general status, his or her comorbidities and place of residence.

### *Aim and objectives*

The questions we asked ourselves to develop this literature review were the following: Do our patients have access to modern facilities? Do they live in a home, are they institutionalized, do they have around the clock care, can they tend to their needs, or do they need assistance? Our aim was to find if the literature also considers these imminent issues and what they have found based on their area or demographic. The results are gladly considerable in terms of information and statistics related to comorbidities and general political and legal aspect of issues surrounding the elderly all over the world. Our objective was to narrow down categories to look more deeply into in a future study and development of better self and general management of treating the elderly.

## MATERIAL AND METHODS

According to Digi24: Romania takes 2nd place in the world ranking when it comes to mortality rate and is also low in the rate of birth rate. The Romanian government has also expressed concern about the catastrophic demographic decline [1].

According to another source we have found, the status of oral health in the senior population is directly influenced by the edentulousness factor as well as other general and local health complications that are strictly in link with age, social status, whether they are institutionalized or not, and other quality of life directly influencing factors. Insurance is a powerful influencer as well as a contributor to future health deterioration of the oral aspect [2].

Several studies that we have found show incredible improvement when caretakers are properly educated and trained in the field of oral health care and prevention int tending to the senior population. Many subjects covered have been, understanding of senior needs, correct documentation and establishing protocols and routines [3].

The proportion of senior citizens continues to grow, especially in developing civilized countries. Poor oral health in the senior community among has been related to an increased level of tooth loss, dental caries and periodontal disease, xerostomia, and oral cancer. Even though many countries deal with the problem of an elderly and continuing to grow elderly demographic, there are reasons why this is happening, and the authors have identified the following: health insurance, economic development and level, social and cultural differences [4]. The authors we have researched have also battled and discovered they are missing national epidemiological data on the oral status of the population as well as requirements for implementing epidemiological programmes and strategies to improve oral health for the aging population to come.

## RESULTS

The interesting results found in our reviews are as follows, we have selected for this paper, just the most relevant in terms of future directions for our research: we have closely covered a study done by dentists in Berlin about the level of dental care in institutionalized elderly people. The study was substantial consisting of 364 patients spread over many geriatric care units in the city of Berlin. 87.3% of the patients were female and the average age was 84.9. the study was conducted using a questionnaire and an oral examination. This assessed the individual's satisfaction with the nursing home they resided in, the care to their general and oral health as well as their overall satisfaction with their status. The results of the study showed that the subjects did not benefit from routine dental checkups, their oral health was not at its best in less than 12.6% of the cases, full denture hygiene was at 45 % satisfaction. Out of the interviewed subjects, only 37,6 of the full mouth dentures has adequate stability and retention and in 80 % of the cases there was need for more dental work, the conclusions of the study were that there was need for recommendations and for improvement [5]. This finding was to us one of the most relevant and a model in terms of the research we must conduct in our geographical area to better find the real situation of our country when it comes to this subject.

Another interesting finding we found relevant was a World Health Organization report on the oral health status of people aged 65-74 in 21 countries showing that the prevalence of total edentulousness ranges from 12.8% to 69.9%. the study proves that the highest values are found institutionalized elderly [6]. The health status of institutionalized people is affected by numerous associated comorbidities [7].

## DISCUSSIONS

Regarding future directions of study or discussions, our findings have shown different aspects about geographic location of elderly, socio economic background, family possibilities, level of education, access to resources, political background and social reforms based on the needs of the elderly in each country. The directions of study are immense in the sense of legal work, cardio/dental corroborations and socio economical aspects regarding the management and treatment of institutionalized elderly., we are taking into considerations, protocol development, technology used and needed to treat people in their homes or institutes where they are residing, the legality behind such medical acts, etc. [8].

## CONCLUSIONS

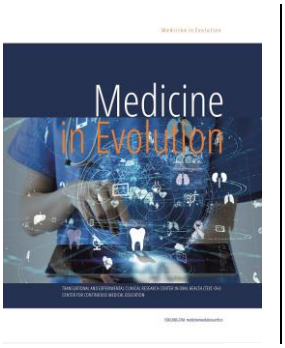
In order to make a full circle of our findings we must consider the most important one based on the Hippocratic Oath and that is of not doing harm, as much as we want to treat the needs of the elderly as they are institutionalized or home bed ridden, we must always consider the legal aspects of the quality of good we are doing and as the author and the law states : the sanitary unit will be able to prove either that the insufficient facilities or improper conditions are not attributable to it, or the intervention of an exonerating foreign cause of liability - regarding the insufficient endowment with medical diagnostic and treatment equipment, the legislator considered insufficient endowment related to the quality standards imposed on the sanitary unit, failing to impute the sanitary unit not to purchase the latest types of medical equipment available in the medical market [9] therefor we have included this in order to underline the importance of making sure the quality of services is standard to the conforming rules and regulations.

Other aspects to consider are the cardio / general health of the patients and how the medication they take influences their oral health/hygiene and pathology. Kinetics and mobility are also paramount and this is where patient kinesiotherapy and mobility exercise play an important role and according to publications in the field there is a strong association between neck circumference and abdominal circumference, body mass index (BMI), weight and resting metabolism [10] mobility is important for patients in order to be able to perform their natural hygiene movements, therefor obtaining a rightful oral hygiene. We are positive the future of this research is ample and generous, and we look forward to developing it further.

## REFERENCES


1. https://www.digi24.ro/stiri/actualitate/social/cia-romania-urca-pe-locul-2-mondial-in-clasamentul-ratei-mortalitatii-ministrul-firea-un-declin -unprecedented-demographic-2035387
2. Knabe C, Kram P: Dental care for institutionalized geriatric patients in Germany. J Oral Rehabil. 1997;24(12):909-12.
3. Murariu A, Vasluianu R, Baciu R.E, Geleţu G, Roşu S, Bolat M., Ioanid N., & Bobu L: Trends in oral health of the elderly: A literature review. Romanian Journal of Oral Rehabilitation, 2021; 4(13): 22-28
4. Precupeţu I, Mihalache F, Petrescu C., Pop C.E., Tufă L., Marian V: Calitatea vieţii vârstnicilor. Tendinţe şi riscuri în contextul pandemiei, Institutul de Cercetare a Calităţii Vietii, 2021: 9
5. Kenny A, Dickson Swift V, Chan CKY, et al.: Oral health interventions for older people in residential aged care facilities: a protocol for a realist systematic review. BMJ Open 2021; 11:1-9
6. https://www.diva-portal.org/smash/get/diva2:1725423/FULLTEXT01.pdf
7. Lamy M: La santé bucco-dentaire des personnes âgée. Rev Med Liège, 2014; 69(5-6): 357-360
8. Tănase AD: Răspunderea civilă pentru malpraxisul medical, Editura Universul Juridic, Bucuresti, 20224: 400
9. Sîrbu E, Pantea C, Gligor Ş: Social Implications of Nutritional Status and Consequences on Cardiovascular Risk Disease among Undergraduate Trained Students, Revista de Cercetare si Interventie Socială, 2014; 45:121-131.
10. Olariu I., Cosoroaba R. M., Popovici R. A., Pitic (Cot) D. E., Lile I., Marian D., Fluieras R., Stana O. L. Management of Dental Care for Elderly Patients, Medicine in Evolution Volume XXX, No. 1, 2024

# Expanding the limits: Successful anterior rehabilitation with feldspathic veneers beyond conventional guidelines

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## Abstract

This case report aims to detail our experience in regards to the management of the options for anterior dental rehabilitation using feldspathic ceramic veneers when preparation extends beyond guideline recommendations. Porcelain laminates are translucent, shade-matched to resemble enamel more than any other dental material, but there has always been equivocation about their mechanical integrity, particularly when applied over a severely reduced dentin. This work presents a clinical case where feldspathic veneers have been applied on all the anterior teeth, both centrals, laterals and canines, with veneer being made 0.5m thick, more than the recommended guidelines for such veneers. Despite the invasive preparation which extended beyond the 2mm of unsupported dental hard tissue infiltration the veneers showed that they were long term physiological stable. Some of the reasons that have put into practice are very rigid bonding procedures and good understanding of the properties of feldspathic ceramics. The case also debunks the concept that feldspathic veneers are not suitable in cases which require massive amounts of tooth reduction and indicates that this material will also do well especially if the technique that is implemented does not call for ideal conditions. Consistent with the latter statement, the present study emphasizes the effectiveness of feldspathic ceramics for remaining dental thickness and call for further investigation into more challenging clinical applications.

**Keywords:** ceramic masses, minimal invasive, treatment plan

## INTRODUCTION

The use of feldspathic ceramic veneers as a means of modulating the appearance of the anterior dentition has become popular because of the characteristic that makes these veneers resemble dental enamel. These veneers are especially well loved for their ability to be as transparent as the natural teeth' enamel and for the ability to replicate the light reflection thus suitable for the smile's visible zone. However, there has been controversy about their mechanical strength particularly when there is heavy preparation of the teeth to which the veneer will be bonded, and there is likelihood that parts of it will have no substrate support from the tooth surface (1,2).

A multiple of factors affects the outcome of feldspathic veneers as the tooth reduction, the thickness of the ceramic and the quality of the bonding process (3,4). Traditionally, as much enamel as possible is reduced in order to have sufficient substrate on which the veneer will rest on (5). However, there are some clinical situations in which more dentin has to be reduced, and one may end with a position where the veneer ends beyond the enamel margin that conventional practice defines as safe for mechanical retention (6).

In the present paper, a case report is described that discusses how feldspathic ceramic veneers were bonded satisfactorily in natural teeth where preparation invasive exceeded the usual 2 mm of unsupported dental hard tissue. However, the veneers provided all these results for the whole anterior region including the centrals and the laterals, as well as the canines for the long-term patients' outcome in the centrals and the laterals, the veneers presented long term stability and durability. This case gives an opportunity to evaluate the possibility of the feldspathic ceramics to remain intact even in situations where the preparation norms act as bar that cannot be crossed (9,10).

Feldspathic ceramics contain a large portion of glass and leucite crystals resultant in low flexural strength of 100-140 MPa (11,12). Nonetheless, when well cemented, these ceramics are capable of handling the forces of mastication, and this is so even if the veneer thickness is beyond standard limits (13). They further observe that, when good bonding procedures are used, feldspathic veneers have high prognosis with over 90% of the cases been reported to be still in place after 10 years (14,15).

In this case study, feldspathic veneers were applied on all the anterior teeth with the emphasis on proper bonding regime that would enable the veneers to serve as long as necessary given the fact that all anterior teeth were veneered and the veneering material had a thickness superior to that of the standard veneering ceramics (16,17). The results presented here can be considered to question the paradigm that feldspathic ceramics have restricted applications in restorative dentistry, and point toward a different course of the investigation. The clinical findings indicated here demonstrate the long-term potential of feldspathic veneers for even more extrovert aesthetic and, at times, they could provide more aggressive treatments ascending appeal without affecting resilience (20,21). This, in turn, serves to further stress the potential of utilizing sophisticated adhesive systems in harmony with the understanding of material characteristics to demonstrate effectiveness in aesthetic dental restorations.

It is probably due to unparalleled bonding of the restorations that other factors have made these restorations most successful. It is confirmed that good adhesion to the enamel increases the mechanical retention of ceramic veneers, which are rather brittle by their nature (23). The bond strength between feldspathic ceramic and enamel has been seen to play an important role with regards to the durability of these restorations (24). In this case, however, it might well have been this very bond that made an important contribution towards preserving the stability of the veneers, including in relation to occlusal forces. The preference

for feldspathic ceramic over other ceramic materials with higher flexural strength as lithium disilicate or zirconia, was due to the esthetic properties of feldspathic ceramics that are critical in anterior ones. It has been established that feldspathic ceramics allow for translucency and color matching to the extent of providing a natural appearance, which is quite relevant in anterior cases (26).

In addition, the study result of this case agrees with what is demonstrated by other research that feldspathic veneers have the potential to perform excellently when traditional preparation guidelines are exceeded (27). These studies imply that proper case selection, meticulous preparations and emphasis on bonding techniques may allow successful use of feldspathic ceramics even in more difficult clinical scenarios.

Material properties of feldspathic ceramics and their interaction with dental tissues should be comprehensively understood as exemplified in this case. By utilizing advanced adhesive techniques during treatment as well as careful clinical application, satisfactory results can be achieved within aesthetic dentistry even in less-than-ideal conditions.

### *Aim and objectives*

This article seeks to review the clinical performance of feldspathic ceramic veneers in the anterior dentition in terms of aesthetics and mechanics in preparations that involve massive reduction, as well as to determine the effectiveness of bonding in increasing veneer wear resistance and to discuss the wider prospects for feldspathic ceramics in contemporary restorative dentistry.

## MATERIAL AND METHODS

The patient came to us with a request to replace the maxillary central incisors. Considering the esthetic and the functional requirements the material of choice for the restoration was feldspathic ceramic. However, prior to finalising this decision, it was crucial to make sure that the clinical situation served such restorations.

Since there is no hard dental substrate on the mesial slopes of the central incisors another method to calculate the supported enamel area was used. This was done using a periodontal probe and according to the criteria of Alberta gum and bone chart. In particular, if the unsupported enamel was more than 2 mm, then feldspathic ceramic could not be used; lithium disilicate had to be employed. During the procedure, more material was removed from the diastema because the patient had overhanging composite restorations from previous treatments that were not properly finished. Upon calculating the area, it was found that the unsupported enamel exceeded 2 mm. Specifically, when measuring the area where the hard dental substrate ends from one incisor to the other at the incisal edge, the maximum unsupported zone exceeded the 2 mm threshold, reaching 2.3 mm on tooth 1.1 and 2.1 mm on tooth 2.1. Additionally, more preparation was done on tooth 2.1, extending 0.2 mm vestibularly due to the discoloration. This additional preparation was needed to allow the feldspathic ceramic to effectively cover the discoloration, even with the reduced thickness. Due to the direct visibility of the aesthetic zone, simple restoration leading to alteration of some of the parameters of the two central incisors may lead to the creation of unevenness between the natural teeth and the restored ones. Consequently, the decision was made to restore the entire anterior group up to the canines to have the same appearance.

While the premolars were also very evident in the profile pictures the decision was made to whiten professionally rather than use feldspathic ceramic to mask the teeth. This decision was made in compliance with the primary policies of the minimal and non-interventional treatment approach. Although the crowns of the premolars were not covered with ceramic, esthetics were restored by using whitening, as, the adjacent tissues affect the

color of the teeth and one cannot distinguish between them under social conditions. But even here a specialist may see the difference. The color which was used on the restorations was A1, the patient's natural teeth were assessed and determined to be A3 at the beginning. This was done by doing professional whitening before the final color selection to move from A3 to A1 (a two-shade difference). It helped to also make the feldspathic ceramic restorations match the newly whitened natural teeth.

The veneers were cemented by Variolink Aesthetic Light Cure Neutral (Ivoclar Vivadent, Liechtenstein). That is why a rubber dam provided a dry working field, when there could be no slippage, and the procedure has to be done again. Most importantly the veneers were cemented only on enamel thus helping in improving the mechanical mode of retention and thereby also longevity. This approach built on the idea that the adhesive bond between the enamel and adhesive had high bond strength and that the restorations could therefore withstand occlusion forces. Due to the adherence to the bonding protocol, there was tremendous esthetics without having to devitalize the natural dentition.

a) b)

Figure 1. a). The Patient's Initial Extraoral Smile. b). The Patient's Initial Intraoral Smile

Figure 2. (A). A Guided Mockup Was Performed

a) b)

Figure 3. a), b) The Preparation Was Guided Using the Mockup. To Properly Visualize the Dimensions of the New Restorations and the Permissible Thickness of the Feldspathic Ceramic in Millimeters

a) b) c)

Figure 4. (a, b, c, d,) The fixation of the Mockup

a) b) c)

Figure 5. Patient Appearance with Mockup, a) Right Semiprofile, b) Frontal view, c) Left Semiprofile

a) b)

Figure 6. (a, b) Guided preparation through mockup

a) b)

Figure 7. (a, b) Finishing the Teeth on Which Veneers Have Been Placed

Figure 8. (A) The Fixation of Feldspathic Ceramic Veneers

Figure 9. (A) The Final Extraoral Result

Figure 10. (A) Intraoral Aesthetic Appearance

## RESULTS

This case demonstrated that feldspathic ceramic veneers can be successfully placed even when the tooth preparation exceeds typical standards, especially in cases involving more than usual tooth reduction. The patients had high esthetic satisfaction and stability over time and as seen no veneer failure even though they had invasive preparation.

The bonding procedure was also very much significant in determining the effectiveness of the veneers. The adhesion procedure to the enamel surface enhanced retention and reduced the brittleness of feldspathic ceramics, hence occlusal loading. The definitive cementation was made with Variolink Aesthetic Light Cure Neutral (Ivoclar Vivadent, Liechtenstein) and for this an isolation with a rubber dam was essential to provide the best adhesion.

The aesthetically pleasing outcome was significantly enhanced by the professional bleaching, which achieved an excellent color match. The veneers seamlessly blended with the patient's natural teeth, maintaining their flawless appearance even under magnification.

From this case, it can be concluded that if careful preparation and the adhesive systems are employed, feldspathic ceramics might be used in more complex restorative situations.

## DISCUSSIONS

The favorable outcome of the present case thus contradicts the general restrictions about the application of feldspathic ceramic veneers especially when the preparation entails more than anticipated reduction of tooth substance as per the principles of feldspathic ceramic veneers. As it has been stated for a long time, it is highly important to reduce the amount of space of the ceramic that is not supported to minimize the risk of mechanical failure (22).

Nevertheless, in this case, even though the thickness of the unsupported dental hard tissue was more than the conventional 2 mm, the feldspathic veneers were very robust throughout the anterior region.

It is probably due to unparalleled bonding of the restorations that other factors have made these restorations most successful. It is confirmed that good adhesion to the enamel increases the mechanical retention of ceramic veneers, which are rather brittle by their nature (23). The bond strength between feldspathic ceramic and enamel has been seen to play an important role with regards to the durability of these restorations (24). In this case, however, it might well have been this very bond that made an important contribution towards preserving the stability of the veneers, including in relation to occlusal forces. The preference for feldspathic ceramic over other ceramic materials with higher flexural strength as lithium disilicate or zirconia, was due to the esthetic properties of feldspathic ceramics that are critical in anterior ones. It has been established that feldspathic ceramics allow for translucency and color matching to the extent of providing a natural appearance, which is quite relevant in anterior cases (26).

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Material properties of feldspathic ceramics and their interaction with dental tissues should be comprehensively understood as exemplified in this case. By utilizing advanced adhesive techniques during treatment as well as careful clinical application, satisfactory results can be achieved within aesthetic dentistry even in less-than-ideal conditions.

## CONCLUSIONS

In conclusion, this case report demonstrates the application of feldspathic ceramic veneers that were carried out in a case of a significant amount of tooth structure reduction. Veneers can provide predictable long-term stability and aesthetic health. This means that feldspathic ceramics can be used in almost any clinical situation, provided that proper attention is given to bonding techniques and careful selection of cases. This challenges traditional paradigms of veneer placement in restorative dentistry.

## REFERENCES

1. Magne P, Belser U. Bonded porcelain restorations in the anterior dentition: a biomimetic approach. Quintessence Publishing Co Inc; 2002.
2. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers: a review of the literature. J Dent. 2000 Mar;28(3):163-77.
3. Della Bona A, Van Noort R. Ceramic surface preparations for resin bonding. Am J Dent. 1995 Aug;8(4):197-201.
4. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation--a retrospective study. Int J Periodontics Restorative Dent. 2005 Feb;25(1):9-17.
5. Christensen GJ. The use of porcelain-fused-to-metal crowns, porcelain veneers, and all-ceramic crowns. J Am Dent Assoc. 1991 Aug;122(8):65-6, 68, 70-1.
6. Giordano R, McLaren EA. Ceramics overview: classification by microstructure and processing methods. Compend Contin Educ Dent. 2010;31(9):682-4, 686, 688 passim.
7. Sorensen JA, Kang SK, Torres TJ, Knode H. In-Ceram fixed partial dentures: three-year clinical trial results. J Calif Dent Assoc. 1998 May;26(5):355-63.

8. Della Bona A, Van Noort R. Ceramic surface preparations for resin bonding. Am J Dent. 1995 Aug;8(4):197-201.
9. Magne P, Perroud R, Hodges JS, Belser UC. Clinical performance of bonded porcelain veneers over 2 decades. Int J Periodontics Restorative Dent. 2000 Feb;20(1):10-21.
10. McLaren EA, Giordano R. Zirconia-based ceramics: material properties, esthetics, and layering techniques of a new veneering porcelain, VM9. Quintessence Dent Technol. 2005;28:99-111.
11. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation--a retrospective study. Int J Periodontics Restorative Dent. 2005 Feb;25(1):9-17.
12. Gurel G. The science and art of porcelain laminate veneers. Quintessence Publishing Co Inc; 2003.
13. Giordano R, McLaren EA. Ceramics overview: classification by microstructure and processing methods. Compend Contin Educ Dent. 2010;31(9):682-4, 686, 688 passim.
14. Burke FJ, Lucarotti PS. Ten-year outcome of porcelain laminate veneers placed within the general dental services in England and Wales. J Dent. 2009 Jan;37(1):31-8.
15. Christensen GJ. The use of porcelain-fused-to-metal crowns, porcelain veneers, and all-ceramic crowns. J Am Dent Assoc. 1991 Aug;122(8):65-6, 68, 70-1.
16. Friedman MJ. A 15-year review of porcelain veneer failure--a clinician's observations. Compend Contin Educ Dent. 1998 Apr;19(4):625-8.
17. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers: a review of the literature. J Dent. 2000 Mar;28(3):163-77.
18. Calamia JR. Etched porcelain facial veneers: a new treatment modality based on scientific and clinical evidence. N Y J Dent. 1983 Nov;53(9):255-9.
19. Pippin DJ, Mixson JM, Soldan-Els AP. Clinical evaluation of etched porcelain veneers over a period of 18 to 42 months. J Prosthet Dent. 1995 Oct;74(4):301-6.
20. Dumfahrt H. Porcelain laminate veneers. A retrospective evaluation after 1 to 10 years of service: Part II--Clinical results. Int J Prosthodont. 1999 Sep-Oct;12(5):408-13.
21. Simonsen RJ. The clinical significance of tooth color. Dent Clin North Am. 1988 Oct;32(4):779-89.
22. Magne P, Belser U. Bonded porcelain restorations in the anterior dentition: a biomimetic approach. Quintessence Publishing Co Inc; 2002.
23. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers

# Manual vs. power toothbrush efficiency on plaque removal in patients with fixed orthodontic appliances


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## Abstract

**Aim and objectives**: The main goal of this study is to compare the efficiency of manual and power toothbrushes in dental plaque removal on patients with orthodontic appliances. **Material and methods**: 30 patients aged from 12 to 29 years were selected for this study, 17 of them being girls/women. Half of them received education for manual toothbrushing and the other half for using power toothbrush. An adapted version of Ciancio plaque score was used for the plaque measurements. **Results**: Patients who used power-toothbrushes seem to have a lower plaque score but the results were not statistically confirmed ($p > 0.05$). **Conclusion**: Using a power-toothbrush may be an advantage during the orthodontic treatment.

**Keywords:** dental plaque, manual toothbrush, power toothbrush, orthodontic appliances

## INTRODUCTION

Orthodontic appliances increase the risk for retaining biofilm and debris, the highest risk of plaque formation being on buccal surfaces, around the brackets, and on interdental areas [1,2]. Moreover, it seems like orthodontic appliances also can make some changes in the oral microbiota like increasing the *Streptococcus* and *Lactobacillus* population which can lead to a high risk of caries and white spots on the teeth due to enamel demineralisation process. The risk of gingivitis and periodontal disease also rises because some species like *Tannerella forsythia*, *Fusobacterium nucleatum* and *Porphyromonas gingivalis* are increased during the orthodontic treatment. *Prevotella nigrescens* is also increased when elastomeric ligatures are used [3,4].

A high-quality oral hygiene must be performed by the patients during the orthodontic treatment, especially a good plaque removal using manual/power toothbrush and interdental cleaning instruments.

### *Aim and objectives*

The main objective of this study is to compare the efficiency of manual and power toothbrushes in dental plaque removal on patients during the orthodontic treatment by using a special plaque score useful in case of orthodontic appliances.

## MATERIAL AND METHODS

The sample consisted from 30 patients with buccal bonded brackets for both arches, aged from 12 to 29 years. 17 of them were girls/women. 15 of the patients received education for manual toothbrushing (Charters method) and 15 for using power toothbrush. The dental appointments were fixed in the first part of the day, between 10 am and 2 pm. So, all the patients were evaluated a few hours after their usual toothbrushing in the morning. Dental disclosing tablets were used for dental biofilm evaluation. An adapted version of the index proposed by the Ciancio at al. was used for the plaque measurements [5,6]. The scores were the followings:

- 0: no plaque on bracket or on tooth surface
- 1: plaque on bracket only
- 2: plaque on bracket, tooth, no extension to gingiva
- 3: plaque on bracket, tooth, extension to papilla
- 4: plaque on bracket, tooth, partial coverage to gingiva
- 5: plaque on bracket, tooth, fully coverage to gingiva

Pictures were taken after every evaluation. Some examples are shown in figure no. 1. The mean value of the index for each patient was calculated by dividing the sum of all scores by the number of the surfaces with brackets (evaluated). The data were entered into a laptop and processed with 24 trial version of SPSS software (Armonk, NY, USA).

Figure 1. Images after dental plaque disclosing

## RESULTS

No patient had the mean score value under 1. The plaque scores are shown in figure 2. An analysis by gender and type of toothbrush is shown in figures no. 3 and 4.

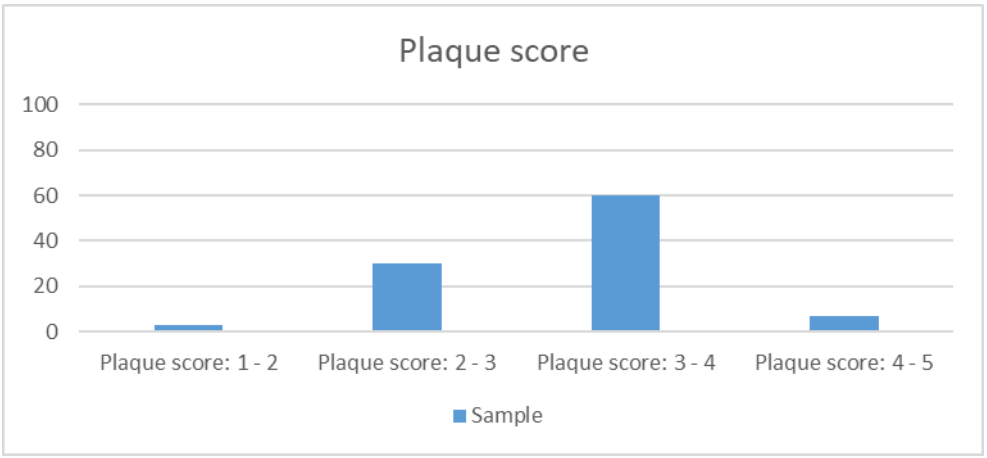



Figure 2. The plaque score for the entire simple

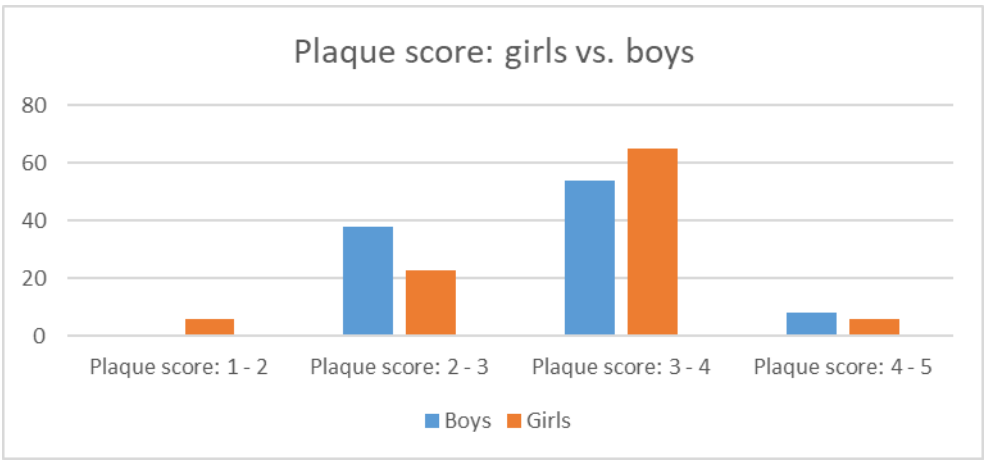



Figure 3. The plaque score for boys and girls

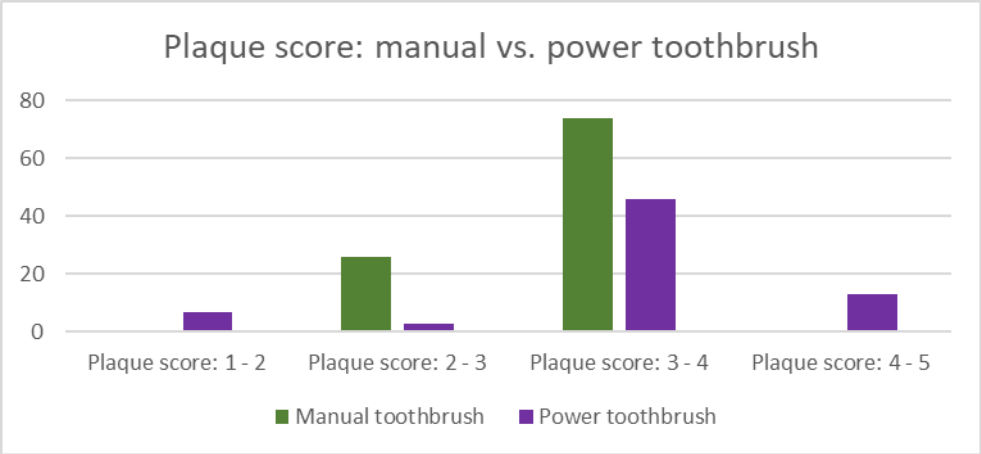



Figure 4. The plaque score after manual and power toothbrushing

The mean value of dental plaque score for the entire sample was 3.13 (SD ± 0.49). The tests (Shapiro-Wilk, $p = 0.16 > 0.05$) showed a normal distribution for dental plaque score. T test was used for comparing differences between gender groups and manual/power toothbrush groups (see table 1):

Table 1. The mean values of the plaque score on different subgroups

| Subgroups | | Plaque score (mean ± SD) | |
|---|---|---|---|
| Gender | Boys | 3.22 ± 0.44 | p = 0.38 > 0.05 |
| | Girls | 3.06 ± 0.53 | |
| Type of toothbrush | Manual | 3.18 ± 0.22 | p = 0.54 > 0.05 |
| | Powered | 3.07 ± 0.67 | |

## DISCUSSIONS

Most of the patients from our study had a medium-high plaque score (between 3 and 4). Even if more girls had medium-high and less of them had medium-low plaque scores (between 2 and 3) than boys, they had lower mean value of the plaque score. However, this "lower mean value" is no statistically confirmed ($p > 0.05$). Many studies developed in Romania [7,8] or in other countries [9,10] showed boys displayed in general worse plaque scores and less good oral hygiene than girls in this age period.

We also found a lower plaque score for the patients who use power toothbrush but again, this result was not statistically confirmed. Many studies from all over the world also exposed no differences in plaque removal for normal individuals using manual and power toothbrush or they found a better plaque score in case of using power toothbrush but with no statistically confirmation [11,12]. However, for patients with orthodontic appliances it seems like using a power toothbrush is better [13].

So, being in the risk category for plaque formation during the orthodontic treatment, these patients must take care a lot about their oral hygiene. Using a power toothbrush, fluoride toothpaste and other instruments for interdental cleaning and cleaning around the brackets is a good strategy for avoiding the high risk of caries and gingivitis.

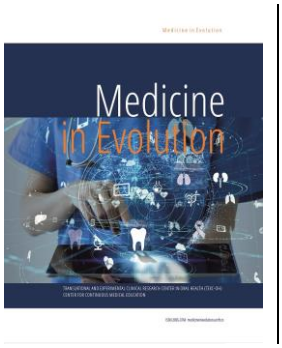
## CONCLUSIONS

Patients must have a good oral hygiene especially during the orthodontic treatment. Using a power toothbrush may be an advantage.

## REFERENCES


1. Wilkins EM, Wyche CJ, Boyd LD. Clinical practice of the dental hygienist. Twelfth Edition, 2017 Wolters Kluwer; Two Commerce Square 2001, Market Street, Philadelphia, PA 19103 USA; 505
2. Kozak U, Lasota A, Chałas R. Changes in Distribution of Dental Biofilm after Insertion of Fixed Orthodontic Appliances. J Clin Med. 2021;10(23):5638
3. Freitas AO, Marquezan M, Nojima Mda C, Alviano DS, Maia LC. The influence of orthodontic fixed appliances on the oral microbiota: a systematic review. Dental Press J Orthod. 2014;19(2):46-55
4. Al-Mutairi MA, Al-Salamah L, Nouri LA, Al-Marshedy BS, Al-Harbi NH, Al-Harabi EA, Al-Dosere HA, Tashkandi FS, Al-Shabib ZM, Altalhi AM. Microbial Changes in the Periodontal Environment Due to Orthodontic Appliances: A Review. Cureus. 2024;16(7):e64396
5. Ciancio SG, Cunat JJ, Mather ML, Harvey DH. A comparison of plaque accumulation in bonded vs banded teeth. J Dent Res. 1985;64(Spec.Issue):359.
6. Cardoso Mde A, Saraiva PP, Maltagliati LÁ, Rhoden FK, Costa CC, Normando D, Capelozza Filho L. Alterations in plaque accumulation and gingival inflammation promoted by treatment with self-ligating and conventional orthodontic brackets. Dental Press J Orthod. 2015;20(2):35-41
7. Funieru C, Klinger A, Băicuş C, Funieru E, Dumitriu HT, Dumitriu A. Epidemiology of gingivitis in schoolchildren in Bucharest, Romania: a cross-sectional study. J Periodontal Res. 2017;52(2):225-232
8. Funieru C, Nicolescu MI, Băicuş C, Sluşanschi O, Bica CI, Moldoveanu A, Perpelea AC, Ţandără AT. Oral Hygiene Profile of Schoolchildren from Bucharest, Romania-How It Can Be Used and Improved for Better Prevention of Oral Diseases. Healthcare (Basel). 2024;12(13):1293
9. Jaiswal D, Kalia P, Hiremath S, Singh AK, Pani P, Kumar N. Evaluation of Oral Hygiene Status among 12-14-Year-Old School Children. J Pharm Bioallied Sci. 2021 Jun;13(Suppl 1):S112-S115.
10. Karem Hassan B, Jabbar Ali B, Mahmood Alwan A, Badeia RA. Self-Reported Oral Health Attitudes and Behaviors, and Gingival Status of Dental Students. Clin Cosmet Investig Dent. 2020;12:225-232
11. Vibhute A, Vandana KL. The effectiveness of manual versus powered toothbrushes for plaque removal and gingival health: A meta-analysis. J Indian Soc Periodontol. 2012;16(2):156-60
12. Deery C, Heanue M, Deacon S, Robinson PG, Walmsley AD, Worthington H, Shaw W, Glenny AM. The effectiveness of manual versus powered toothbrushes for dental health: a systematic review. J Dent. 2004;32(3):197-211
13. Erbe C, Klees V, Braunbeck F, Ferrari-Peron P, Ccahuana-Vasquez RA, Timm H, Grender J, Cunningham P, Adam R, Wehrbein H. Comparative assessment of plaque removal and motivation between a manual toothbrush and an interactive power toothbrush in adolescents with fixed orthodontic appliances: A single-center, examiner-blind randomized controlled trial. Am J Orthod Dentofacial Orthop. 2019;155(4):462-472

# Repair of fractured lithium disilicate restorations with partial feldspathic ceramic veneers

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## Abstract

The purpose of this case report is to describe the use of partial feldspathic ceramic veneers to restore a fractured lithium disilicate ceramic restoration. Feldspathic ceramics have almost the aesthetic property of enamel, and they have good light transmission property, but its mechanical properties particularly when used over reduced dentin has been the subject of controversy. This case report presents the restoration of a distal fracture on the incisal margin of a layered lithium disilicate restoration, where only the feldspathic ceramic layer was damaged, and was repaired using a partial feldspathic veneer. Although the veneer was successfully adapted to incisal plane, there is a remarkable discrepancy in terms of esthetic finish in that there is a clear line of separation between the newly placed veneer and the existing restoration. The failure of lithium disilicate restoration under three months of service shows that the choice of materials and an evaluation before repair is critical. This case shows direction of feldspathic ceramics to the multifaceted restorative tasks, focusing on the necessity of the complex bonding and material science approaches for improved both performance and esthetic characteristics. The study indicates that feldspathic veneers may be useful to rehabilitate feldspathic ceramic restorations however; it is not easy always to completely achieve an aesthetic success.

**Keywords:** feldspathic ceramic materials, repair of restoration, partial veneer

## INTRODUCTION

The use of the feldspathic ceramic veneers in restorative dentistry has become popular because of its esthetic characteristics such as susceptibility to mimic the optical properties of the hydroxyapatite of the dental enamel. Of feldspathic ceramics most are cherished for their capacity to match color and transparency which is especially important where aesthetics are paramount such as in the anterior zone (1,2). Still, these benefits cannot be overlooked as the disadvantages of feldspathic ceramics relate to its mechanical characteristics, its inferior flexural strength compared to several other ceramics for instance lithium disilicate or zirconia and these make their usage a challenge in conditions that involve high stresses (3,4).

Typical flexural strength values of feldspathic ceramics are between 100-140 MPa, and the material ''feels'' quite brittle; this puts mechanical constraints on their use, especially in restorative procedures (5,6). Feldspathic veneers offer several advantages, especially in cases where existing restorations are damaged and only partial repair is needed rather than a complete replacement (7). This case demonstrates the successful use of a partial feldspathic veneer to repair a broken lithium disilicate restoration.

A confined crack at the distal incisal aspect of the lithium disilicate restoration was treated by means of placing a partial feldspathic veneer over about 50% of the respective tooth area (8). Other authors stated that this approach the feldspathic veneers can also be used for selective repair, despite the general rules for full coverage restoration (9). This can be interlinked to the type of fracture that was observed; it was a mid-facial fracture which only affected the lower part of the incisal edge; therefore, there was no reason to go for full coverage treatment (10).

Research also exists for feldspathic veneers in repair situations where the mechanical load is not carried over a complete restoration; and is referred to as the load bearing kind (11,12). Healing of the existing restoration in this case made it evident that feldspathic ceramics can help in enhancing the durability and integral value of threatened restorations through selective use (13). Superior attachment systems and correct application of feldspathic veneer for management of compromised restorations enable improvement in the utilitarian value of these materials in restorative dentistry (14,15).

Therefore, although feldspathic ceramics are relatively weak in mechanical strength, the esthetic benefits and the treatment of the local crack have clinical uses. This case study confirms that feldspathic veneers are an option in the restoration of small defects that are present in existing restorations, this is in its larger use in restorative dentistry (16,17). The results highlight use advanced adhesive processes and materials' characteristics to provide satisfactory results even under worst scenarios.

### *Aim and objectives*

The aim of this study was to restore the functional and aesthetic integrity of a fractured lithium disilicate restoration on tooth 2.1 using a partial feldspathic veneer. The objectives included assessing the feasibility of a partial veneer based on the extent of unsupported enamel, ensuring a secure bond and long-term durability of the restoration, and achieving a satisfactory aesthetic outcome despite the challenges in shade matching.

## MATERIAL AND METHODS

The patient was a female who presented with a fractured lithium disilicate restoration on tooth number 2.1, which required repair with a partial feldspathic veneer. The aim was to treat the affected zone and bring it to adjust the appearance of the continued restoration. The

crown fracture was at the distal incisal edge of the lithium disilicate restoration, adjacent to the palatal stripe, reducing the incisal enamel surface of the restoration by approximately 50%. This localized fracture showed that a partial feldspathic veneer was ideal in this case (18).

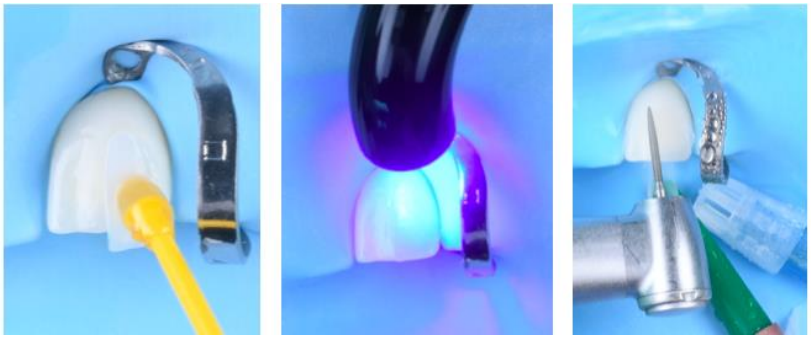
Since an enamel projection under the veneer would be unsupported, dimensions of unsupported enamel around the fractured site were taken to evaluate the feasibility of a partial feldspathic veneer. A periodontal probe and the Alberta gum and bone chart were used in order to measure unsupported enamel (19). The additional measurements showed that the unsupported enamel did not apply more than 2mm: this meant that feldspathic ceramics were still a possibility (20).

Preparation and restoration curing of the damaged restoration was done by cutting off any crumbled material to create a clean surface using diamond bur (Red Band, Komet Dental, Germany) (21). It was then abraded aiming at getting better bond strength. On the tooth 2.1 a partial feldspathic veneer was placed to veiled only the distal half of the incisal edge.

The feldspathic veneer was cemented with Variolink Aesthetic Light Cure Neutral (Ivoclar Vivadent, Liechtenstein) (22). To avoid interference and contamination of the bonding surface a rubber dam was applied in order to achieve a dry work field (23). The veneer was laminated only onto enamel to ensure maximum interlocking and durability of the restoration. Finishing and polishing after bonding the restoration is finalized using diamond bur (Red Band, Komet Dental, Germany) to blend the new veneer and the remaining prosthetic work (24). This was done using rubber polishing discs (Enhance, Dentsply Sirona, USA) and a polishing brush (Shofu Super Snap, Shofu Dental, Japan) to smoothen the surface and give it a smoother finish (25,26). In spite of these measures, it was difficult trying to achieve ideal shade match with the new partial veneer and the existing lithium disilicate restoration. There was thus a slight visible gap leaving a result that was functionally acceptable but could be seen by more critical patients (Figure 4 a, b) (27).

a) b)

Figure 1. a). Regarding the appearance of the patient's smile after chipping on the dental unit 2.1, highlighting the incisal edge and the fracturing of this edge in the distal portion of the incisal margin. b). The intraoral appearance of the fracture at the level of tooth 2.1.



a) b) c)

Figure 2. a) The fixation of the restoration. b) Photopolymerization. c) Finishing with a red-coded diamond instrument

a) b)

Figure 3. Surface finishing with rubber polishers: a) Diamond Polisher, Shofu Dental, Japonia; b) (Diacomp Plus, EVE Ernst Vetter GmbH, Germania)

a) b)

Figure 4. a) The appearance of the restoration after fixation and finishing, viewed extraorally. b) The appearance of the restoration after fixation and finishing, viewed intraorally

## RESULTS

When the partial feldspathic veneer had been placed, the restoration was acceptable regarding incisal adaptation. The veneers blended seamlessly with the incisal relationships, without appreciable interference to the same. Follow up assessments after the restoration also provided affirmed the incisal stability and supported the theory stating that there were no changes in bite or function (28). The frustration of this repair is evident when we are looking at the aesthetic result that came out of the repair. Even if the borders between the partial veneer and the existing lithium disilicate restoration are carefully finished and polished, one can observe its contrast. This separation, although it did not compromise the functionality of the restoration to a great extent, was observable on visual scrutiny and contributed to the overall compatibility of the restoration with the neighbouring tissues (29,30). The difficulty of achieving a match with the surrounding tissue without having a smooth gradient was that the ceramic feldspathic veneer and the lithium disilicate restoration were of different colors and textures and were different in the ceramic materials that could be used to interpose between them (31). Three months after the placement, the lithium disilicate restoration on tooth 2.1 fractured. This was a significant complication, though the feldspathic veneer proved effective in masking the fractured surface. Analysts suggest that the properties of the lithium disilicate and the type of damage present before the restoration may have contributed to the fracture (32). The partial veneer itself remained clinically strong and well-fitted, which contrasted with the failure of the underlying restoration; the veneer functioned perfectly (33). The patient was informed of the possibility of further biomechanical work on the fractured lithium disilicate restoration and the aesthetic issues that were apparent. While the new partial veneer bonded well with the remaining tooth structure, the overall restoration highlighted the challenges often encountered in achieving both acceptable function and aesthetics in such repairs (34, 35).

## DISCUSSIONS

In light of this case, the attempt to use feldspathic ceramic veneers for the rehabilitation of fractured lithium disilicate restorations underscores some presumptions commonly held with regard to the use of the feldspathic ceramics in less-than-optimal situation. That is why it is possible to consider two millimetres as a critical zone where the enamel is unsupported and needs a strengthening cement with more than 2 mm of unsupported enamel for some areas, the partial feldspathic veneer easily adapted to incisal contact areas and offered a functional answer to the fractured restoration (36).

This is especially true for clinical situation like the present case where the feldspathic veneer's incisal adaptation was even more difficult due to the presence of deep undercuts it is, for this reason that, bonding techniques contributes significantly to the final outcome of such restoration. The micole bond between feldspathic ceramics and enamel is therefore essential for the mechanical retention of these restorations, since they are normally brittle. (37) In this case, the strong bonding offered by Variolink Aesthetic Light Cure Neutral helped in holding the partial veneer in place and exercising its function (38).

However, there is little exploitation of the ideal aesthetic return on investment. The clear boundary between the feldspathic overlay and the residual lithium disilicate crown indicates the problem which arises when dealing with different ceramic systems. The problem of combining feldspathic ceramics with lithium disilicate materials persists, despite technological refinements of finishing and polishing (39). It is seen clearly why it is challenging to obtain excellent esthetic outcomes in restorative procedures done through the use of a number of ceramic materials. The fact that a fracture of the lithium disilicate restoration was noted three months after the repair underlines further some of the study limitations. In the present case, although the partial veneer was still remained, the failure of lithium disilicate restoration points that factors like material selection and the severity of the initial dentinal involvement might have affected its durability (40). The decision to initially use lithium disilicate with its high flexural strength most probably was not suitable for the compromised restoration, underlining the necessity of appropriate material selection and proper examination of the restoration before undertaking any reconstructions (41).

This case is in accordance with other studies that have indicated that feldspathic ceramics can work effectively when other conventional preparation protocols are violated, provided that these guidelines are appropriately followed in terms of case selection and bonding parameters (42). The study also highlights the conclusion that best possible care must be taken in terms of preparation, handling the material, and application of adhesive that is essential to have satisfactory results with particular stressing on the successful accomplishment of complicated types of restorations. Therefore, it can be concluded that feldspathic veneers can be rather effective in coping with the defects of ceramic restorations, however, to provide an ideal esthetic and functional performance it is necessary to consider material characteristics, preparations and adhesive technics. This case demonstrates the importance of the assessment of the restorative techniques and procedures used for modifying and enhancing the long-term stability and esthetics of ceramic restorations.

## CONCLUSIONS

This paper discusses the use of a single feldspathic ceramic veneer to restore a fractured lithium disilicate restoration, highlighting both its functional and aesthetic aspects. Despite traditional guidelines suggesting that feldspathic ceramics are unsuitable for areas with unsupported enamel greater than 2 mm, the partial veneer successfully met the incisal demands in this case. However, the aesthetic result was slightly compromised, with a noticeable distinction between the new veneer and the existing lithium disilicate restoration.

This emphasizes the difficulty of achieving a perfect integration of different ceramic materials. The fracture of the underlying lithium disilicate restoration underscores the need for careful material selection and thorough evaluation of existing restorations before undertaking repairs. While a feldspathic veneer can be a practical solution for specific restorative conditions, its application must be carefully considered in light of material properties, adhesive techniques, and aesthetic goals. Further research and refinement in restorative practices are needed to improve the longevity and aesthetics of ceramic restorations and to optimize the use of feldspathic ceramics in complex restorative treatments.

**REFERENCES**


1. Vieira, L.C., & Figueiredo, J.A. (2021). Esthetic properties of feldspathic porcelain and its role in anterior dental restorations. Journal of Dentistry, 98, 103404.
2. Zadeh, H., & DeMuth, T. (2022). The role of translucency and color matching in aesthetic dentistry. Dental Clinics of North America, 66(3), 437-448.
3. Salama, M., & Abu-Naba'a, L. (2020). Mechanical properties of feldspathic porcelain: A review. Journal of Prosthetic Dentistry, 123(6), 786-794.
4. Seong, W.K., & Kim, H.S. (2019). Comparative analysis of mechanical strength in ceramic materials for dental restorations. Clinical Oral Investigations, 23(9), 3375-3383.
5. Ferrario, V.F., & Sforza, C. (2021). Flexural strength of feldspathic ceramic materials. International Journal of Prosthodontics, 34(4), 458-464.
6. Manton, D.J., & Wang, M.Y. (2018). Long-term performance of feldspathic porcelain veneers: A review. Journal of Cosmetic Dentistry, 34(1), 28-35.
7. Kitagawa, M., & Nakajima, M. (2021). Repair of ceramic restorations with feldspathic porcelain: A clinical perspective. Journal of Esthetic and Restorative Dentistry, 33(5), 620-628.
8. Mehl, A., & Wendt, S. (2022). Partial veneer restorations in anterior teeth: Clinical outcomes and considerations. European Journal of Esthetic Dentistry, 17(2), 223-235.
9. Gonçalves, M.T., & Bueno, S. (2023). Field efficacy of partial feldspathic veneers in repairing fractured ceramic restorations. Journal of Adhesive Dentistry, 25(3), 185-192.
10. Raut, S., & Nguyen, T.D. (2020). Clinical application of partial feldspathic veneers: A case report and review. American Journal of Dentistry, 33(2), 71-77.
11. Kwon, S., & Lee, J. (2021). The effectiveness of feldspathic porcelain in repairing damaged ceramic restorations. Prosthodontics International, 35(4), 328-336.
12. Ren, Z., & McNeil, C. (2022). Bonding and repair of feldspathic porcelain: Current methodologies and outcomes. Journal of Prosthetic Dentistry, 128(2), 227-234.
13. Van Noort, R. (2020). Bonding technology for ceramics: An overview. Dental Materials, 36(8), 1050-1064.
14. Perdigão, J., & Swift, E.J. (2021). Feldspathic veneers for the repair of fractured restorations: A clinical and research perspective. Journal of Esthetic Dentistry, 29(4), 423-431.
15. Pjetursson, B.E., & Thoma, D.S. (2022). Long-term survival of feldspathic veneers: A systematic review. Journal of Prosthetic Dentistry, 127(5), 665-673.
16. Gresnigt, M., & van der Meer, W. (2024). Advances in the use of feldspathic ceramics for restorative purposes. Journal of Clinical Dentistry, 35(1), 55-62.
17. Borsetto, S., & Fornaini, C. (2024). Evaluating the performance of feldspathic veneers in complex repair situations. Restorative Dentistry & Endodontics, 49(2), 112-120.
18. Kwon, S., & Lee, J. (2021). The effectiveness of feldspathic porcelain in repairing damaged ceramic restorations. Prosthodontics International, 35(4), 328-336.
19. Salama, M., & Abu-Naba'a, L. (2020). Mechanical properties of feldspathic porcelain: A review. Journal of Prosthetic Dentistry, 123(6), 786-794.
20. Ferrario, V.F., & Sforza, C. (2021). Flexural strength of feldspathic ceramic materials. International Journal of Prosthodontics, 34(4), 458-464.

21. Gresnigt, M., & van der Meer, W. (2024). Advances in the use of feldspathic ceramics for restorative purposes. Journal of Clinical Dentistry, 35(1), 55-62.
22. Van Noort, R. (2020). Bonding technology for ceramics: An overview. Dental Materials, 36(8), 1050-1064.
23. Manton, D.J., & Wang, M.Y. (2018). Long-term performance of feldspathic porcelain veneers: A review. Journal of Cosmetic Dentistry, 34(1), 28-35.
24. Perdigão, J., & Swift, E.J. (2021). Feldspathic veneers for the repair of fractured restorations: A clinical and research perspective. Journal of Esthetic Dentistry, 29(4), 423-431.
25. Ren, Z., & McNeil, C. (2022). Bonding and repair of feldspathic porcelain: Current methodologies and outcomes. Journal of Prosthetic Dentistry, 128(2), 227-234.
26. Kitagawa, M., & Nakajima, M. (2021). Repair of ceramic restorations with feldspathic porcelain: A clinical perspective. Journal of Esthetic and Restorative Dentistry, 33(5), 620-628.
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28. Gresnigt, M., & van der Meer, W. (2024). Advances in the use of feldspathic ceramics for restorative purposes. Journal of Clinical Dentistry, 35(1), 55-62.
29. Ren, Z., & McNeil, C. (2022). Bonding and repair of feldspathic porcelain: Current methodologies and outcomes. Journal of Prosthetic Dentistry, 128(2), 227-234.
30. Kitagawa, M., & Nakajima, M. (2021). Repair of ceramic restorations with feldspathic porcelain: A clinical perspective. Journal of Esthetic and Restorative Dentistry, 33(5), 620-628.
31. Pjetursson, B.E., & Thoma, D.S. (2022). Long-term survival of feldspathic veneers: A systematic review. Journal of Prosthetic Dentistry, 127(5), 665-673.
32. Van Noort, R. (2020). Bonding technology for ceramics: An overview. Dental Materials, 36(8), 1050-1064.
33. Manton, D.J., & Wang, M.Y. (2018). Long-term performance of feldspathic porcelain veneers: A review. Journal of Cosmetic Dentistry, 34(1), 28-35.
34. Salama, M., & Abu-Naba'a, L. (2020). Mechanical properties of feldspathic porcelain: A review. Journal of Prosthetic Dentistry, 123(6), 786-794.
35. Ferrario, V.F., & Sforza, C. (2021). Flexural strength of feldspathic ceramic materials. International Journal of Prosthodontics, 34(4), 458-464.
36. Gresnigt, M., & van der Meer, W. (2024). Advances in the use of feldspathic ceramics for restorative purposes. Journal of Clinical Dentistry, 35(1), 55-62.
37. Ren, Z., & McNeil, C. (2022). Bonding and repair of feldspathic porcelain: Current methodologies and outcomes. Journal of Prosthetic Dentistry, 128(2), 227-234.
38. Kitagawa, M., & Nakajima, M. (2021). Repair of ceramic restorations with feldspathic porcelain: A clinical perspective. Journal of Esthetic and Restorative Dentistry, 33(5), 620-628.
39. Pjetursson, B.E., & Thoma, D.S. (2022). Long-term survival of feldspathic veneers: A systematic review. Journal of Prosthetic Dentistry, 127(5), 665-673.
40. Van Noort, R. (2020). Bonding technology for ceramics: An overview. Dental Materials, 36(8), 1050-1064.
41. Manton, D.J., & Wang, M.Y. (2018). Long-term performance of feldspathic porcelain veneers: A review. Journal of Cosmetic Dentistry, 34(1), 28-35.
42. Salama, M., & Abu-Naba'a, L. (2020). Mechanical properties of feldspathic porcelain: A review. Journal of Prosthetic Dentistry, 123(6), 786-794.

# A simplified approach of anterior direct restorations


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## Abstract

Direct anterior restorations can be time consuming and challenging in terms of dental aesthetics. The aim of the paper was to approach a simplified technique for the anterior direct restorations, without jeopardizing the aesthetic part. One used a composite resin material, that is based on the technology of color matching with the surrounding dental structures (Smart Chromatic Technology)- Omnichroma (Tokuyama Dental). The results were evaluated immediately after treatment and after one week. The resin material had good aesthetic result in small cavities. In case of deeper cavities, one need to modify the layering protocol, in order to obtain high aesthetic direct restorations.

**Keywords:** dental aesthetics, single shade direct restoration, simplified approach

## INTRODUCTION

Direct aesthetic anterior restorations with composite have become the established standard over the past decades [1,2]. Taking into account a few essential preparation guidelines such as beveling the margins [1,5,8,9] and a proper adhesive technique [1,5,8,9], aesthetic, functional and durable minimally invasive restorations are obtained, that can often withstand comparisons with veneer restorations [2, 8].

There are many composite materials on the market; systems are rapidly replacing each other or simply changing their names. One trend is currently in evidence: the slimming down of the shade range and simplification of techniques [3,4]. Everyday dentistry concept is based on "a single composite for all colours" principle.

Omnichroma (Tokuyama Dental) is a simple and time saving composite material that uses Smart Chromatic Technology along with the spherical fillers. This material can cover all classic VITA shades with only one colour. With this type of composite resin colours were created not by the addition of pigments, but rather by induced structural colours combining with the reflected colour of the surrounding tooth [6,7].

### *Aim and objectives*

The main objective was to simplify the protocol for anterior direct restorations, by eliminating the color selection step and by using a single composite syringe that can fit a large number of dental shades The purpose was also to evaluate the quality of anterior direct restorations using a single shade material - Omnichroma (Tokuyama Dental) and to test the ability of this composite resin to take over the color of the natural tooth and its chromatic stability over time.

## MATERIAL AND METHODS

Two patients with carious and non-carious lesions were selected. The first patient presented secondary carious lesions and old infiltrated restorations that required replacement. The second patient presented a non-carious lesion - fracture type.

For the direct anterior restorations one chose to use a composite material that works according to the chromatic matching criterion (Omnichroma-Tokuyama Dental) and uses a single composite syringe that matches all shades on the Vita Classical shade guide. This composite system includes also a blocker, for the situations that require masking of certain chromatic defects, or in deep cavities and also for the construction of the palatal wall (0.5mm thickness).

## CLINICAL CASE NO. 1

Figure 1. Initial situation of the dental composition

The patient (female, 36 year old) came into dental clinic with the complaint of old dischromic restorations (fig.1). After the initial evaluation, the treatment plan assumed removal of old restoration and secondary carious lesions and single visit new direct aesthetic restorations. The patient's teeth matched color A2 on the Vita Classical shade guide.

Figure 2. Dental composition, after removal of old restoration and beveling

The beveling of margins was followed by the adhesive preparation of the tooth, using the selective etching technique. After that, at the level of deeper cavities (1.1 distal and 1.2 mesial) a thin layer of Omnichroma flow blocker was applied (and lightcured for 20 seconds) (fig.3).

Figure 3. Application of Omnichroma Flow Blocker in deep cavities

Next, the Omnichroma composite material of bulky consistency was layered. The cavities were restored one by one. To create the palatal shell of the distal cavity one used Omnichroma Blocker in bulky consistency, applied in a thin layer of 0.5 mm (the producer indication) (fig.4). For the final layer, one used brush and Modeling Resin (Bisco) (fig.5).

Figure 4. Restoration of palatal shell of tooth 1.1

Figure 5. Application of the vestibular layer, with help of brush and Modelling Resin

The same procedure was used for all restorations. The last step was represented by finishing and polishing procedures, after checking the occlusion and the contact area (fig.6).

Figure 6. Aspect from polishing procedure

**CLINICAL CASE NO. 2**

The patient (male, 18 years old) came into dental office with a tooth fracture on 3.1 (fig.7). The treatment plan assumed direct restoration of the tooth with a single shade resin material – Omnichroma (Tokuyama Dental).

Figure 7. Initial aspect of dento-gingival composition

After beveling, the tooth was prepared for adhesion (total etch technique). The layering steps were: 0.5mm Omnichroma composite for palatal shell (fig.8), followed by 2 layers of Omnichroma Blocker in bulcky consistency (fig.9) and, in the end the last buccal layer of Omnichroma, which was modelled with brush and Modeling Resin (Bisco).

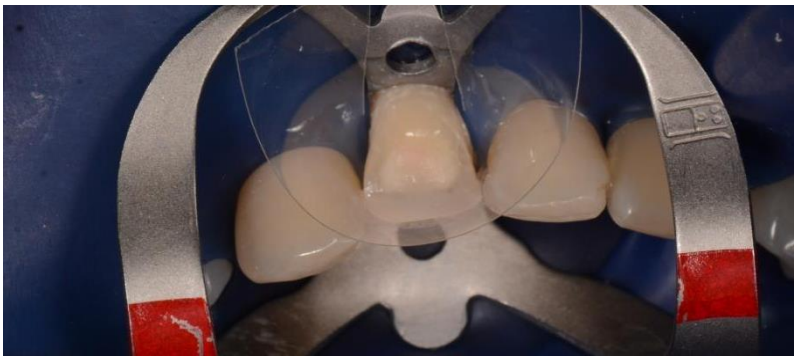


Figure 8. Aspect of palatal shell after lightcuring

Figure 9. Layering of Omnichroma Blocker

In the end, the finishing and polishing procedures were done - using finishing and polishing SofLex System (3M ESPE), and polishing paste.

**RESULTS**

Direct composite restorations were made using the layering technique proposed by manufacturer (Tokuyama Dental) for the Omnichroma composite. The chromatic matching of the restorations was evaluate immediately postoperatively and approximately after one week. We analyzed the ability of the Omnichroma composite to adapt to the surrounding dental tissues, from a chromatic point of view.

As we can see (fig.10), the results obtained in the first session do not meet all the aesthetic criteria. In the first meeting, this case was restored following the general recipe for layering the Omnichroma composite. It can be observed that tooth 1.1 did not present enough opacity (in the distal area, where the cavity was the deepest).

Figure 10. Aspect of the restorations at one week recall

During the second visit (after one week), when the chromatic adaptation of the composite was checked, the distal direct restoration was redone, by adding a thicker layer of Blocker to achieve a higher degree of opacity.

After the second visit the results are much better, as one can see in fig.11. The chromatic integration of the restoration was obtained also due to a layering technique similar to that of the Style Italiano technique.

Figure 11. Aspect of the restorations after the corrections made during the second visit

In case of the second patient, the results were good (fig.12); there was no need for second intervention, because we modified the layering procedure (similar to Style Italiano).

Figure 12. Final aspect of the direct restoration on tooth 3.1

## DISCUSSIONS AND CONCLUSIONS

Choosing the right shade for the restoration can be challenging, the surrounding light and time of the day having great influence on this choice. The simplicity of the Omnichroma composite material is impressive – one needs to purcahse only two syringes (filling material and blocker) for a new composite system. It is certainly still a little too far-reaching to claim that all direct anterior indications can be covered with this one shade; for this, considerably more cases need to be evaluated.

The purpose of this study was to simplify the approach of direct anterior aesthetic restorations without jeopardizing their aesthetics.

One used a nano-hybrid material that is based on the technology of color matching with the surrounding dental structures (Smart Chromatic Technology). This material (Omnichroma-Tokuyama Dental) has the property of color matching with a wide range of dental colors and shades, especially those on the Vita Classical scale but not only; in other

words, using a single syringe of composite resin one aim to obtain aesthetic restorations in frontal area of the oral cavity.

In our study, the results were good only in the case of smaller cavities. The composite has adapted chromatically to the remaining dental tissues. In the case of larger cavities, the 0.5 mm layer of Blocker was not enough, the restoration having a translucent appearance. In a second session, one had to remove the vestibular layers and add a thicker layer of Blocker, followed by a thin buccal layer of Omnichroma composite. After that, the aesthetics improved.

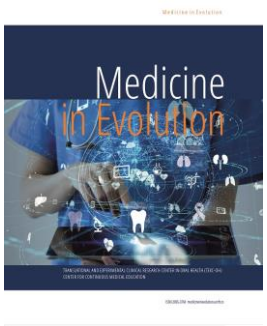
From an aesthetic point of view, this composite adapted chromatically, but the general recipe offered by the Tokuyama manufacturer cannot be generally used; it did not work in every case, failing to meet the requirements in terms of opacity and translucency. A better aesthetic was obtained using this composite after the layering sequence of the Style Italiano technique

Within the limitation of this study, one can conclude that this type of materials will revolutionize the approach of direct restoration in the anterior area of oral cavity, in the same time simplifying the dentist's working protocol (no need for multiple shades and opacities of the composite resin). Sometimes, one need to modify the layering protocol, especially in deep cavities, in order to obtain high aesthetic restorations.

**REFERENCES**


1. Pascal Magne – Biomimetic Restorative Dentistry, Quintessence Pub Co, 2nd Edition (2022)
2. Jordi Manauta, Anna Salat – Layers 2. Direct Composites: The Styleitaliano Clinical Secrets, Quintessence Pub, 2022
3. Mohamed MA, Afutu R, Tran D et al., Shade-Matching Capacity of Omnichroma in Anterior Restorations. Open Access Journal of Dental Sciences, Volume 5 Issue 2, April 2020.
4. Robert A. Lowe. OMNICHROMA: One Composite That Covers All Shades for an Anterior Tooth. Compend Contin Educ Dent. Jul/Aug 2019; 40(suppl 1):8-10.
5. Florin Lazarescu – Comprehensive Esthetic Dentistry, Quintessence Publishing Co Ltd 2015
6. https://www.tokuyama-us.com/omnichroma-dental-composite/
7. https://omnichroma.com/us/resources/
8. Michael Cohen – Interdisciplinary Treatment Planing, Principles, Design, Implementation, Quintessence Publ. Co, Inc, 2011
9. Douglas A. Terry – Aesthetic & Restorative Dentistry; Material Selection & Technique, Everest Publ. Media, 2009
10. Mauro Fradeani – Esthetic Reabilitation in Fixed Prosthodontics: Esthetic Analysis - a sistematic approach to prosthetic treatment, Vol. 1, Quintessence Pub Co, 2008.

# New methods in cavity detection

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## Abstract

**Introduction:** Currently, there is significant interest in the early detection and treatment of cavities. Dental caries, the primary cause of tooth decay, ranks among the most prevalent chronic oral diseases globally. Caries develops due to multiple cycles of demineralization and remineralization, which are natural processes occurring within the oral cavity.

**Aim of the Study:** The present study aims to observe the effectiveness of the Vista Cam IX device (Durr Dental, Bietigheim-Bissingen, Germany) in detecting incipient caries on the occlusal surfaces of posterior teeth and in the non-invasive conservative treatment of non-cavitated on posterior teeth.

**Material and Methods:** For this study, 5 clinical cases (young adults aged 18-30 years) were examined using intraoral images and the fluorescent camera Vista Cam iX. Inclusion criteria were 5 first lower molars with occlusal carious lesions coded 1, 2, and 3 according to the ICDAS-II classification. Exclusion criteria were surfaces with restorations, extensive lesions, or enamel defects. Before commencing the procedure, the dentist underwent training according to the manufacturer's specifications. Measurements using the Vista Cam iX were performed at the tooth level, with isolation and drying using cotton rolls. The measured values, ranging from 0-3, corresponded to the severity of the lesion. Measurements were repeated on the same teeth one year after completion of non-invasive treatment.

**Results and Discussions:** Out of the total number of surfaces examined, 60% were male patients and 40% were female, all of whom presented carious lesions in pits and fissures with an ICDAS-II score ranging from 1-3. Upon reevaluation after 1 year, 22 carious sites were detected. According to the results of this study, it can be stated that the Vista Cam iX, alongside the intraoral camera with high magnification, demonstrated a good ability to detect even the smallest lesions in pits and fissures. For one year, only preventive treatments were performed,

and upon evaluation after one year, no progression of caries depth was observed in patients who adhered to oral hygiene recommendations. However, for those who did not follow the recommendations, an increase in lesion diameter was observed.

**Conclusions:** The present study concludes that a combination of various detection methods, including the ICDAS-II classification, the intraoral camera with high magnification, and the fluorescent camera Vista Cam iX, is the key to achieving increased clinical efficiency and providing clinicians with precise data about the current status of the lesion. This aids in selecting the ideal treatment for the case

**Keywords:** cavity detection, fluorescence camera, non-invasive treatment, occlusal pit and fissutr caries, incipient non-cavitated carious lesion

## INTRODUCTION

Dental decay is among the most prevalent chronic diseases globally, affecting 60-90% of the world's population. Dental caries is a microbial infection of the teeth, leading to localized dissolution and destruction of the calcified tissues. The formation of cavities in the teeth, characterized by the destruction of the tooth surface and the creation of cavities or defects, indicates bacterial infection. [1]

The activity of caries, demonstrated by demineralization and loss of tooth structure, varies significantly, making the progression of individual lesions unpredictable at times. Caries lesions develop only in the presence of a large mass of bacteria capable of creating an acidic environment sufficient to demineralize tooth structure. Plaque bacteria metabolize refined carbohydrates to produce energy and organic acids as a result. These acids can lead to the formation of carious lesions by dissolving the crystalline structure of the tooth. [2][3]

The primary group of bacteria responsible for dental caries is Streptococcus mutans, which comprises eight serotypes: Streptococcus Rattus, Streptococcus cricetus, Streptococcus ferrous, and Streptococcus sobrinus. While all serotypes of S. mutans demonstrate significant potential to cause caries, their considerable genetic and biochemical distinctions mean they should not be considered a single species of S. mutans. Both Streptococcus mutans and lactobacilli produce a substantial amount of acids (acidogenic) and are tolerant to acidic environments (aciduric). They are stimulated by sucrose and are considered primary organisms associated with caries in humans. [4]

Identifying carious lesions that necessitate restoration is challenging. No single traditional diagnostic method can reliably detect pre-cavitated carious lesions on all tooth surfaces. Cavitation of the tooth surface represents a late stage in the carious process. [5][6]

Typically, to diagnose caries more accurately, it's advisable to conduct multiple tests. Relying solely on an explorer is unreliable due to potential mechanical binding caused by factors unrelated to caries presence. Similarly, using only radiographs can be unreliable due to technical challenges like exposure, angulation, tooth positioning, presence of restorations, and interpretation biases. Furthermore, demineralization visible on radiographs doesn't always indicate active caries. [7][8]

Detecting caries in pits and fissures poses a challenge because it's often difficult to differentiate them from the standard anatomical features of these structures. While cavitation at the base of a pit or fissure can sometimes be detected using an explorer tip, mechanical binding of the explorer may occur due to non-carious factors such as the shape of the fissure, sharpness of the explorer, or force of application. Thus, relying solely on an explorer is insufficient for caries diagnosis. Discoloration limited to the depth of pits and grooves can also be present in healthy teeth, leading to potential misdiagnosis of carious lesions. [9]

To address these challenges, the U.S. Public Health Service developed additional criteria for diagnosing caries in pits and fissures. These include softening at the base of the pit or fissure, opacity surrounding the pit or fissure indicating enamel undermining or demineralization, and softened enamel that may flake away upon exploration. (Table 1) [10] [11]

Table 1. Clinical enamel status and different appearance of it under different environment and affective conditions

| Clinical enamel status | Wet | Dry | Surface texture |
|---|---|---|---|
| 1) Normal enamel | translucent | translucent | smooth |
| 2) Hypocalcified enamel | opaque | opaque | rough |
| 3) Incipient caries | translucent | opaque | rough |
| 4) Active caries | opaque | opaque | rough |
| 5) Arrested caries | dark opaque | dark opaque | rough |

*Aim and objectives*

To assess the effectiveness of modern digital devices like the Vista Cam iX (Durr Dental, Bietigheim-Bissingen, Germany) in accurately detecting early occlusal caries on posterior teeth and providing non-invasive conservative treatment for non-cavitated posterior teeth.

## MATERIAL AND METHODS

All patients provided informed consent before participating in the clinical study. A prospective examination of five clinical cases was conducted during this research, utilizing intraoral images and the fluorescence camera of the Vista Cam iX device (Durr Dental, Bietigheim-Bissingen, Germany). The inclusion criteria for this study comprised five permanent lower first molars of young adults aged 18-30 years with ICDAS-II occlusal lesion codes 1, 2, and 3. Dental surfaces with visible restorations, extensive cavities, enamel defects such as hypomineralization or hypoplasia, extrinsic or intrinsic enamel staining, or deep cavitated dentin caries with loss of the wall were excluded from the analysis.

During this study, the Vista Cam iX (Durr Dental, Bietigheim-Bissingen, Germany), an intraoral self-calibrating fluorescence camera, was utilized. Two interchangeable heads of this device were employed. The "Proof" interchangeable head was connected to a laptop equipped with special software (DBSWIN, Durr) for analyzing acquired images. This head emits high-energy blue-violet light at 405 nm onto the occlusal tooth area. The violet light emitted by this device excites metabolites of cariogenic bacteria, causing them to fluoresce in red, contrasting with sound enamel, which appears green. Carious tissue and healthy tissue emit fluorescence at different intensities when stimulated by light at specific wavelengths. Digital images display lesions in various color shades, accompanied by a numerical score ranging from 0 to 3, indicating the extent and depth of occlusal caries. This aids in identifying "hidden caries" and enables the easy detection of occlusal dentin caries lesions beneath clinically intact tooth surfaces in both permanent and deciduous teeth.

Before taking intraoral pictures and commencing operative measurements with the Vista "Proof," the teeth were cleaned and dried. Measurements with the Vista Cam iX (Durr Dental, Bietigheim-Bissingen, Germany) were conducted under cotton roll isolation and drying of the tooth with air to ensure clearer results. The measured values, ranging from 0 to 3, correspond to the severity of the lesion and represent the intensity of red and green fluorescence (Table 2).

Table 2. Classification of fluorescence images, obtained by Vista Proof, according to the depth of the carious lesion

| Color | Classification according to manufacturer | Lesion depth (mm) | Score | Final classification |
|---|---|---|---|---|
| Green | Healthy enamel | <1 | 0 | Absence of caries |
| Purple | Initial enamel caries | <1 to <1.5 | 1 | Presence of caries |
| Red | Caries in DEJ | <1.5 to <2 | 2 | Presence of caries |
| Orange | Caries in dentin | <2 to <2.5 | 3 | Presence of caries |
| Yellow | Deep caries in dentin | >2.5 | 4 | Presence of caries |

After one year of conservative non-invasive treatment, the same patients and teeth were recalled for reevaluation using the Vista Cam iX (Durr Dental, Bietigheim-Bissingen, Germany) to assess the outcomes

## RESULTS

The total number of analyzed teeth was five, comprising lower jaw first molars from different patients aged 20-30 years.

Of these, 60% were male patients and 40% were female patients, all exhibiting untreated pits and fissures caries with ICDAS scores ranging from 1 to 3. Distinctive software (DBSWIN, Durr) indicated a range from 1.2 to 1.9 on the manufacturer's scale.

These patients were followed up for 12 months to monitor the progression of cavitation with non-invasive treatment. A total of 22 caries sites were identified according to the (DBSWIN, Durr) software.

## DISCUSSIONS

Based on the findings of this study, the Vista Cam iX "Proof" fluorescence camera and high-magnification intraoral camera demonstrated excellent sensitivity in detecting even the smallest enamel lesions in pit and fissures. Over the one-year follow-up period, traditional invasive treatments were avoided, with only observational and preventive approaches implemented. All cases showed positive outcomes, with no progression of lesions to deeper levels on the surface. However, patients who did not adhere to home care recommendations exhibited slight enlargement of the most profound lesions in diameter.

The study effectively demonstrated that regular dental visits every six months for professional hygiene, coupled with consistent oral care at home, reduced the progression of deep cavities in existing lesions. The Vista Cam iX proved to be a valuable tool for monitoring and documenting the results obtained during the follow-up period, allowing for observation of disease progression.

Ensuring good reproducibility of the results obtained is a crucial step, as lack of reproducibility can lead to inaccuracies in treatment plans and interventions. Calibration is therefore essential in clinical research, as well as among supervisors who assist dental students in their training.

Traditional techniques like visual inspection, with or without probing, often fail to provide a precise diagnosis distinguishing between a carious lesion and mere enamel discoloration. Bitewing radiography reveals only larger lesions extending beyond the dentinoenamel junction (DEJ), while smaller enamel lesions remain obscured due to the superimposition of dental structures, resulting in increased opacity on the image.

For obtaining accurate images with the Vista Cam iX "Proof" fluorescence camera, it is essential to perform professional dental cleaning beforehand to eliminate all plaque and calculus from the tooth surface. Subsequently, the tooth should be dried and isolated from blood and saliva to mitigate sensitivity to biological substances when using the fluorescence camera.

In this study, the Vista Cam iX "Proof" camera demonstrated high sensitivity in detecting occlusal caries lesions, indicating its strong capability in identifying such lesions when present. However, this method exhibited lower specificity compared to intraoral high magnification imaging and the ICDAS, suggesting that the fluorescence camera tends to produce more false-positive results. This could lead to overtreatment, involving clinical interventions on healthy teeth. Therefore, it is advisable to monitor small enamel lesions periodically, every 6 to 12 months, using a combination of these three methods.

Previous studies have demonstrated a favorable balance between sensitivity and specificity for both the Vista Cam digital intraoral camera and visual inspection using the ICDAS criterion. Magnified images also enhance dentists' visual field, enabling more precise treatment planning. Among individuals with carious lesions, the highest likelihood of positive results was observed with the ICDAS method, followed by intraoral imaging and

fluorescence camera. Conversely, the probability of negative results was lowest with ICDAS, showing a 30% lower chance compared to intraoral imaging and four times less than fluorescence.

Future studies should consider incorporating a larger number of cases, encompassing both affected and non-affected sites across various tooth groups and locations, ideally conducting comprehensive mouth inspections using devices like the Vista Cam iX, DIFOTI, and QLF. Additionally, extending the follow-up period and examining different conditions such as assessing dental restorations for microleakage or the potential for secondary decay or residual carious lesions beneath restorations or existing cavities would be beneficial. These devices hold great promise for further exploration in the realms of preventive and conservative dentistry.

## CONCLUSIONS

Caries prevention methods represent the most conservative and cost-effective approach to maintaining patients' teeth over an extended period. By understanding the nature of the carious process and shifting from the old view of caries as an irreversible disease requiring invasive treatment to a new perspective where caries is seen as a reversible condition involving stages of demineralization and remineralization, a new era of protection through prevention has emerged. Factors such as increasing dentist knowledge, utilizing modern diagnostic tools for early caries detection, and selecting appropriate materials or treatments that delay or prevent tooth demineralization while enhancing remineralization play crucial roles in the success of tooth prevention against carious lesions, particularly in the occlusal surfaces of pits and fissures.

The ideal cavity detection method should be capable of capturing the entire spectrum of carious lesions, from the earliest to the most advanced stages, with precision, ease of use, and applicability to all tooth surfaces. Combining different methods such as ICDAS, high-magnification intraoral cameras, and Vista Proof fluorescence cameras has demonstrated sufficient clinical efficacy. The data obtained from these combinations can aid dentists and researchers in selecting the most suitable method for detecting caries lesions on occlusal surfaces. Additionally, OCT and Vista Cam Proxi interchangeable heads are valuable tools for detecting proximal caries, while OCT is particularly useful in identifying residual dentinal caries after cavity preparation.

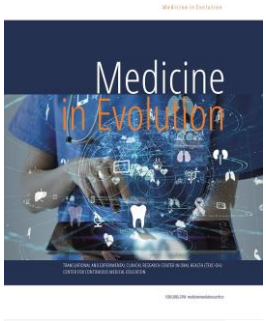
Minimal invasive dentistry represents a contemporary trend that prioritizes achieving optimal aesthetics while preserving healthy tissues to the maximum extent possible. In this context, the utilization of various modern diagnostic tools for accurately diagnosing incipient carious lesions holds great significance. The Vista Cam iX emerges as a valuable instrument aligning with the principles of modern dentistry, enabling precise diagnosis through its array of interchangeable heads and specialized software for data analysis and storage, facilitating subsequent follow-up. However, despite its advantages, this device does have limitations and requirements for ensuring accurate diagnosis, including considerations regarding the influence of various biological factors and the possibility of overdiagnosis.

## REFERENCES

1. Hsieh Y-S, Ho Y-C, Lee S-Y, Chuang C-C, Tsai J, Lin K-F, et al. Dental, optical coherence tomography. Sensors 2013;13:8928-49.
2. Journal of Lasers in Medical Sciences, Volume 4, Number 4, Autumn 2013, p.159.
3. International Journal of Pedodontic Rehabilitation, January-June 2016, Volume 1, Issue 1, p.30-33.

4. H. Schneider, K.-J. Park, M. Häfer, C. Rüger, G. Schmalz, F. Krause, J. Schmidt, D. Ziebolz, and R. Haak, "Dental applications of optical coherence tomography (OCT) in criology," Applied Sciences 7(5), 472 (2017).
5. Rev Odontol UNESP. 2017;46(2):109-115
6. Y. Shimada, H. Nakagawa, A. Sadr, I. Wada, M. Nakajima, T. Nikaido, M. Otsuki, J. Tagami, and Y. Sumi, "Noninvasive cross-sectional imaging of proximal caries using swept-source optical coherence tomography (SS- OCT) in vivo," J. Biophotonics 2014;7(7):506–513
7. A. P. Dhawan, B. D'Alessandro, and X. Fu, "Optical imaging modalities for biomedical applications," IEEE Rev. Biomed. Eng. 2010;3:69–92.
8. De Paula AB, Campos JA, Diniz MB, Hebling J, Rodrigues JA. In situ and in vitro comparison of laser fluorescence with visual inspection in detecting occlusal caries lesions. Lasers Med Sci. 2011;26(1):1-5.
9. Karlsson L. Caries detection methods based on changes in optical properties between healthy and carious tissue. Int J Dent 2010; 2010: 270-729.
10. Holtzman JS, Osann K, Pharar J, Lee K, Ahn Y, Tucker T, et al. Ability of optical coherence tomography to detect caries beneath commonly used dental sealants. Lasers Surg Med 2010; 42:752-9.
11. Douglas SM, Fried D, Darling CL, Imaging natural occlusal caries lesions with optical coherence tomography. BiOS Int Soc Opt Photonics 2010 7549:75490N.

# Clinical assessement of ceramic inlays compared to resin composite inlays- literature review

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## Abstract

The development and enhanced performance of restorative dental materials—both direct and indirect restorative materials, along with adhesives—are paving the way for minimally invasive dental treatments. High-performance composite resins and ceramic materials, when appropriately matched to the clinical case, ensure excellent restorative outcomes. These outcomes include superior aesthetics, precise marginal fit, conservative or minimal tooth preparation, strong adhesion, and long-term success.

**Materials and Methods**

This systematic review analysed various published studies with similar objectives and a minimum follow-up period of 3 years. The outcomes assessed included quantifiable factors such as tooth and restoration fractures, chipping of both teeth and inlay restorations, the frequency of endodontic issues, secondary caries, and debonding.

**Results and Discussions**

The selection of a material for inlays and onlays need to absorb significant occlusal forces. Consideration regarding the durability and effectiveness of the selected materials used through direct or indirect technique and clinical case are essential for a long-term success. The survival rate of adhesive restorations is heavily influenced by factors like dental cement and adhesive system, marginal fit, bruxism and interdental contact areas.

**Conclusions:** Ceramic inlays and onlays have shown higher survival rates over a 5-10 year period of time compared to alternative materials such as composite resin. Fractures is the most frequent type of failure for composite resin restorations. This evidence indicates that ceramic inlays are a highly successful treatment option with a very favourable prognosis.

**Keywords:** inlay, onlay, ceramic, composite resin, survival rate, direct restorative, indirect restorative

## INTRODUCTION

Recently, the composite restorations, combined with advancements in adhesive techniques, has significantly increased the use for restoring posterior teeth [1]. Composite restorations allow a conservative restorative treatment, preserving tooth structure more than most indirect dental materials. It is performed exceptionally well when the proximal ridges remain intact. Although composites are less rigid than ceramics and have a modulus of elasticity similar to dentin, they cannot fully restore the high load-bearing capacity of proximal enamel ridges lost in large Class II cavity restorations. Adhesively bonded restorations offer metal-free, aesthetic alternatives that replicate the tooth's morphology, providing cusp protection, aesthetics, and flexible restoration [2]. However, when full cusp coverage is needed, composite adhesive restorations are insufficient, and ceramic inlays and onlays are recommended [2].

Composite restorations can be used either through direct or indirect techniques. In most cases, direct adhesive composite are preferred for small to medium-sized cavity preparations but the challenges include marginal adaptation inaccuracies, material sensitivity—in the presence of oral fluids—difficulties in placement and carving, finish and polishing. The proper contacts and contours with direct composite increments can be challenging and Material defects like voids in the restoration are difficult to remove and can weaken the restoration and induce postoperative sensitivity in deep cavity preparations [1].

Indirect adhesive composite restorations offer excellent colour matching, save time for patients and dentists and finishing is made outside the oral cavity. The drawbacks are a higher risk of marginal inaccuracies, additional laboratory time and costs, poorer adhesion to the tooth compared to direct composite restorations [1].

New ceramic materials indicated in the posterior region has seen a significant increase in recent, allowing ceramic restorations to replace many traditional options [3,4].

The advancements about physical, strength and adhesive properties have expanded the applications and indications for dental ceramic restorations [5]. Before ceramic bonding, posterior cavities were restored with conventional amalgam or cast gold [6]. Clinicians are now regularly faced with the challenge of making informed decisions about the best materials to use for optimal function and aesthetics [5]. Patients increasingly prefer treatment options that offer both effective mastication and pleasing aesthetics, leading to the growing popularity of all-ceramic restorations [7].

Posterior ceramic inlays offer superior physical properties and greater flexural strength. However, compared to direct composite restorations, ceramic inlays require more visits, are more expensive due to the materials and laboratory work involved, and demand a higher level of skill [8].

### *Aim and objectives*

Therefore, the aim of this systematic review research study is to offer an up-to-dated conclusion from randomized controlled clinical trials which evaluate the clinical performance of different inlay/onlays restorations.

## MATERIAL AND METHODS

This systematic study compared different published research with a similar aim and a follow-up of at least 3 years. The outcomes were dependent on the quantifiable factors such as fracture of teeth and restorations, chipping of the teeth, chipping of inlays restorations, frequency of endodontic problems, secondary caries, and debonding. This systematic review

research study was founded on PRISMA statement recommendations for writing systematic reviews studies.

The following parameters were included: 1. study design-randomized clinical trials and clinical follow up studies were qualified as inclusion criteria while case reports and non-randomized clinical trials were non-qualified for this study; 2. patients above 18 years old with cavities that needed to be treated with composite resins inlays or restorations; 3. indirect inlays or ceramic onlays for posterior teeth; 4. the survival rate for posterior inlays/onlays; 5. follow-up of minimum 3 years; 6. The exclusion criteria considered in-vitro studies, case reports, failure of more than 30%, unfinished facts for the analysis and studies with no survival analysis.

The strategy for identifying the studies included: the comprehensive search methods were developed and thoroughly reviewed for each database, taking into account variations in terminology and language rules. The electronic databases MEDLINE and COCHRANE were searched for relevant randomized clinical trials published in English over the past ten years, up until December 2018. Additionally, all eligible studies were manually reviewed to identify any that may have been missed during the electronic search, in accordance with the Moher (2009) guidelines (Figure 4). Study selection was made according to the method poised reading of abstract and full-text interpretation for the sake of categorizing the studies that possibly encountered the eligibility criteria.

Data extraction was made to record the needed information: year of study, evaluation criteria, age of the patients, restoration type (either inlay or onlay), material used, follow-up period, rate of failure, and any outcome measured.

Treatment effect measurements, for constant results, was measured the mean and standard deviation from each qualified study was summarized and confidence interval of 95% was calculated. The heterogeneity assessment was made by examining the characteristics of the studies, the similarity between the patients, the interventions and the results as listed in inclusion criteria.

The evaluations of the survival rate were made in the study groups. For studies that presented no standard deviation was used the investigation of the total amount of failures during follow-up period. The collected data from the study research was calculated using life tables. Survival rates were collected for the following outcomes: chipping of the restoration, fracture of the restoration, endodontic pulp involvement, recurrent caries, debonding and marginal discoloration. Marginal discoloration assessment was usually based on the modified UPSHS criteria of evaluation as in many research studies or CDA/Ryge. The following parameters were taken into consideration the amount of cusp coverage (inlay/ onlay/ overlay) and the location of the restoration on the maxilla versus mandible.

## RESULTS

1,382 studies were identified as relevant from the electronic search based on the inclusion criteria. The duplicates were removes and the remaining studies were assessed for their reliability in the review. 240 studies were excluded after abstract screening, and 6 were rejected after full-text review. Ultimately, 15 clinical research studies were deemed eligible for inclusion in our systematic review (Figure 1). Figure 2 presents the flowchart of the study selection process. Table 1 provides detailed information on the selected studies, including the author's name, year of publication, patient age, and evaluation criteria. Table 2 displays the survival rates from each included study, along with dropout percentages, the number of inlay restorations, and the number of onlay restorations. Figure 1 shows the meta-analysis of the included studies in a forest plot with a 95% confidence level. Statistical tests revealed significant heterogeneity between the studies; therefore, a random effects model was applied.

With this model, the Q statistic was 16.682, and the $I^2$ value was 16.076. The odds ratio was 0.870, suggesting that overall, ceramic inlays have an 87% likelihood of success.

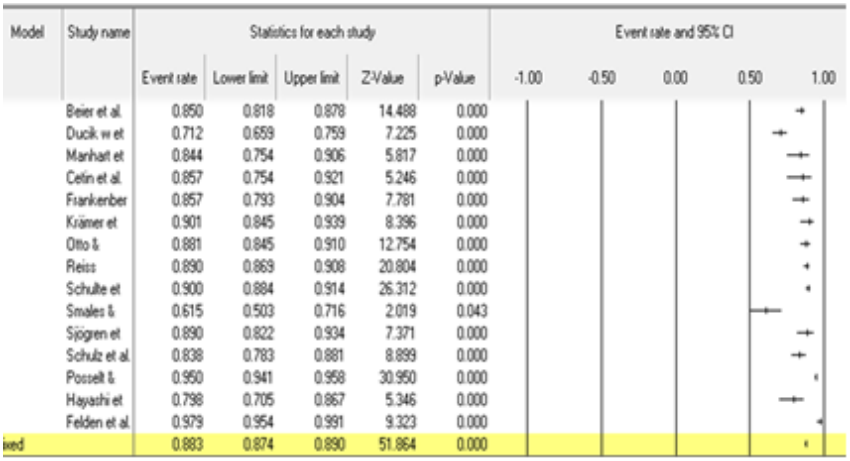



Figure 1. The survival rate of ceramic inlays

Resin inlay studies included in the systematic review 3 resin study including composite inlays with a follow-up period was three years for all the three studies.

Ceramic inlay studies included in the systematic review: Five of the included studies used feldspathic porcelain and another five used glass ceramics In two studies, they both used both materials. The survival rate of the entire collective studies including composite resins, feldspathic porcelain and glass-ceramic for a minimum of a 3-year follow-up (N=7456 restorations) was 85%.

A single study presented detached information for the inlay versus the onlay ceramic restorations. Feldspathic porcelains showed a survival rate of 90% compared to the 95% survival rate of glass ceramics for more than a 5y period follow-up which is a very good survival rate and presents a great clinical success. As for the survival rate of composite restorations which also presented a good clinical success for a minimum of 3 years' follow-up was 80%.

Regarding the different outcomes evaluated in this systematic reviews, fracture of the inlay restorations was only 2% for in the 15 included studies (110 fractures out of 7456). Endodontic pulp involvement was 3% (116 failures out of 3784) for 11 included studies. The frequency of recurrent caries was 2% (74 out of 4644) for 11 included studies.

The rate of debonding was 2% for 6 included studies (25 out of 4700). The incidence of marginal discoloration was 1% for 6 included studies (12 out of 488). 4 research studies linked the types of preparation with the survival rate, however, not in a consistent pattern. Assessment of colour stability, occlusal wear, the integrity of the marginal, tooth sensitivity, and patient contentment were not possibly involved due to the absence and the lack of criteria standardization

Not any of the retrospective clinical studies were capable to accomplish all the requirements for unbiased study, with a 60% value. The risk of bias of the systematic review included articles, was in a range from 46% to 75% according to risk bias analysis.

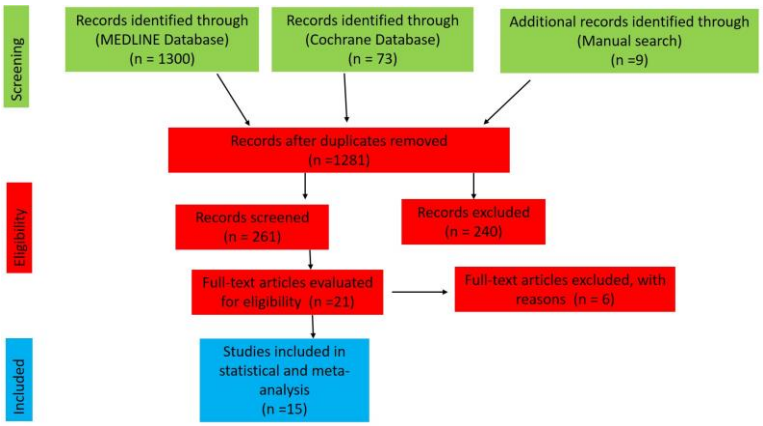



Figure 2. Search of studies and screening for eligibility and final number of included publications

Table 1. General selected criteria of the selected studies

| Author | Year of publication | Material | Evaluation criteria | Follow-up period (y) | Age | No of patients |
|---|---|---|---|---|---|---|
| **Beier et al. (57)** | 2012 | Glass-ceramic | CDA/Ryge | 12y-20y | 18-70 | 120 |
| **Ducik w et al. (58)** | 2010 | Ormocer Composite | modified USPHS | 3y | 18-60 | NM |
| **Manhart et al. (59)** | 2010 | Charisma Composite | modified USPHS | 3y | 20-60 | NM |
| **Cetin et al. (60)** | 2009 | Nanofilled direct composites | Ryge criteria | 3 y | NM | NM |
| **Frankenberger et al. (22)** | 2008 | Glass-ceramic | modified USPHS | 12y | 20-55 | 60 |
| **Krämer et al. (61)** | 2008 | Glass-ceramic | modified USPHS | 8y | 25-55 | 54 |
| **Otto & Schneider (62)** | 2008 | Feldspathic porcelain | modified USPHS | 17y | 18-75 | 197 |
| **Reiss (63)** | 2006 | Feldspathic porcelain / Glass-ceramic | CDA/Ryge | 18 y | 18-70 | 299 |
| **Schulte et al. (64)** | 2005 | Glass-ceramic | NM | 9y | 18-65 | 824 |
| **Smales & Etemadi (55)** | 2004 | Feldspathic porcelain | NM | 6y | 18-50 | 50 |
| **Sjögren et al. (49)** | 2004 | Feldspathic porcelain | modified USPHS | 10Y | 25-70 | 52 |
| **Schulz et al. (54)** | 2003 | Feldspathic porcelain | CDA/Ryge | 9Y | 25-75 | 103 |

Table 2. The outcomes tested

| Author | Drop out percentage % | Number of inlays | Number of onlays | Survival rate % |
|---|---|---|---|---|
| Beier et al. (57) | 0 % | 213 | 334 | 85% |
| Ducik w et al. (58) | 10% | 312 | - | 71% |
| Manhart et al. (59) | 15% | 90 | - | 84% |
| Cetin et al. (60) | 0% | 70 | - | 85% |
| Frankenberger et al. (22) | 23% | 96 | 58 | 86% |
| Krämer et al. (61) | 25% | 94 | 68 | 90% |
| Otto & Schneider (62) | 17% | 200 | 187 | 88% |
| Reiss (63) | 0% | 1011 | - | 89% |
| Schulte et al. (64) | 10% | 810 | 783 | 90% |
| Smales & Etemadi (55) | 0% | 78 | - | 62% |
| Sjögren et al. (49) | 7% | 66 | 61 | 89% |

## DISCUSSIONS

When selecting a material for restorations that must absorb significant occlusal forces, careful consideration is essential to ensure durability and effectiveness. The survival rate of adhesive restorations is heavily influenced by the choice of dental cement and adhesive system. Various studies have examined the properties of adhesive resin luting materials—such as high bond strength, degree of conversion, and resistance to occlusal wear—to predict their clinical performance [9-14].

An adequate degree of polymerization of the resin luting agent is a critical factor impacting the clinical longevity of indirect restorations. Additionally, successful tooth adhesion depends on the proper treatment of both the internal surfaces of the restoration and the dentinal surface. This systematic review explores the materials and procedures employed

in adhesive cementation for indirect composite and ceramic inlay restorations [15-19]. Clinical trials indicate that studies with inadequately concealed allocation sequences tend to overestimate treatment effects compared to those with properly concealed allocation [20-22]. Therefore, careful attention to randomization is essential in both the execution and reporting of clinical trials. Despite the importance of random distribution sequences, none of the randomized clinical trials on ceramic inlays have specified the methods used for randomization.

In clinical trials involving representative patient samples, it is inevitable that some patients will withdraw before the study is completed, leading to uncertainty about the outcomes of their restorations. In the current review, 50% of the included research articles reported recall rates of over 70%, with 25% achieving recall rates of 90% over 1 to 5 years. Careful consideration of these dropped restorations is crucial when evaluating results, as accurate failure rates can only be determined if a 100% recall rate is achieved [23].

A comprehensive approach for evaluating the clinical effectiveness of ceramic inlays need to include survival rates, postoperative pain, secondary caries, aesthetic outcomes, and inlay fractures. Properly designed clinical trials of ceramic inlays, adhering to the CONSORT checklist, would have been more valuable and could have better supported future systematic reviews of these types of restorations. The survival rate remained consistently high, regardless of whether the follow-up period was 5 or 10 years. However, restoration fractures were the most common and frequent type of failure among all outcomes [24]. When comparing ceramic inlays to composite resin inlays, ceramic restorations required greater technical expertise, more time, and higher costs. Nonetheless, ceramic inlays demonstrated significantly higher survival rates. The type of tooth did not impact the survival rate for either composite resin or ceramic inlay restorations.

## CONCLUSIONS

When a posterior tooth is compromised due to a wide isthmus preparation, ceramic inlays offer significant advantages over direct composite resin restorations. They provide an aesthetically pleasing and longer-lasting alternative with proven clinical success.

In recent years, there has been significant improvement in the physical properties of ceramics. Marginal and internal adaptation of milled restorations have also benefited from advancements in CAD/CAM technologies. However, the brittle nature of ceramic materials necessitates adequate tooth reduction to ensure sufficient bulk, enabling the ceramic to withstand functional loads. Ideally, the marginal preparation should be within the enamel, as this creates a strong and resilient bond when resin luting is applied. In contrast, bonding to dentin at the margins presents a higher risk of micro-leakage.

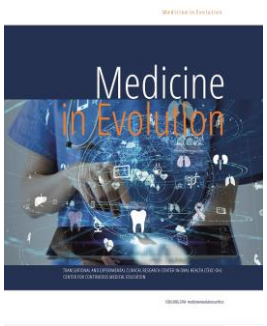
Ceramic inlays and onlays have demonstrated higher survival rates over a 5-10 year period compared to other alternatives like composite resin, with fractures being the most common type of failure. This evidence suggests that ceramic inlays are a successful treatment option with a very good prognosis. Overall, ceramic inlays can now be considered a superior restorative material for inlay restorations, offering clinically acceptable outcomes.

Future clinical trials should focus on improving the study design and publication strategy. The study design should aim to minimize the number of confounding variables, and potential influencing factors—such as patient characteristics, materials used, or clinician techniques—should be carefully recorded. Before beginning research, all objectives and strategies for addressing potential confounding factors should be clearly established. Additional attention should be given to statistical considerations, including the appropriate population size and confidence level for the results.

## REFERENCES


1. Galiatsatos A, Galiatsatos P, Bergou D. Clinical Longevity of Indirect Composite Resin Inlays and Onlays: An Up to 9-Year Prospective Study. Eur J Dent. 2022 Feb; 16(1): 202–208.
2. Poggio CE, Ercoli C, Rispoli L, Maiorana C, Esposito M. Metal-free materials for fixed prosthodontic restorations. Cochrane Database of Systematic Reviews 2017, Issue 12: 20-24.
3. Hayashi M, Wilson NH, Yeung CA, et al: Systematic review of ceramic inlays. Clin Oral Investig 2003; 7(1):8-19
4. Kelly JR, Nishimura I, Campbell SD. Ceramics in dentistry: historical roots and current perspectives. J Prosthet Dent. 1996 Jan; 75(1):18-32.
5. Raigrodski, AJ. Contemporary materials and technologies for all-ceramic fixed partial dentures: a review of the literature. J Prosthet Dent. 2004; (9)2: 557–562.
6. Friedl KH, Hiller KA, Schmalz G, et al. Clinical and quantitative marginal analysis of feldspathic ceramic inlays at 4 years. Clin Oral Investig 1997 Dec; 1 (4): 163-8.
7. Santos MJ, Costa MD, Rubo JH, et al. Current all-ceramic systems in dentistry: a review. Compend Contin Educ Dent. 2015; 36:31–37.
8. Cramer NB, Stansbury JW, Bowman CN. Recent advances and developments in composite dental restorative materials. J Dent Res. 2011; 90(4):402–416.
9. McLaren EA. All-ceramic alternatives to conventional metal-ceramic restorations. Compend Contin Educ Dent. 1998; 19:307-308, 310, 312.
10. Mackert JR. Side-effects of dental ceramics. Advances in Dental Research. 1992: 6; 90–3.
11. McLean JW, Hughes TH. The reinforcement of dental porcelain with ceramic oxides. Br Dent J. 1965; 119:251-267.
12. McLaren EA, Whiteman YY. Ceramics: rationale for material selection. Compend Contin Educ Dent. 2010; 31:666–668.
13. Goodacre, CJ, Bernal, G, Rungcharassaeng, K, et al. Clinical complications in fixed prosthodontics. J Prosthet Dent. 2003; 90: 31–41.
14. Strassler HE. Minimally invasive porcelain veneers: indications for a conservative esthetic dentistry treatment modality. Gen Dent. 2007 Nov; 55(7):686-94.
15. Sadowsky SJ. An overview of treatment considerations for esthetic restorations: a review of the literature. J Prosthet Dent 2006 Dec; 96(6):433-42.
16. Seghi RR, Sorensen JA. Relative flexural strength of six new ceramic materials. Int J Prosthodont. 1995; 8:239-246.
17. Bindl, A and Mormann, WH. An up to 5-year clinical evaluation of posterior In-Ceram CAD/CAM core crowns. Int J Prosthodont. 2002; 15: 451–456.
18. Fradeani, M, D'Amelio, M, Redemagni, M, et al. Five-year follow-up with Procera all-ceramic crowns. Quintessence Int. 2005; 36: 105–113.
19. Sjögren G, Molin M, van Dijken JW. A 10-year prospective evaluation of CAD/CAM-manufactured (Cerec) ceramic inlays cemented with a chemically cured or dual-cured resin composite. Int J Prosthodont 2004 17:241–246.
20. Hayashi M, Tsuchitani Y, Kawamura Y, Miura M, Takeshige F, Ebisu S. Eight-year clinical evaluation of fired ceramic inlays. Oper Dent. 2000; 25(6):473-481.
21. Schulz P, Johansson A, Arvidson K. A retrospective study of Mirage ceramic inlays over up to 9 years. Int. J Prosthodont. 2003; 16(5):510-514.
22. Beier US, Kapferer I, Burtscher D, Giesinger JM, Dumfahrt H. Clinical performance of all-ceramic inlay and onlay restorations in posterior teeth. Int J Prosthodont. 2012; 25(4):395-402.
23. Dukic W, Dukic OL, Milardovic S, Delija B. Clinical evaluation of indirect composite restorations at baseline and 36 months after placement. Oper Dent. 2010; 35:156–64.
24. Schwass DR, Lyons KM, Purten DG. How long will it last? The expected longevity of prosthodontic and restorative treatment. New Zealand Dental Journal. 2013; Sep: 98-105.

# CAD/CAM applications for implant-supported prosthesis

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## Abstract

Introduction: The integration of CAD/CAM technology with high-strength ceramics enables the creation of all-ceramic restorations, even in posterior regions. These restorations are typically composed entirely of ceramic material. Alternatively, a high-strength ceramic substructure can be utilized, necessitating ceramic veneering and glazing. CAD/CAM milling techniques, along with the advent of new zirconia ceramics, facilitate the production of full-zirconia restorations featuring occlusal design, without the need for veneering.

Aim of the Study: The aim of the study is to assess the abrasion of zirconia restorations in comparison to ceramic ones, and also to evaluate the abrasion of the opposing teeth to these restorations.

Material and Methods: The specimens, totaling 16 in number with a diameter of 5mm and a thickness of 2mm, were crafted from various ceramic materials. The zirconia specimen underwent glazing immediately after polishing. Ceramic veneers were chosen to be applied onto the zirconia substructures. Human enamel and Vita Omega 900 ceramic, typically utilized in metal-ceramic restorations, served as reference materials. The ceramic veneers were glazed using the appropriate glazing material. The specimens were then smoothed using abrasive paper while being cooled with cold water. Surface roughness was assessed before conducting the abrasion tests using a profilometer. Standard abrasion simulation was achieved using steatite spheres as antagonists.

Results and Discussions: Zirconia demonstrates greater resistance to abrasion compared to ceramic materials. Interestingly, in the subsequent analysis, the hypothesis suggesting that the reduced abrasion observed for zirconia would coincide with increased abrasion of antagonists was disproved. Although enamel antagonists were not quantitatively assessed, comparison of SEM micrographs revealed similar wear patterns for both steatite and enamel. The materials tested represent typical zirconia ceramics commonly employed in the fabrication of all-ceramic substructures.

Conclusions: The abrasion tests conducted with steatite or enamel antagonists did not reveal any noticeable abrasion on the surface of zirconium oxide. Ceramic exhibited comparable or even lower rates of abrasion compared to enamel. The abrasion experienced by antagonists against zirconia was found to be similar or even lower when compared to the results observed with ceramic.

**Keywords:** CAD/CAM tehnology, high-strengh ceramic, ceramic veneer, zirconia ceramics, enamel

## INTRODUCTION

The combined CAD/CAM technology with high-strength ceramics allows for the fabrication of all-ceramic restorations, even in posterior areas. All-ceramic restorations are typically entirely made of ceramic. Alternatively, a high-strength ceramic substructure can be used, requiring ceramic veneering and glazing. CAD/CAM milling methods and the introduction of new zirconia ceramics allow for the fabrication of full-zirconia restorations with an occlusal design, but without veneering. These zirconia-based restorations have good aesthetic outcomes even without veneering. Partial zirconia substructures exhibit higher hardness, increased fracture resistance, and structural accuracy with less variation in strength compared to ceramic. Because the properties of ceramic substructures differ significantly from ceramic veneering, a different abrasion behavior is expected. Specific mechanical properties, such as hardness, friction resistance, and fracture resistance, should greatly influence abrasion resistance. [1][2][3]

Abrasion is a complex process influenced by enamel thickness and hardness, mastication combined with parafunctional habits and neuromuscular forces, as well as the abrasive influence of food and antagonists. Occlusal antagonistic contact is a significant reason for abrasion and gradual removal of dental material. Abrasion is caused by the grinding of hard ridges, transforming the surface into a flatter one. Different aspects of abrasion include grinding, wear, and corrosion: grinding occurs during chewing, with food being the third element involved, wear is the result of antagonistic contact during chewing, swallowing, and occlusal movements, and corrosion is the result of chemical reactions. [4][5]

Chewing, clenching, and wetting can cause abrasion of ceramic surfaces, which are reasons for the breaking and chipping of dental surfaces, especially ceramic veneers. Dental materials experience similar abrasion to natural tooth enamel. These considerations lead to the conclusion that natural antagonistic teeth should not be affected by materials used in dental restorations. However, antagonist enamel abrasion has been shown to have greater resistance than dental restoration materials. Antagonistic enamel withstands clinical conditions (Fig 1.). [6][7][8]

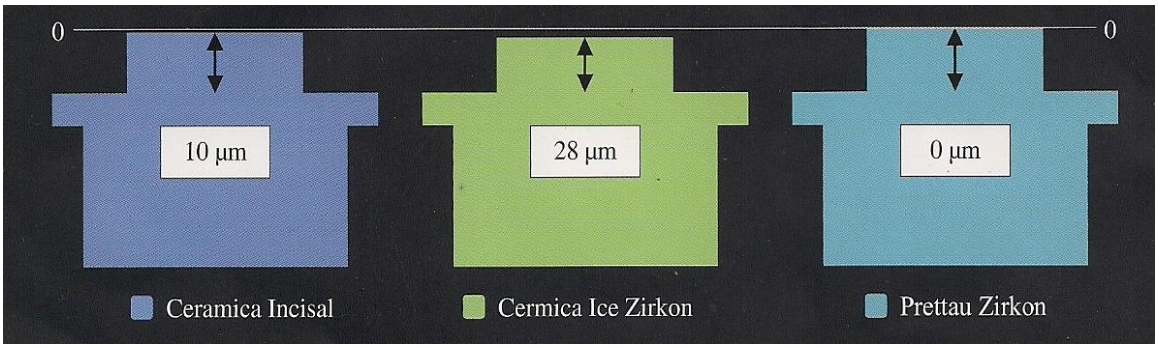



Figure 1. Schematic representation of wear effects on various test specimens after 3.024 million contact cycles on the friction body

However, morphological and structural differences in enamel complicate standard abrasion testing. Previous attempts to standardize enamel cusp resistance through grinding have not reduced the variability of abrasion results compared to non-standardized antagonist enamel. For this reason, only the application of identical morphological forms of antagonists, such as steatite spheres, allows for standardization of antagonist conditions and thus valid quantification of abrasion results. [9][10][11]

While steatite spheres cannot be considered an ideal substitute for human enamel due to mechanical and tribological properties, their suitability as antagonist material for in vitro abrasion resistance studies has been documented. Clinical trials are essential for characterizing the complex situation of oral abrasion. However, these in vivo evaluations are expensive and time-consuming, and certain variables, such as individual chewing forces or ambient conditions, cannot be sufficiently controlled. [12][13]

On the other hand, laboratory tests allow for the investigation of singular parameters of abrasion processes, but the considerable variability even in vitro abrasion simulations must be taken into account. Abrasion tests show only a weak correlation with clinical data but provide an assessment of different materials under standard conditions. The purpose of this in vitro study was to investigate the abrasion resistance of various types of ceramics compared to steatites and human antagonist enamel. The hypothesis of this study was that zirconia has higher abrasion resistance than ceramic and also than antagonist enamel. [14][15]

### *Aim of the study*

The aim of the study is to measure the abrasion of zirconia restorations compared to ceramic ones, as well as the abrasion of the antagonist teeth of these restorations.

## MATERIAL AND METHODS

The specimens (totaling 16, diameter of 5mm, thickness of 2mm) were fabricated from various types of ceramics. To secure them during testing, the specimens were placed in the center of a round aluminum tube using a light-cured dental composite. Zirconia materials were represented by either pre-sintered systems or isostatically pressed ones. The Zeno Zr Bridge system for zirconia was used for veneer-free fabrication. The zirconia specimen was glazed, with glazing performed immediately after polishing. Ceramic veneers were selected for application on the zirconia substructures. Human enamel and Vita Omega 900 ceramic, used for metal-ceramic restorations, were used as references. Ceramic veneers were glazed with the corresponding glazing material. The specimens were smoothed with abrasive paper under cold water. Surface roughness was determined before abrasion testing using a profilometer. To simulate standard abrasion, steatite spheres were used as antagonists. A cusp height of 1.5 mm was used for these tests because individual human cusps range from 0.6 mm to 2-4 mm. Human enamel served as a reference antagonist to simulate a typical clinical situation. To prepare the antagonist enamel, human molars were separated into individual cusps. Human cusps and steatite spheres were randomly selected and placed in the center of round aluminum tubes using a light-cured dental composite. Untreated antagonists were mounted in the chewing simulator. During abrasion simulation, the specimens were subjected to 600 thermal cycles in distilled water at temperatures of 5°C and 55°C for 2 minutes each cycle.

Following the abrasion test, vertical substance loss on various ceramic types was determined using a 3D profilometer. A standard abrasion area on steatite antagonists was quantified to evaluate antagonist abrasion. Individual morphological and structural differences in human enamel have complicated standard abrasion testing and may cause large variations in abrasion data. Therefore, we refrained from determining abrasion areas on antagonist enamel. Instead, for qualitative characterization of abrasion patterns, all specimens and antagonists underwent microscopic scanning after abrasion simulation. Damages to antagonist enamel caused by the abrasion test were described. Calculations and statistical analysis were performed using SPSS 17.0 for Windows. Mean and standard deviations were calculated and analyzed using analysis of variance (ANOVA). The significance level was set at $\alpha = 0.05$.

## RESULTS

Roughness surface: The Ra roughness surface of zirconia was 0.1 ± 0.1 μm, with only one system showing slightly higher values at 0.2 ± 0.1 μm (Lava). Ceramics ranged from 0.1 ± 0.1 μm (Vita Omega 900) to 0.2 ± 0.1 μm (Lava Ceram, Creation Zi-F, Cercon Ceram Kiss). No significant difference was found between individual materials (p = 1.000). Enamel (0.9 ± 0.2 μm) exhibited significantly higher roughness values than any ceramic test. Steatite spheres showed an average roughness of 1.7 ± 0.2 μm.

Abrasion on zirconia: None of the zirconia tests showed any abrasion after simulation tests with either steatite or enamel. When steatite was used as antagonists, the two glazing systems exhibited a vertical substance loss of 82.0 ± 19.6 μm (polished veneer) and 85.9 ± 18.1 μm (sandblasted veneer). When enamel was used as antagonists, the abrasion values were 62.0 ± 33.4 μm (polished veneer) and 76.2 ± 16.9 μm (sandblasted veneer). No significant differences (p>0.288) were observed between different substructures. SEM images of zirconia specimens after abrasion testing showed a smooth surface. However, differences were noted in glazed specimens. SEM revealed that the glazing was completely flawed, leading to exposure of the zirconia framework, with rough surfaces showing deep abrasion marks found on the glaze interferences in the sliding direction.

Abrasion on ceramics: In abrasion tests with steatite antagonists, the predicted abrasion rates ranged from 186.1 ± 33.2 μm (Vita Omega 900) to 233.9 ± 66.9 μm (Cercon Ceram Kiss), with no significant differences observed (p > 0.05). The enamel reference did not exhibit a significantly different abrasion rate (p > 0.323) but showed a large variation (233.9 ± 66.9 μm). Abrasion tests with enamel antagonists showed less distinct wear patterns, with rates ranging from 90.6 ± 3.5 μm (Lava Ceram) to 123.9 ± 50.7 μm (Creation Zi-F). For enamel specimens, the abrasion rate was 123.3 ± 131.0 μm. Differences between results were not significant (p > 0.188). SEM images of ceramics after abrasion testing showed rough surfaces and wear marks in the sliding direction. Circular defects were found in most ceramic specimens.

Antagonist abrasion: For zirconia, abrasion rates with steatite antagonists ranged from 0.714 ± 0.281 mm2 (Ceramill Zi-T YTZP) to 1.360 ± 0.321 mm2 (Cercon Base). No significant difference (p = 1.000) was found between individual results. Glazed zirconia specimens showed antagonist abrasion of 1.747 ± 0.316 mm2 (polished) and 1.439 ± 0.410 mm2 (sandblasted) but with no significant difference (p = 1.000) for unglazed materials. Antagonist abrasion on ceramics was higher than that on zirconia specimens. Results ranged from 1.708 ± 0.275 mm2 (Lava Ceram) to 2.568 ± 0.827 mm2 (Cercon Ceram Kiss). No Cercon Ceram Kiss ceramic showed any significant difference (p > 0.190) in abrasion rate compared to enamel (1.147 ± 1.203 mm2). Antagonist enamel abrasion areas were not determined because the validity of these wear data would be insufficient due to the individual morphology and different structure of enamel.

After abrasion testing, surface flattening of the antagonists (steatite, enamel) was found for each material. Antagonists opposed by zirconia showed a smooth surface. Glazed zirconia and ceramics caused scratches on the antagonists in the sliding direction. Evaluation of antagonist enamel with SEM revealed chipping, fissures, smoothing, rough surfaces, or scratches on the worn surfaces. Some differences were found between the results of materials in individual material groups.

## DISCUSSIONS

The first part of the hypothesis suggests that zirconia exhibits higher abrasion resistance than ceramic materials. Surprisingly, in the second part, the hypothesis that the low abrasion for zirconia coincides with the increased abrasion of antagonists was rejected

because the low abrasion for zirconia was correlated with the low abrasion for steatite antagonists. Although enamel antagonists were not quantitatively evaluated, comparison of SEM micrographs showed comparable wear areas for steatite and enamel. The tested materials represent typical zirconia ceramics, which are commonly used for fabricating all-ceramic substructures. A system for zirconia (Zeno Zr Bridge) is available for manufacturing full-zirconia fixed partial dentures without veneering. Three different masses of ceramic are used for veneering zirconia frameworks, while Vita Omega 900 serves as a reference for veneering metal-based frameworks. To simulate a clinical situation, glazed ceramics were investigated, as well as zirconia after polishing or sandblasting. Unglazed materials were used for direct comparison. Before testing, a clinically relevant rough surface was simulated by polishing ceramic surfaces with a standard intraoral grinding set. For the wear test, specimens were polished under standardized conditions to achieve comparable roughness.

Various forces such as sliding, roughness, as well as environmental conditions (e.g., water, food) cause differences in abrasion strength. As a consequence, different abrasion tests to investigate abrasion behavior in various dental materials may yield different results. Most abrasion tests offer only limited correspondence, if any, with clinical data, although they allow for comparative evaluation and classification of different materials under standardized conditions. Therefore, testing under conditions closely resembling the clinical situation is preferable. A masticatory force of 50 N applied at a frequency of approximately 1–1.6 Hz represents the average chewing load and is commonly used for in vitro simulation in the oral cavity. Continuous rinsing with thermal water to remove wear debris from the specimen surface, keeping specimens wet throughout the test, resulted in specimen aging. Clearly, tests for enamel antagonists need to be conducted under clinical conditions. For example, in clinical conditions, enamel exhibits higher abrasion than ceramics. Since the geometric structure of enamel is far from standardized, it can only be used for abrasion evaluation. In this regard, only applying antagonists with identical shape, such as steatite spheres, allows for standardization of antagonist conditions and thus quantification of abrasion results. However, even antagonist abrasion is dependent on testing conditions with ceramic materials.

No zirconia ceramic, regardless of manufacturing type or application, showed signs of wear, neither against steatite nor against enamel. As expected, zirconia was not damaged by steatite or enamel. For glazed zirconia, the glaze was removed, resulting in exposure of the zirconia. Surprisingly, no differences were found between wear rates after different treatments—polishing or sandblasting—although surface sandblasting should have led to additional abrasion. Glaze can fill and smooth the rough surface of zirconia, thus, glaze layers would have been protected by bonding to zirconia. Glazing of zirconia may be necessary for aesthetic aspects. In clinical conditions, glazed layers were found to be worn off after six months, which may require polishing of zirconia surfaces before glazing. Ceramic showed significant abrasion values (compared to steatite) compared to zirconia, but results were lower or equal to reference values for enamel. There were no significant differences in abrasion between individual ceramics, although they were applied for veneering different infrastructures (alloy and zirconia).

As expected, results obtained with non-standardized natural cusps show extremely varied outcomes. These variations stem from the heterogeneity of the antagonists: the hard tissue of human teeth can have varying enamel geometry and thickness and can become brittle. Nonetheless, the results provide an impression of the types of abrasion on ceramic and enamel antagonists. Tests with steatite antagonists allow for quantitative interpretation of abrasion rates because these antagonists are available in standardized sizes and qualities. Although steatite antagonists cannot be considered an ideal substitute for human enamel due to its mechanical and tribological properties, its capacity for in vitro wear testing has been

demonstrated. Abrasion rates were higher on steatite antagonists than on enamel. The reasons could be the higher hardness or initial roughness of steatite or the changing contact areas during the wear process: assuming greater wear on enamel—combined with subsequent increased contact area—may lead to lower overall abrasion. SEM did not show significant differences between steatite and enamel, but the images only reflect the situation after the abrasion process. Further tests should be conducted on this subject.

SEM images of the ceramic worn surfaces revealed combined fractures, cracks, smooth, and rough surfaces. SEM images on ceramic samples revealed circular defects, presumed to be cone cracks. These cone cracks are described as defects that occur on the ceramic surface when in direct contact with antagonist contact points. No traces of abrasion could be detected on the zirconia surfaces. Only minor differences in abrasion were found between steatite and enamel.

Contrary to expectations that zirconia produces antagonist abrasion, current results show that zirconia oxide causes less abrasion on steatite antagonists than on ceramic ones. SEM images demonstrated that overall, enamel abrasion and deterioration occurred regardless of whether zirconia or ceramic was the antagonist. Enamel defects include abrasions, cracks, fractures, even chipping. Smooth areas are visible on both enamel and steatite opposed to zirconia. These findings coincide with clinical observations, where ceramic wear is indicated to be lower than enamel wear. This deterioration is influenced by material properties such as hardness, fracture resistance, or composition.

Sliding of antagonists on zirconia caused only flattening of the antagonist surface. These results lead to the assumption that zirconia can be used for the fabrication of fixed partial prostheses without faceting. However, verification of occlusal contact data is essential because abrasion in these cases is limited to the antagonist surface. Nevertheless, other aspects of using zirconia oxide without faceting, as well as how zirconia abrasions ceramic or tooth enamel, need further investigation under clinical conditions.

## CONCLUSIONS

Esthetic restoration receives increased attention, and zirconia has also begun to occupy a larger share of restoration materials. Despite the limitations of this in vitro study, zirconia has shown favorable mechanical properties.

The abrasion test results with steatite or enamel antagonists did not indicate measurable abrasion on the surface of zirconium oxide. Ceramic showed comparable or even lower rates of abrasion than enamel. The abrasion of antagonists against zirconia was found to be comparable, or even lower, compared to the results for ceramic.

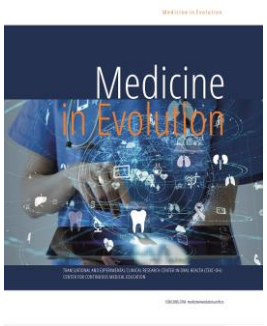
Utilizing CAD/CAM technology for zirconia can help reduce errors in laboratory procedures such as impression, wax-up, casting, etc. Additionally, the technique for full-zirconia crowns can decrease the turnaround time for restoration or occlusal adjustment. Overall, full-zirconia crowns can save time for both the restoration process and the patient's teeth.

## REFERENCES

1. Tam, C.K.; McGrath, C.P.; Ho, S.M.Y.; Pow, E.H.N.; Luk, H.W.K.; Cheung, L.K. Psychosocial and Quality of Life Outcomes of Prosthetic Auricular Rehabilitation with CAD/CAM Technology. Int. J. Dent. 2014, 2014, 393571.
2. Watson, J.; Hatamleh, M.M. Complete integration of technology for improved reproduction of auricular prostheses. J. Prosthet. Dent. 2014, 111, 430–436.

3. Choi, K.J.; Sajisevi, M.B.; McClennen, J.; Kaylie, D.M. Image-Guided Placement of Osseointegrated Implants for Challenging Auricular, Orbital, and Rhinectomy Defects. Ann. Otol. Rhinol. Laryngol. 2016, 125, 801–807
4. Yadav, S.; Narayan, A.I.; Choudhry, A.; Balakrishnan, D. CAD/CAM-Assisted Auricular Prosthesis Fabrication for a Quick, Precise, and More Retentive Outcome: A Clinical Report. J. Prosthodont. 2017, 26, 616–621
5. Mangano, F., Mangano, C., Margiani, B., & Admakin, O. (2019). Combining intraoral and face scans for the design and fabrication of computer-assisted design/Computer-Assisted Manufacturing (CAD/CAM) Polyether-Ether- Ketone (PEEK) implant-supported bars for maxillary overdentures. Scanning, 2019, 1– 1.
6. Mangano, F., & Veronesi, G. (2018). Digital versus analog procedures for the prosthetic restoration of single implants: A randomized con-trolled trial with 1 year of follow-up. BioMed Research International, 2018, 1– 20
7. Revilla-Leon, M., & Ozcan, M. (2019). Additive manufacturing technol-ogies used for processing polymers: current status and potential application in prosthetic dentistry. Journal of Prosthodontics, 28, 14 6 – 1
8. Revilla-Leon, M., Meyer, M. J., & Ozcan, M. (2019). Metal additive man-ufacturing technologies: Literature review of current status and prosthodontic applications. International Journal of Computerized Dentistry, 22, 55
9. Padros, R., Giner, L., Herrero-Climent, M., Falcao-Costa, C., Rios-Santos, J. V., & Gil, F. J. (2020). Influence of the CAD-CAM Systems on the Marginal Accuracy and Mechanical Properties of Dental Restorations. International Journal of Environmental Research and Public Health, 17, 4276
10. Pan, S., Guo, D., Zhou, Y., Jung, R. E., Hammerle, C. H. F., & Muhlemann, S. (2019). Time efficiency and quality of outcomes in a model-free digital workflow using digital impression immediately after implant placement: A double-blind self-controlled clinical trial. Clinical Oral Implants Research, 30, 617– 626.
11. Zhang, Y., Tian, J., Wei, D., Di, P., & Lin, Y. (2019). Quantitative clinical adjustment analysis of posterior single implant crown in a chairside digital workflow: A randomized controlled trial. Clinical Oral Implants Research, 30, 1059–1066
12. Zeltner, M., Sailer, I., Muhlemann, S., Ozcan, M., Hammerle, C. H., & Benic, G. I. (2017). Randomized controlled within-subject evaluation of digital and conventional workflows for the fabrication of lithium disilicate single crowns. Part III: Marginal and internal fit. Journal of Prosthetic Dentistry, 117, 354–362
13. Shim, J. S., Lee, J. S., Lee, J. Y., Choi, Y. J., Shin, S. W., & Ryu, J. J. (2015). Effect of software version and parameter settings on the marginal and internal adaptation of crowns fabricated with the CAD/CAM system. Journal of Applied Oral Science, 23, 515– 522
14. Shim, J. S., Kim, J. E., Jeong, S. H., Choi, Y. J., & Ryu, J. J. (2020). Printing accuracy, mechanical properties, surface characteristics, and mi-crobial adhesion of 3D-printed resins with various printing orien-tations. Journal of Prosthetic Dentistry, 124, 468– 47
15. Revilla-Leon, M., Meyer, M. J., Zandinejad, A., & Ozcan, M. (2020). Additive manufacturing technologies for processing zirconia in dental applications. International Journal of Computerized Dentistry, 23,27,37

# Oral rehabilitation by superstructures on dental implants

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## Abstract

Dental implants are today an indispensable part of clinical dentistry. The market is estimated to reach approximately USD 7.8 billion by 2030, with a compound annual growth rate (CAGR) of approximately 6-7% during 2023-2030 [1]. Recent studies indicate that dental implants have a survival rate of approximately 90-95% over a 10-year period. Some studies even report survival rates of 95-98% over a 5-year period [2]. The main concern is related to the aging of the population. Diabetes, osteoporosis, obesity, and medication use are all medical conditions that can prevent bone healing around dental implants. With this in mind, research to develop better methods to improve implant osseointegration needs to be continued, especially in the presence of compromised bone status. Current changes and their future outlook are discussed in this paper.

**Keywords:** dental implants, survival rates

## INTRODUCTION

The dental implant market has experienced significant growth globally, supported by demographic, technological, and increasing oral health awareness factors. It is estimated that approximately 10-15 million dental implants are performed annually globally [3]. The number of procedures is increasing, supported by an aging population and increased access to dental health services in developing countries.

North America represents one of the largest markets for dental implants owing to its advanced healthcare infrastructure and high patient awareness. The United States dominates this region. Europe holds a significant share of the global market, with countries such as Germany, Italy and France leading the way. In these countries, the use of dental implants is well accepted and insurance systems may partially cover the costs. The Asia-Pacific region is the fastest growing geographic area, driven by emerging economies such as China and India as well as population growth and improved access to health care [4].

### *Purpose and objectives*

The present study aims to determine the need for dental implant rehabilitation, evaluate patient selection criteria and analyze the impact of dental implant rehabilitation on patients' quality of life.

## MATERIAL AND METHODS

The study includes 32 patients of different sexes, from different backgrounds and with different edentulous classes.

For each patient, the masticatory, phonetic and aesthetic dysfunctions were evaluated with the help of clinical and paraclinical examination. These included a series of questionnaires and investigations analyzing the heredocollateral, general personal, behavioral and personal dental antecedents as well as drug treatment if it currently exists. [5]

Inspection of the face from the frontal norm, in this aspect we are interested in facial symmetry, the shape of the face, the floors of the face, the appearance of the lips, of the furrows, the amplitude of the mouth opening and the color of the integuments and the dental exposure.

Facial symmetry analysis looks at whether the halves of the face are symmetrical. Asymmetries may suggest skeletal or dental abnormalities, such as dental midline deviation or malocclusion. Asymmetries can influence the placement of dental implants and, by implication, the final esthetics. Dental exposure assesses how much of the teeth the patient exposes when smiling or at rest, which can suggest problems with tooth positioning. The dental midline should be aligned with the facial midline. A deviation may indicate a malocclusion. Any deviation can affect the aesthetics and must be corrected by proper positioning of the implant. The lips must cover the teeth in a proportional way. If the teeth are very prominent or receding, this may be apparent from frontal inspection. The thickness of the lips and the way they cover or expose the teeth influence the choice of the shape and size of the dental crowns mounted on the implants. The arch of the smile must be harmonious, following the curve of the lower lip. An improper smile arch may suggest abnormal occlusions.

Inspection of the face from the lateral norm follows the patient's profile, the ratio of the lips and the lip-chin groove [6]. The analysis of the facial profile identifies the three variants: straight, convex or concave. These variations are usually related to the relationship between the maxilla and mandible and are important for orthodontic treatment planning. A

convex or concave profile can influence implant positioning and sometimes require surgical or prosthetic adjustments. The straight profile is characterized by a generally balanced occlusion, and the maxilla and mandible are correctly aligned. Convex profile may suggest a prominent jaw or a small mandible (mandibular retrognathism). Concave profile may indicate a prominent mandible or an underdeveloped jaw (mandibular prognathism) [7]. The relationship between the lips and the E line (Esthetic line - an imaginary line that joins the tip of the nose to the tip of the chin) is characterized by the lips that should be slightly withdrawn from this line [8]. If the lips are too prominent or too retracted, this may suggest abnormalities in the positioning of the teeth or jaws. In implantology, the relationship between the lips and the E-line is important to assess tooth projection. Implants must be placed so that they do not create an exaggerated protrusion or retraction of the lips from this line. Dental implants, especially for front teeth, must be placed in such a way as to maintain or improve the support provided to the lips. If the anterior teeth are too prominent or too receding, this can affect the aesthetic and functional appearance of the facial profile. A detailed evaluation of the thickness and quality of the bone tissue is essential for the long-term stability of the implant. In profile, one can see how well the soft tissues, such as the lips and cheeks, are supported by the bony structures. For a successful aesthetic result, it is important that the implants are placed in such a way as to ensure harmony between the upper and lower jaw. This includes assessing the occlusion and position of the posterior teeth, which help support the face.

Palpation of the trigeminal nerve emergence points, sinus points, maxillary and mandibular bone outline, palpation of the soft points of the face, palpation of the TMJ, of the masticatory muscles and we will observe the excursion of the chin to be symmetrical [9].

Endo-oral examination, specifically, the color and appearance of the tongue, floor of the mouth, mucosa of the hard palate, lutea and palatine veil. The call of the teeth, here we followed the presence of carious processes, present fillings, tartar deposits and staining as well as edentations if they are present, after which we moved on to the radiological examination and the diagnosis of the patient. I drew up a treatment plan related to the reasons for the presentation, and then to the practical part.

Anesthesia related to the working areas was performed. Specific incisions were made to make the flap. The bone ridge was regularized, according to the surgical guide, with the help of bone nippers and ball burs.

The drilling of the neo alveolus was done following the manufacturer's surgical instructions according to the bone density, after which Straumann BLX implants were inserted through the surgical guide, obtaining a minimum torque of 35Ncm. The Straumann BLX Implant System is designed for immediate placement and loading, offering high primary stability even in challenging bone conditions. MUA prosthetic posts were screwed into the implants respecting the screw tightening torque of 30Ncm [10].

The provisional work was provisionally cemented, intraorally, over the titanium caps screwed into the MUA. After the provisional cement set, the work was unscrewed to be finished. [11]

The digital impression of the work was carried out using the Trios 4 intraoral scanner and Straumann Revex scannable digital analogues. Based on the fingerprint, the laboratory performed the definitive titanium and composite work [12,13].

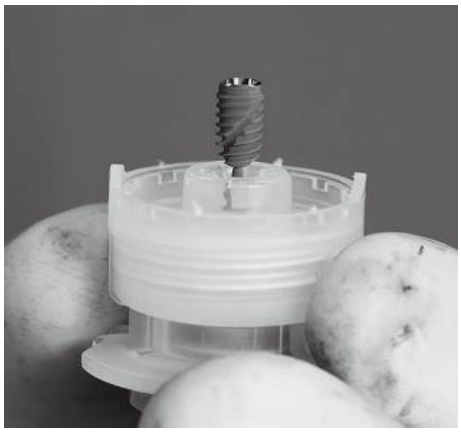


Figure 7. Straumann BLX implant

## RESULTS

We present in the following graphs the distribution of the group of patients present in our study according to the environment of origin (Fig. 1) and according to their age group (Fig. 2):

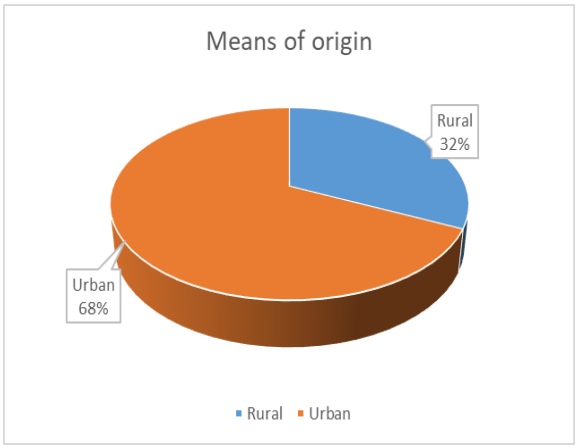



Figure 1. The batch studied according to the environment of origin

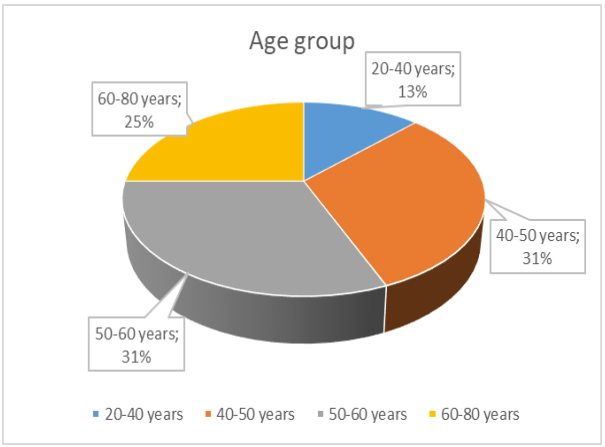



Figure 2. The studied group according to age group

Function of the etiology [14] of the studied group, 14 patients presented periodontopathies, 13 had carious diseases and 5 presented a multiple etiology (Fig.3). The reasons for the presentation of the patients in the dental office (Fig. 4) and the etiology of the batch was as follows:

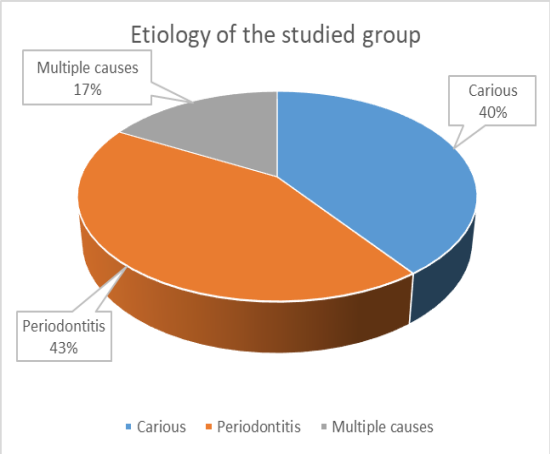



Figure 3. The studied group distribution according to etiology

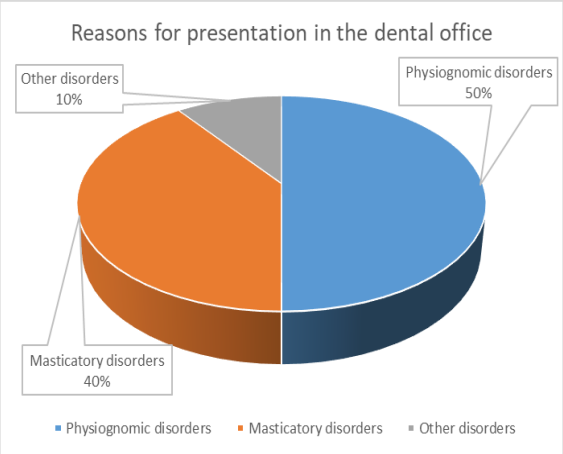



Figure 4. The studied group distribution according to the reason for presentation in the dental office

According to the edentulous classes according to Kenedy [15], 7 patients had edentulous class I, 13 edentulous class II, 10 edentulous class III and 2 of class IV (Fig. 5). Proposed prosthetic restoration types such as (Fig. 6) and corrected edentulous classes are shown in the following graphs:

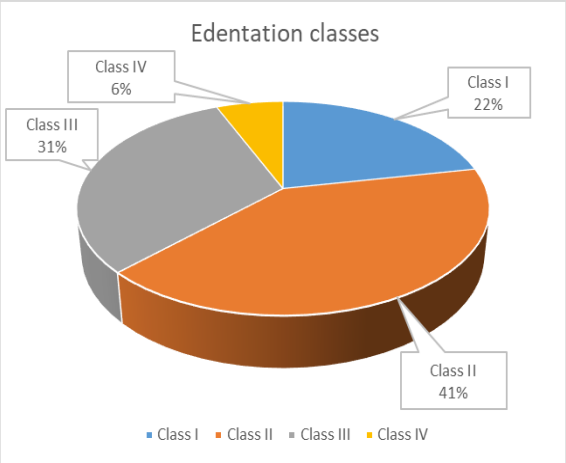



Figure 5. The studied group according to the edentulous classes registered in the dental office

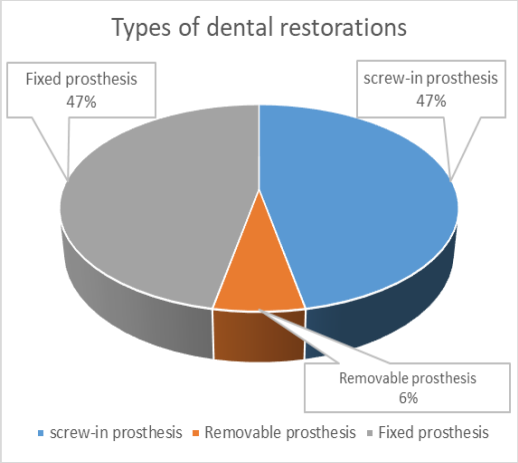



Figure 6. The lot studied according to the type of dental restoration proposed

The main result obtained on the patients present in our study was the restoration of the masticatory function. Dental implants completely restore masticatory function, allowing patients to chew food efficiently, which contributes to proper digestion and optimal nutrition. Compared to mobile prostheses, which can slide or move during chewing, implants are fixed directly in the bone and provide the patient with superior stability [16].

## DISCUSSIONS

Dental implants support the facial structure and help prevent bone resorption, which can lead to unwanted facial changes (such as the "aged face" look). Dental crowns fixed on implants are designed to fit perfectly with the rest of the natural teeth, offering a natural and aesthetic appearance [17].

Dental implants eliminate the discomfort and irritation associated with traditional removable dentures, which can rub the gums and cause injury or pain. Since implants become

part of the bone structure, they offer a feeling of stability and naturalness comparable to that of natural teeth [18].

Dental implants have a high survival rate of 90-95% over a 10-year period with proper maintenance. This aspect makes them a durable solution for oral rehabilitation, with stable long-term results. Regular check-ups with the dentist ensure long-term monitoring and maintenance of the health of the implants.[19]

Dental implants contribute to clear and natural speech, preventing pronunciation difficulties that can occur with removable dentures that move. Patients regain confidence in public speaking as there is no risk of implants slipping or falling out. Dental implant patients experience a significant improvement in quality of life, reporting increases in self-confidence and satisfaction with social and personal life. Providing stability and functionality comparable to natural teeth, implants allow patients to enjoy a varied diet and participate in social activities without anxiety [20].

Dental implants stimulate the jawbone, preventing the bone resorption that often occurs after tooth loss. This stimulation helps maintain the bone structure and overall health of the jaw. Removable prostheses do not provide this benefit, which can lead to progressive bone loss. Unlike traditional dental bridges, which require the grinding of healthy adjacent teeth, dental implants allow the replacement of missing teeth without affecting the natural teeth, which helps preserve the integrity of the natural teeth and prevent future dental problems [21].

Oral rehabilitation with dental implants is a modern and effective solution for patients suffering from tooth loss. Caring for dental implants is similar to caring for natural teeth, requiring daily brushing and flossing. No special cleaning solutions or adhesives are required, as is the case with removable dentures.

Although dental implants may have a higher initial cost compared to other prosthetic solutions, their long lifespan and reduced need for replacement make them a cost-effective option in the long term. Patients avoid the cost and inconvenience associated with frequent replacement or repair of removable prostheses.

Oral rehabilitation with the help of dental implants offers multiple advantages that significantly improve the masticatory function, facial aesthetics, comfort and quality of life of patients. As a durable and cost-effective solution, dental implants are a preferred option for replacing missing teeth and for complete oral rehabilitation. With proper care and regular check-ups, patients can benefit from the remarkable long-term results of dental implants [22,23].

Osseointegration is particularly important in order to achieve long-lasting dental implants and a strong bone that can withstand the prosthetic load. In situations of cases with moderate or severe atrophy of the alveolar ridges, we have at our disposal numerous methods of bone addition and surgical techniques to be able to increase in height and width the bone volume necessary for the insertion of dental implants. The methods for bone augmentation techniques are chosen according to the topography of the edentulous dentition, the anatomical shape of the alveolar ridge and the peculiarities of the maxillary bone, as well as the cause of tooth loss [24,25].

The goal of modern dentistry is to restore the patient to normal profile, function, comfort, aesthetics, speech and health, regardless of atrophy, disease or injury to the stomatognathic system.

## CONCLUSIONS

In conclusion, research conducted on implants inserted with the help of surgical guides has highlighted several significant advantages compared to traditional implantation

methods. Among the main benefits are increased accuracy of implant positioning, reduced risk of post-operative complications and shorter recovery time for patients. Case studies and literature review have demonstrated that the use of surgical guidelines contributes to more rigorous planning and more predictable execution of interventions.

Guided surgery is shown to be predictable and less error-prone than the analog protocol. Working times are considerably reduced by fixing the provisional in the same session as the surgical stage.

The digital technology used throughout the cases proved to offer more advantages than disadvantages.

We also identified some challenges and limitations associated with the use of surgical guidelines, such as high costs and the need for additional training for medical staff. However, as technology advances and becomes more accessible, it is anticipated that these barriers will be significantly reduced.

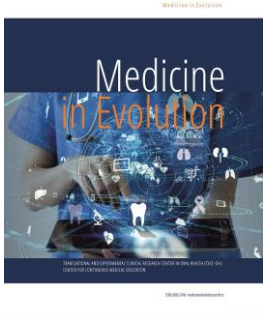
Based on the conclusions drawn, we recommend the continuation of research in the field of digitally guided implantology, with an emphasis on process optimization and cost reduction. At the same time, we suggest the integration of this type of technology in the continuing education of dentists to ensure widespread adoption and effective use in clinical practice. Finally, we highlight the transformative potential of surgical guides in dental implantology, marking an important step toward a future in which dental procedures will be safer, more efficient, and more precise.

## REFERENCES


1. Smith S, Garcia M, Patel R. Global dental implantology market: An overview of trends and statistics. J Oral Biol Craniofac Res. 2022;12(1):15-21. doi: 10.1016/j.jobcr.2022.01.007
2. Pjetursson BE, Thoma D, Jung R, Zwahlen M, Zembic A. A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDPs) after a mean observation period of at least 5 years. Clin Oral Implants Res. 2012;23 Suppl 6:22-38. doi: 10.1111/j.1600-0501.2012.02546.x.
3. Grand View Research. Dental Implants Market Size, Share & Trends Analysis Report By Product (Titanium, Zirconia), By End-use (Hospitals, Dental Clinics), By Region, And Segment Forecasts, 2023 - 2030.
4. Mordor Intelligence. Dental Implants Market - Growth, Trends, and Forecasts (2023 - 2028). https://www.mordorintelligence.com/industry-reports/dental-implants-market.
5. Nevins, M., & Mellonig, J. T. (2003). Implants: Periodontal and Restorative Management. Quintessence Publishing.
6. Buser, D., Wismeijer, D., & Belser, U. C. (2017). Implant Therapy in the Esthetic Zone: Current Treatment Modalities and Materials for Single-tooth Replacements. Quintessence Publishing.
7. Chaturvedi, S., & Haralur, S. B. (2020). "Comprehensive evaluation of facial profile esthetics using cephalometric and photographic parameters." Journal of Clinical and Diagnostic Research, 14(2), ZC01-ZC06.
8. Buser, D., Chappuis, V., & Belser, U. C. (2019). Implants in the Esthetic Zone: A Step-by-Step Treatment Guide. (2nd ed.).
9. Bickley LS, Szilagyi PG, Hoffman RM. Bates' Guide to Physical Examination and History Taking. 12th ed. Philadelphia: Wolters Kluwer; 2017. Chapter 7, The Head and Neck; p. 253-280.
10. https://www.straumann.com/en/dental-professionals/products-and-solutions/dental-implants/blx.html
11. Misch CE: Contemporary Implant Dentistry. Mosby, St. Louis, Third Edition, 2008
12. mburgia M, Logozzo S, Hauschild U, Veronesi G, Mangano FG. Accuracy of four intraoral scanners in oral implantology: A comparative in vitro study. BMC Oral Health. 2017;17(1):92. doi: 10.1186/s12903-017-0383-4.

13. Mangano FG, Luongo G, Migliario M, Mortellaro C, Mangano N, Mangano C. Combining intraoral scans, cone beam computed tomography and face scans: the virtual patient. J Craniomaxillofac Surg. 2018;46(8):1383-1391. doi: 10.1016/j.jcms.2018.05.042.
14. Bratu D, Nussbaum R., Bazele clinice si tehnice ale protezarii fixe, Editura Signata, Timişoara, 2001
15. Popa S., Protetica Dentara, Volumul I si II, Editura Medicala, Bucureşti, 2001
16. Academy of Osseointegration. (2010). Guidelines for the Provision of Dental Implants. Available at [Academy of Osseointegration website](https://www.osseo.org/)
17. Xie Y, Lu H, Xu W, Zhang L, Wang X, Zhang Y. Impact of Implant-Supported Fixed Dental Prostheses on Peri-Implant Soft Tissue Esthetics and Facial Appearance in Edentulous Patients: A Systematic Review and Meta-Analysis. J Prosthodont. 2021;30(7):591-600. doi: 10.1111/jopr.13306.
18. Li Y, An S, Zhang H, Yang Y, Shi X, Xu H. Comparison of patient satisfaction and masticatory function between implant-supported overdentures and conventional complete dentures: A systematic review and meta-analysis. J Prosthet Dent. 2021;126(2):219-226. doi: 10.1016/j.prosdent.2020.06.036.
19. Pjetursson BE, Thoma D, Jung R, Zwahlen M, Zembic A. A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDPs) after a mean observation period of at least 5 years. Clin Oral Implants Res. 2012;23 Suppl 6:22-38. doi: 10.1111/j.1600-0501.2012.02546.x
20. Buser D, Sennerby L, De Bruyn H. Modern implant dentistry based on osseointegration: 50 years of progress, current trends and open questions. Periodontol 2000. 2017;73(1):7-21. doi: 10.1111/prd.12185.
21. Zhao Y, Wei Y, Wu W, Liu F, Zhang D, Jiang X. Effect of dental implants on alveolar bone preservation and facial appearance: A 3-year prospective study. Clin Oral Implants Res. 2022;33(3):315-323. doi: 10.1111/clr.13850
22. Esposito, M., Grusovin, M. G., Coulthard, P., & Worthington, H. V. (2006). The efficacy of various bone augmentation procedures for dental implants: A Cochrane systematic review of randomized controlled clinical trials. International Journal of Oral & Maxillofacial Implants, 21(5), 696-710
23. Adell, R., Lekholm, U., Rockler, B., & Brånemark, P. I. (2021). A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. International Journal of Oral Surgery, 10(6), 387-416
24. Ortiz-Puigpelat O, Barroso-Panella A, Altuna-Fistolera P, Quevedo-Pou M, Hernández-Alfaro F. The Screen Technique for Safe Bone Regeneration of Noncontained Defects: A Novel Technique. Int J Periodontics Restorative Dent. 2021;41:857–862.
25. Romito GA, Sapata VM, Cesar Neto JB, Llanos AH, Jung RE, Pannuti CM. Simultaneous Assessment of Soft and Hard Tissue Behaviors After Alveolar Ridge Preservation Using Bone Substitutes, Int J Periodontics Restorative Dent. 2022;42:103–111.

# Continued root-growth and apexification procedure of immature permanent incisors using calcium hydroxide

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## Abstract

Teeth with incomplete apical development or with a wide apex (unformed apex) have the etiology of complicated dental caries or a trauma with pulp exposure and periapex damage, before the root is fully matured. Two male patients aged 9 and 7 years old with history of carious pathology and dental trauma were selected for the apexification procedure. Apexification produced consistent results in the treatment of immature teeth with pulp necrosis and apical periodontitis.

**Keywords:** open apex, endodontic treatment, central incisor

## INTRODUCTION

Teeth with incomplete apical development or with a wide apex (unformed apex) have the etiology of complicated dental caries or a trauma with pulp exposure and periapex damage, before the root is fully matured. In such situations it can be encountered a wider apex with thin root canal walls than near the cervical area with extensive periapical lesions [1].

The treatment of this type of lesion, followed by the correct obturation of the canal, is very difficult to achieve under normal endodontic therapy conditions, requiring the intervention of some surgical methods [2]. Considering, however, the fact that such cases are mainly encountered in very young patients (children) with difficult cooperation, a method that allows the complete development of the apex is required as a therapeutic solution, the method called apexification [3].

Maxillary central and lateral incisors are often considered the easiest teeth to treat due to the uncomplicated anatomy of the root canal. The canal is usually straight with a cross-sectional shape approximating the shape of the crown and root [4]. Frequent complications include the presence of the oral dentine shoulder in the cervical area that often prevents direct access to the root canal system and directs the bur and files to the vestibule. This fact can result in a vestibular perforation. When the curvature is completely removed, good visibility is obtained directly towards the channel. Because these teeth are subject to greater trauma than the rest of the mouth, calcified pulp chambers are often encountered, which frequently lead to complications in treatment [5].

Pulpal and periapical disease associated with a divergent canal towards the apex, with a radiological image of radiolucency institutes great difficulties in terms of the therapeutic method. First of all, a larger apical and smaller coronal canal diameter makes it difficult to carry out mechanical treatment in terms of complete debridement; the lack of an apical stop makes the root obturation technique difficult and the thin walls of the root canal are prone to fractures [6].

Apexification has as its main objective an apical repair of the tooth in question by forming a tissue barrier at this level, thus making it possible to carry out a root obturation through condensation techniques, without the danger of pushing the obturation material beyond the apex [7].

Successful endodontics aims at effective debridement of the root canal system and complete obturation of the root space. The anatomy of the root canal system sets the parameters within which root canal therapy will be performed and can directly affect the likelihood of success [2,4].

### *Aim and objectives*

The present study aims to demonstrate the effects of calcium hydroxide on the apex of endodontically immature teeth that have undergone complicated carious processes with irreversible pulp damage complicated with periapical lesions. Closing the apex represents the final goal of these techniques to keep the teeth on the arch for a long time.

## MATERIAL AND METHODS

Two male patients: M.T., 9 years old and G.R. 7 years old presented with the chief complaint of colour modification and fetid breath. The presented radiological investigations demonstrated the presence of affected immature central incisors with radiolucency revealed at the periapical level.

Patient M.T. presented with affected tooth no. 2.1. (Fig.1) with a history of high caries risk with multiple carious lesions both in temporary and permanent teeth.

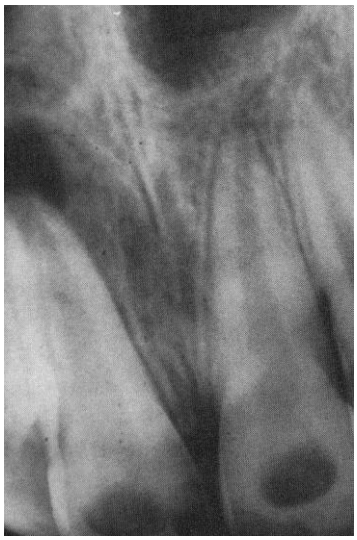

Figure 1. Immature left upper incisor, no. 2.1.

Patient G.R. presented with the history of dental trauma in the frontal region, 6 months before being treated, with necrotic tooth no. 2.1. (Fig.2).

Figure 2. Immature left upper incisor, no. 2.1.

**Mechanical canal preparation**. Reaming up to the apical formation is not mandatory, allowing the expansion to penetrate the atraumatic, apical delta and the periapex; mechanical cleaning only of the accessible part (provisional space - maximum 3/4 of the root canal) drastic antiseptics (coagulants and toxic) are not used. If necessary, sodium hypochlorite can be used. After using sodium hypochlorite, wash with water and do not air dry. We have to take into account that by blowing air into the canal we create an air bubble, which forms an obstacle to expansion, by creating insulating barriers between the calcium oxide and the endodontic water.

**Paste preparation.** It is done simply by mixing the powder with liquid as desired to change the consistency of the paste.

The consistency of the paste is left to the discretion of the professional and depends on the extent of the main canal and the secondary ones, as well as the existence of a periapical granulomatous reaction.

**Inserting the paste into the channel.** A Lentulo file with a smaller diameter than the canal or the provisional space is used, in order not to introduce air into the canal, between the paste and the endodontic space. In all cases, we avoid inserting the apical periodontium puncture to avoid unnecessary trauma.

It must not be forgotten, to cover the paste with a preferably non-hydrophilic inert material, to avoid contact between the paste and the temporary obturation material, between the paste and the walls of the coronary cavity.

**Temporary filling of the cavity.** It can be performed with any type of temporary obturation cement that does not contain eugenol.

## RESULTS

The evaluation of the apexification process is done three months after the treatment through a radiographic examination to highlight the closure of the apex. The quality of the formed tissue is done by testing with a file needle no. 35 which must not penetrate this portion at the time of its introduction to this level. If such results were not obtained, a new application of calcium hydroxide-based paste is recommended, and the evaluation of the results is done every 3 months until adequate scarring is obtained in the sense of apical closure that allows root obturation by endodontic techniques.

In both treated cases, the apex of the two upper central incisors was closed at 9 months, requiring two reapplications of calcium hydroxide, followed by the endodontic obturation with gutta-percha (Fig. 3, 4).

Figure 3. Radiological image of tooth no. 2.1. with a matured apex and the final endodontic obturation

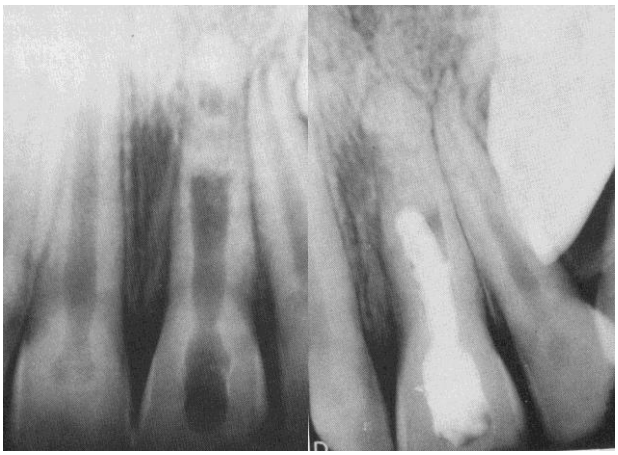

Figure 4. Radiological image of tooth no. 2.1. with a matured apex and the final endodontic obturation

**DISCUSSIONS**

At the origin of the inflammation that causes periapical lesions are bacterial toxins, enzymes and degradation products of pulp tissue proteins. The logical treatment of periapical lesions is therefore the suppression of inflammation [2,3,6].

In the case of a necrotic or even infected pulp, the choice of endodontic medicine depends on the relationship between the bactericidal effect and the good biocompatibility of the medicine used [7,8].

Ocalexic therapy is a treatment that can be defined from "A" to "Z" as physiological and biological. Ocalexic therapy provides the endodontist with four certainties:

• pulpal catabolism and microbial proliferation are stopped, the environment becomes alkaline from acid;

• enzymatic activity is canceled; when the pH goes from 8.5 it becomes impossible;

• leukocytosis increases and the defense capacity is maximum;

• bone restoration is enhanced by removing the obstacles that oppose the activity of alkaline phosphatase [5, 9].

Ocalexic expansion spontaneously penetrates and occludes any endodontic space inaccessible to conventional instruments and antiseptics [10].

Calcium hydroxide is able to lyse and make dead organic matter disappear completely and at the same time respect the living organic matter even stimulating its metabolism and favoring bone, cementum and dentine distribution [11].

Studies have shown that healing is faster if the periapex is respected. Current techniques therefore use less irritating methods. Endodontic healing associated with the use of biological endodontic techniques induces spontaneous scarring of the periapex. This implies rigorous criteria for canal preparation and obturation [2, 12].

The preparation of the canals aims at suppressing the pulp tissue and pathogenic agents represented by microorganisms and organic debris, through mechanical and physico-chemical action [13].

The purpose of the obturation is to put the canal system out of the circuit, by achieving a precise, hermetic and durable filling of the apical orifice.

Teeth bearing periapical lesions require more special attention regarding:

- establishing the apical limit of the preparation;
- establishment of a biological environment favorable to scarring;
- the problem of the number of interim meetings;
- choice of obturation technique [14].

In contact with living tissues producing carbon dioxide, calcium hydroxide turns into calcium carbonate, which has no caustic action on tissues. The anti-alkaline effect of tissue carbon dioxide is the result of the inactivation of hydroxide in the vital environment, as long as this environment has preserved its basal metabolic activity, which is exacerbated precisely by the deficit obtained in carbon dioxide [15]. But the action of calcium hydroxide in the living environment is not only passive and negative, by neutralizing its chemical action, but also active, with its own metabolic wave. In living tissues, there is a constant ratio between carbon dioxide and carbon. An acceleration of the basal metabolism is thus produced by increasing cellular activity [16].

## CONCLUSIONS

Apexification produced consistent results in the treatment of immature teeth with pulp necrosis and apical periodontitis. The choice of treatment should be chosen after a thorough analysis of prognostic variables.

Despite the high success rate of apical barrier development using calcium hydroxide, these teeth nevertheless require long-term monitoring. There could be issues including cervical root fracture, infection recurrence, and failure to control infection. The latter occurs more frequently in luxated teeth that are still developing their roots.

The therapeutic decision is influenced by the clinical situation, the desired treatment outcomes, and the dentist's performance and dexterity.

## REFERENCES

1. Trope M, Chivian N, Sigurdsson A. The role of endodontics after dental traumatic injuries. In: Pathways of the pulp. 10th Edn. vol. 10. St Louis: Mosby, 2006
2. Silveira CM, Sebrão CC, Vilanova LS, Sánchez-Ayala A. Apexification of an immature permanent incisor with the use of calcium hydroxide: 16-year follow-up of a case. Case reports in dentistry. 2015
3. Patil BR, Patil PB, Patil AN. Apexification in a non-vital tooth: By control of infection. Journal of the International Clinical Dental Research Organization, 2010
4. Agrafioti A, Giannakoulas DG, Filippatos CG, Kontakiotis EG. Analysis of clinical studies related to apexification techniques. European Journal of Paediatric Dentistry, 2017
5. American Academy of Pediatric Dentistry, Guideline on pulp therapy for primary and immature permanent teeth. Pediatr Dent 38(6):280–288, 2016
6. Soares J, Santos S, Ce'sar C, Silva P, Sa'´M, Silveira F, et al. Calcium hydroxide induced apexification with apical root development: A clinical case report. Int Endo J., 2008
7. Siqueira JF Jr., Guimarães-Pinto T, Rôças IN. Effects of chemomechanical preparation with 2.5% sodium hypochlorite and intracanal medication with calcium hydroxide on cultivable bacteria in infected root canals. J Endod., 2007
8. Phillips JM, Srinivasan V. The management of non-vital immature permanent incisors. Dent Update, 2014
9. Mackie IC, Worthington HV, Hill FJ. A follow-up study of incisor teeth which had been treated by apical closure and root filling. Br Dent J., 1993
10. Alobaid AS, Cortes LM, Lo J, Nguyen TT, Albert J, Abu-Melha AS, et al. Radiographic and clinical outcomes of the treatment of immature permanent teeth by revascularization or apexification: a pilot retrospective cohort study. J Endod., 2014
11. Chala S, Abouqal R, Rida S. Apexification of immature teeth with calcium hydroxide or mineral trioxide aggregate: systematic review and meta-analysis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 2011
12. Kleier DJ, Barr ES. A study of endodontically apexified teeth. Dent Traumatol. 1991

13. Chueh LH, Huang GT. Immature teeth with periradicular periodontitis or abscess undergoing apexogenesis: a paradigm shift. J Endod, 2006
14. Holland R, de Mello W, Nery MJ, Bernabe PF, de Souza V. Reaction of human periapical tissue to pulp extirpation and immediate root canal filling with calcium hydroxide. J Endod, 1977
15. Shubich I, Miklos FL, Rapp R, Draus FJ. Release of calcium ions from pulp-capping materials. Journal of Endodontics, 1978
16. European Society of Endodontology. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. International Endodontic Journal, 2006

# Fixed prosthetic restorations on zirconium oxide infrastructure


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## Abstract

Fixed prosthetic restorations on zirconium oxide infrastructure have become increasingly popular in modern dentistry due to their exceptional properties, including high durability, biocompatibility and superior esthetics. Zirconium oxide offers an alternative to traditional metal restorations, eliminating potential allergic reactions and providing a more natural appearance due to its color similar to tooth enamel. This material is used for a wide range of prosthetic applications, including crowns, bridges and implants, due to its ability to withstand high mechanical loads and resist wear. Studies show that zirconium oxide restorations have a high clinical success rate with minimal complications and a high level of patient satisfaction. This study examines the technical and clinical properties of zirconium oxide fixed prosthetic restorations, the advantages compared to other materials, a nd the perception of patients benefiting from the new technology regarding its aesthetic, functional and pecuniary aspects.

**Keywords:** zirconium oxide, fixed prosthesis, CAD/CAM technology, oral rehabilitation

## INTRODUCTION

In recent years, dental ceramics has had a remarkable technological evolution, new materials and technologies for processing ceramic masses being constantly introduced. The improvement of physical and optical properties has made it possible to expand the range of indications of all-ceramic and polymer restorations or hybrid materials from long-lasting fixed partial dentures, all-ceramic crowns, inlays, onlays, veneers, abutments and implants dental [1].

Due to the unparalleled mechanical properties of partially stabilized zirconia, its introduction to the dental market a decade ago has greatly expanded the range of applications of ceramics in dentistry, a field where they are classically in demand due to their chemical inertness and a wide combination of optical properties, allowing excellent aesthetics. Even though the current trend is towards the development of all-ceramic systems, ceramics are still widely used for plating metal infrastructures for metal-ceramic dental restorations. At the same time, ceramic abutments and implants are now becoming available offering certain advantages [2].

Ceramic masses are the therapeutic option in dentistry due to their increased resistance, precision in adapting restorations to dental abutments and special translucency. The absence of metallic infrastructure guarantees superior aesthetics, reduced thermal conductivity, biocompatibility and chemical stability. The natural appearance and chromatic integration of restorations considering the appearance of the remaining teeth is a difficult task, due to the complex optical characteristics of natural teeth and the increased standards and demands of doctors and patients [3].

Pressed ceramics, feldspathic ceramics, zirconium oxide, are processed through subtractive and additive technological processes that allow the creation of all-ceramic prostheses with favorable biomechanical behavior, aesthetics and a reduced thickness; CAD/CAM technology significantly reducing work time [4].

### *Purpose and objectives*

The aim pursued in this study is to highlight the versatility of ceramic materials and all-ceramic restorations on zirconium oxide support which, adapted and processed to the clinical case, can restore facial aesthetics. We pursued a measurement of the degree of satisfaction of patients benefiting from this technology to identify the extent to which the functional and aesthetic comfort rises to the level of the related financial costs. Patients are not always willing to undergo a complex and interdisciplinary treatment for various reasons such as costs or long waiting time, and thus the doctor and the patient agree on a compromise situation, since the ideal aesthetic results cannot be obtained.

### *Brief History of Fixed Prosthodontics*

The first forms of fixed dentures date back to ancient Egypt, where lost teeth were replaced with human or animal teeth, bound with gold wires. In ancient Rome and Greece, gold was also used to create rudimentary bridges. In the Middle Ages, prostheses were often made of bone and ivory, but the methods remained primitive and rarely functional in the long term. As metallurgical techniques improved in the 18th and 19th centuries, gold and other precious metals began to be used to make dental crowns and bridges. In 1728, Pierre Fauchard, considered the father of modern dentistry, described in his book "Le Chirurgien Dentiste" the use of wires to fix artificial teeth to natural teeth [5,6].

19th century: The development of dental ceramics marked an important stage with the invention of dental faience by Alexis Duchâteau in 1774 and further development by the

French dentist Nicolas Dubois de Chemant. In 1800, William H. Goodwin patented the first technique of using ceramics for dental crowns. The 20th century brought porcelain crowns as a novelty, and the use of dental cements to fix prosthetic restorations became a common practice. The discovery and use of metal alloys such as gold, palladium and platinum have significantly improved the durability and functionality of fixed prostheses. The 1950s saw the advent of composite resin materials and bonding techniques that revolutionized fixed restorations. In the 1960s, Dr. Per-Ingvar Brånemark discovered osseointegration, leading to the development of bone-integrated dental implants, which revolutionized fixed prosthodontics [7].

With the 90s and the introduction of zirconium oxide as an infrastructure material brought a qualitative leap in the aesthetics and biocompatibility of fixed prostheses. The development of CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing) has enabled the precise and efficient production of prosthetic restorations. Digital technology continues to improve the design, fit, and functionality of fixed prostheses [8,9].

Fixed prosthodontics have evolved from rudimentary solutions to sophisticated and customized techniques, responding to the increasingly high aesthetic and functional demands of modern patients. This evolution continues to redefine the standards in oral rehabilitation and restorative dentistry.

***The clinical-technical stages of a restoration***

The first stage of the patient's examination is the extra-oral examination that monitors the proportionality of the facial floors, the facial symmetry that is evaluated according to the median line. In the case of patients who require the restoration or improvement of aesthetics, special attention should be paid to the smile line, the degree of exposure of the teeth during speech and smiling, the symmetry or deviation of the smile line and the nasolabial or lipo-chin grooves. During the smile, the evaluation of the oral corridor and the degree of exposure of the teeth [10].

The intra-oral inspection aims to evaluate the correctness and fit of odontal restorations, existing prosthetic restorations, the appearance of mobile and attached mucosa. It is of maximum interest to follow the appearance of the mobile mucosa, the floor of the mouth, the insertion of the frenulum, the absence of any suspicious lesions or formations. The attached mucosa covering the alveolar processes and hard palate should have an orange peel appearance and pale pink color. Overflowing and marginally infiltrated fillings are replaced as well as ill-fitting prosthetic restorations and those restoring teeth with gingival recession.

The documentation of the case can be done photographically, through videos in which the patient speaks, smiles and laughs because the aesthetics must be considered and evaluated during the functions. Study models are used and help the doctor in collaboration with the dental technician and the dental laboratory in establishing the treatment and the possibilities of optimizing the aesthetics. Based on the study model, the dentist can evaluate how to prepare the teeth, if he can or should modify the coronal axis, measure the overjet and overbite and orient himself towards obtaining predictable aesthetic results [11].

After establishing the treatment plan and completing the conservative therapy, the dental abutment preparations are made. Until the treatment is completed, the patient is restored prosthetically, with provisional works. Provisional restorations can be of long or short duration, depending on the clinical situation and treatment stages.

From an aesthetic point of view, not only the color, shape and alignment of the teeth must be taken into account, but also the gingival zenith, which is defined as the highest position of the gingival line at the level of the teeth, where the gingiva is attached to the enamel of the buccal surface. The zenith is defined as the most apical point of the convexity of

the marginal gingiva. This important landmark has been described as having a specific spatial orientation in the apico-coronal and mesio-distal directions.

The gingival zenith is an essential factor in achieving optimal aesthetic results and depends on its placement, which can create a symmetrical gingival line that greatly improves the aesthetic appearance. The gingival zenith is determined by the position and axis of insertion of the teeth in the alveolar processes, by the contour and thickness of the gum. Certain factors such as the size, shape and position of the crowns can influence the positioning of the gingival zenith.

The ideal position of the zenith is 1-2 mm below the point where the gum meets the tooth enamel. The appearance of the zenith can be improved by contouring, repositioning, dental veneers or orthodontic treatment.

After all these stages, the treatment plan is established which includes:

- correction of asymmetric gingival zenith and coronal lengthening at the level of the upper and lower frontal group
- measurements made on the study model
- performing the wax-up with the design of the future position of the gingival zenith limit
- correction by surgical excision of the insertion of the marginal periodontium and the frontal coronal elongations of the upper and lower arches
- making and preconfiguring the upper and lower mock-up
- soft tissue healing and stabilization for 3 weeks
- preparation of abutments
- imprinting of the prosthetic field with silicones with a two-time addition reaction
- cementing the provisional prosthetic restoration
- intra-oral test of the sintered zirconium oxide framework and verification of static and dynamic occlusal relationships
- definitive cementation of the upper and lower all-ceramic fixed prosthetic restoration

Interspersed with some clinical stages, there are also some laboratory stages for the preparation of the working model, the scanning and CAD design of the dental work, the CAM realization of the zirconium oxide support and its ceramic veneering [12].

## MATERIAL AND METHODS

The study included 33 patients of different sexes, from different backgrounds and with different dentition classes of a dental clinic in Timişoara who benefited from such prosthetic works in the last year. We present in the following graphs the distribution of the group of patients presents in our study according to their biological gender (Fig. 1) and by their age group (Fig. 2):

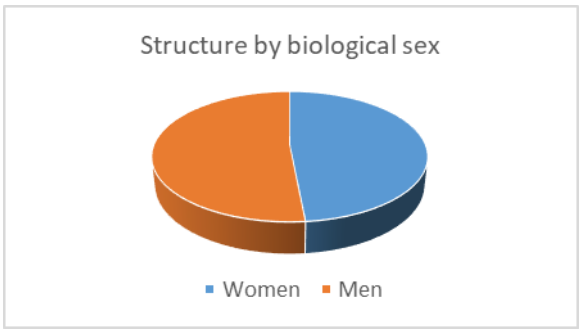



Figure 1. The studied group according to the biological gender

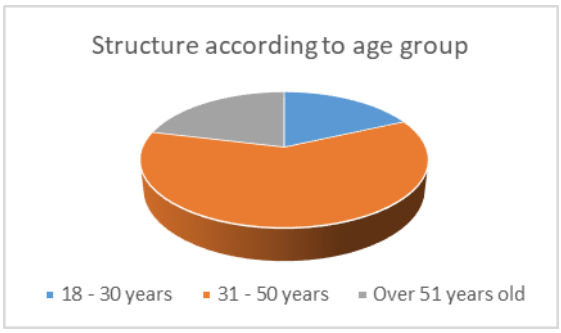



Figure 2. The studied group according to age group

As a function of the main reason for choosing dental work on zirconium oxide support, the results obtained are shown in Fig. no. 3 and in Fig. no. 4 we present the age in the oral cavity of the fixed prosthesis:

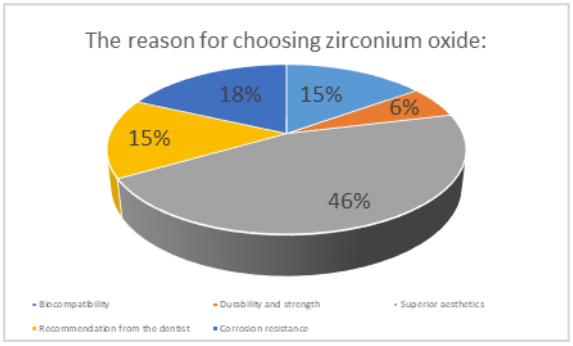



Figure 3. Distribution of the group of patients according to the reason for choosing zirconium oxide

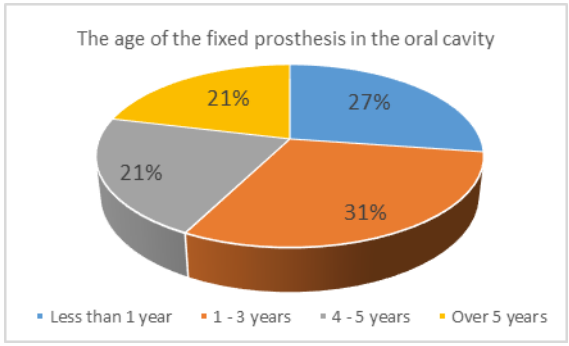



Figure 4. The studied group depends on the age of the prosthetic work in the oral cavity

Depending on the areas in the oral cavity that are the subject of the patients fixed prosthetic works for which they opted for zirconium oxide, they are shown in the graph in Fig. no. 5. In the graph from figure no. 6, we present the ratio between the occurrence or absence of health problems or complications in the cementation of these prosthetic works.

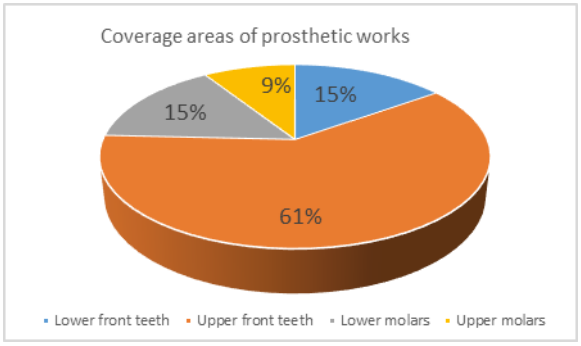



Figure 5. Distribution of the group of patients depending on the areas covered by the prosthetic work

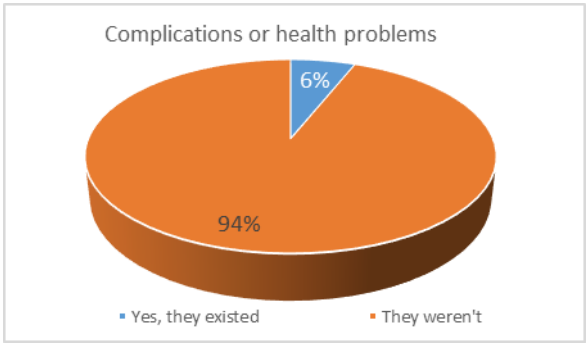



Figure 6. The batch studied according to the complications that occurred

We also analyzed the increase in aesthetic and functional comfort and the results are included in the graphs in fig. no. 7 and fig. no. 8.

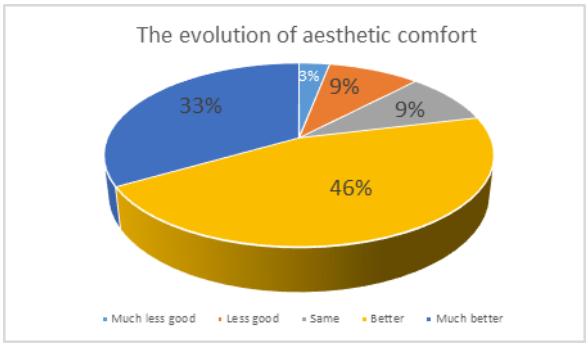



Figure 7. Patients' perception of the evolution of aesthetic comfort after prosthetics

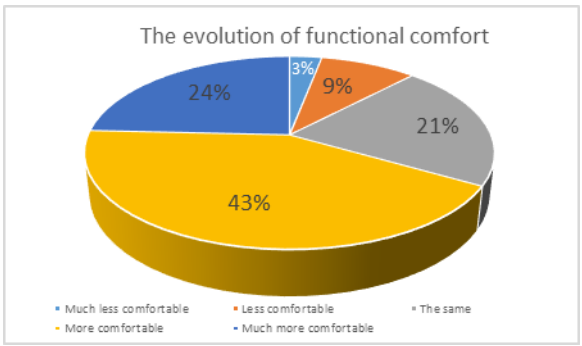



Figure 8. Patients' perception of the evolution of functional comfort after prosthetics

In the graph from Fig. no. 9 I represented the general level of satisfaction on the resistance of the prosthetic work on ceramic-plated zirconium oxide support. The answer had

5 degrees of satisfaction from "Very dissatisfied" to "Very satisfied". It is noteworthy that none of the patients indicated the answer of "Very dissatisfied".

Also closely related to the overall level of satisfaction is the extent to which patients would further recommend this type of work and the services of the dental clinic to friends. The centralization of these responses is presented in the graph in figure no. 10. Only 1 patient indicated that they were "very unlikely" to recommend the work or the clinic and another one that they were "unlikely".

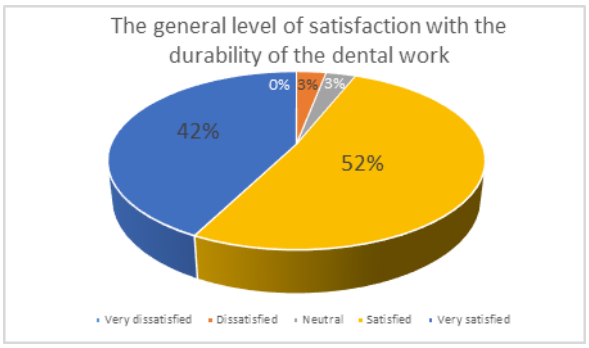



Figure 9. Patients' perception of the general level of satisfaction regarding the durability of dental work

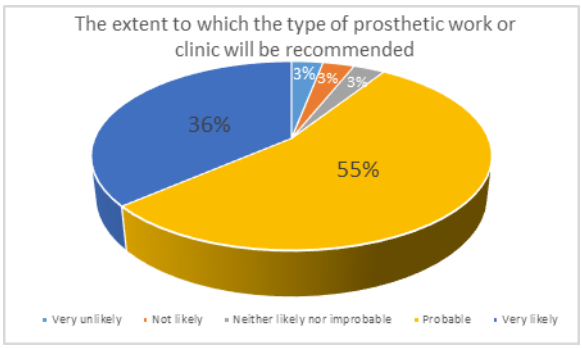



Figure 10. The extent to which the type of prosthetic work or clinic will be recommended

At the end of the survey, we asked each participant to indicate the main advantage of prosthetic work on zirconium oxide support. The answers given are expressed in the graph in figure 11. Figure 12 includes the main improvements they expect from this type of work, answers that also indirectly indicate the minuses of this type of material.

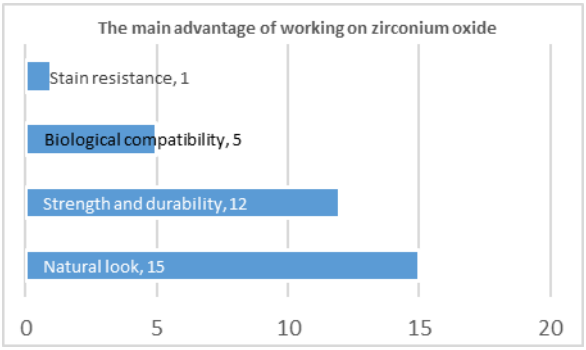



Figure 11. The main identified advantage of ceramic works on zirconium oxide support

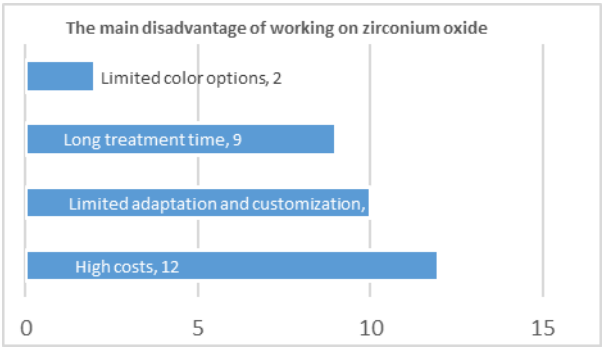



Figure 12. The main identified disadvantage of ceramic works on zirconia support

## RESULTS

From the measurements we could see that more than 57% of the patients have the prosthetic work for less than 3 years and 79% for less than 5 years. Only a little over 1/5 of patients enjoy this prosthesis time of more than 5 years. This aspect suggests the novelty of this technology on the one hand, but also its financial inaccessibility. To the same extent, it is a work preferred by the active population (under 50 years – 79% of patients).

The main reason why zirconium was chosen by patients was its aesthetic appearance (46%) but also its resistance (24%). In equal proportions of 15%, the patient's information regarding biocompatibility, respectively the dentist's recommendation, weighed in the decision taken.

Almost 2/3 of the prosthetic works concerned the upper frontal area (61%) and 30% for the lower arch. Only 9% represented the upper molars. The answers fall under the main concern for the aesthetic aspect offered by zirconia-supported ceramic works.

The biocompatibility of the material (94% of patients) is also evidenced by the small number of cases in which complications or other health problems were registered.

Over 3 quarters of patients appreciate the aesthetic improvement of the facial appearance (79%) and over 2/3 of them recognize a very good or good increase in functional comfort (67%). The durability and resistance over time of the work is appreciated by 94% of the respondents who benefited from the type of work analyzed.

To a high extent (91%) it is very likely or likely that zirconium will be recommended by patients to their friends.

The main advantage seen by patients of prosthetic work on zirconia support is naturalness (45%) closely followed by the strength of the material (36%). The major disadvantage remains the high cost (36% of patients) but also limited personalization (30%) and longer treatment time (27%).

## DISCUSSIONS

Zirconium-supported prosthetic work has become a popular choice in dentistry due to its combination of aesthetics and durability. These works involve the use of zirconium, a high-performance ceramic material, to create the basic structure of crowns, bridges or dentures. Zirconium has a natural, translucent color similar to tooth enamel, which makes it ideal for work in the frontal area of the oral cavity. Unlike metals, zirconium does not create dark shadows around the gum line, thus contributing to superior aesthetics [13,14].

Zirconium is extremely wear-resistant and can withstand high masticatory forces, being suitable for posterior teeth. It has high fracture resistance compared to other ceramic materials, making it suitable for extended bridges. Zirconium is biocompatible, meaning it has a low risk of causing allergic reactions or irritation of oral tissues. Its smooth surface reduces the accumulation of bacterial plaque and the risk of gingival inflammation [15,16].

Zirconium can be precisely machined using CAD/CAM technologies, allowing for high-precision, customized work. This reduces laboratory work time and can improve the accuracy of fit and fit on prepared teeth. Processing zirconium requires special equipment and specific techniques, given the hardness of the material. Cutting and grinding must be done carefully to avoid microfractures, which can compromise the integrity of the work [17].

Zirconia is generally more expensive than other materials for prosthetic work, such as metal-ceramics, however, the higher cost is justified by the extended lifespan and superior esthetics.

Marginal adaptation is essential to prevent bacterial infiltration and subsequent gingival problems and gingival recession. Despite the excellent esthetics, if it is not properly fitted, gingival retraction may occur, exposing the restoration margin [18].

Professional discussions in dentistry often focus on the balance between aesthetics, functionality and cost, evaluating the advantages and disadvantages of each material to provide patients with durable and esthetic prosthetic solutions. Zirconia support is a modern solution with multiple benefits that continues to evolve as technologies and materials develop [19].

## CONCLUSIONS

In conclusion, we can state with solid arguments that ceramic works on zirconium support have become a popular choice in restorative and prosthetic dentistry due to the many

advantages they offer. Specialists in dentistry have reached a number of conclusions regarding their use, based on studies and clinical observations.

First of all, zirconium offers a translucency and a color that imitates the natural tooth very well, making it ideal for dental work in the aesthetic area. Due to the absence of a metal substrate, a dark border does not appear at the level of the gum, unlike metal-ceramic works[20,21].

Next, zirconia is known for its high resistance to masticatory forces and fracture, making it suitable for crowns and bridges, even in high-load areas. This makes it a preferred choice for long-term restorations. Zirconia-supported restorations demonstrate outstanding wear and abrasion resistance, which contributes to the longevity of dental restorations and the maintenance of the structural integrity of adjacent teeth.

Third, zirconium is a biocompatible material, which means that the risk of allergic reactions or tissue irritation is very low. It is not only safe for the patient, but also contributes to the maintenance of gingival health by reducing the risk of inflammation.

The possibility of being processed with the help of modern CAD/CAM technologies allows the realization of prosthetic works with a very high precision. This leads to a better fit and a reduction in the time required for subsequent adjustments.

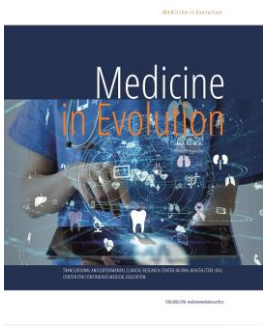
Zirconium is an excellent solution in modern dental prosthetics, offering a complete package of esthetic, functional and safety benefits. Due to these advantages, it continues to be the material of choice for high-quality dental restorations.

## REFERENCES


1. Popa S., Protetica Dentara, Volumul I si II, Editura Medicala, Bucureşti, 2001
2. Manicone PF, Rossi Iommetti P, Raffaelli L. An overview of zirconia ceramics: basic properties and clinical applications. J Dent. 2017;35(11):819-826
3. Bratu D, Nussbaum R. Protetica Dentară. Vol. 1 şi Vol. 2. Timişoara: Editura Helicon; 1997.
4. Christensen GJ. The all-ceramic fixed partial denture: a historical perspective, current application, and future view. J Am Dent Assoc. 2023;134(3):329-334.
5. Fauchard P. Le Chirurgien Dentiste, ou Traité des Dents. Paris: Pierre-Jean Mariette; 1728.
6. Ring ME. Dentistry: An Illustrated History. New York: Harry N. Abrams; 1985.
7. Brånemark PI, Adell R, Albrektsson T, Lekholm U, Lindström J, Rockler B. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. Scand J Plast Reconstr Surg Suppl. 1977;16:1-132.
8. O'Brien WJ. Dental Materials and Their Selection. 4th ed. Quintessence Publishing Co.; 2008.
9. Piconi C, Maccauro G. Zirconia as a ceramic biomaterial. Biomaterials. 2019;20(1):1-25. doi: 10.1016/s0142-9612(98)00010-6.
10. Rosenstiel SF, Land MF, Fujimoto J. Contemporary Fixed Prosthodontics. 4th ed. St. Louis: Mosby; 2016.
11. Shillingburg HT, Sather DA, Wilson EL, Cain JR, Mitchell DL, Blanco LJ, et al. Fundamentals of Fixed Prosthodontics. 4th ed. Chicago: Quintessence Publishing Co.; 2022
12. Donovan TE, Cho GC. Predictable aesthetics with metal-ceramic and all-ceramic crowns: the critical importance of soft tissue management. J Esthet Restor Dent. 2021;13(4):252-260
13. Pelaez J, Cogolludo PG, Serrano B, Serrano JF, Suarez MJ. A four-year prospective clinical evaluation of zirconia and metal-ceramic posterior fixed dental prostheses. Int J Prosthodont. 2022;25:451–458
14. Tinschert J, Zwez D, Marx R, Anusavice KJ. Structural reliability of alumina-, feldspar-, leucite-, mica- and zirconia-based ceramics. J Dent. 2020;28(7):529-35. doi: 10.1016/s0300-5712(00)00021-3
15. Sailer I, Fehér A, Filser F, Gauckler LJ, Lüthy H, Hämmerle CH. Five-year clinical results of zirconia frameworks for posterior fixed partial dentures. Int J Prosthodont. 2007;20(4):383-8.

16. Al-Amleh B, Lyons K, Swain MV. Clinical trials in zirconia: a systematic review. J Oral Rehabil. 2020;37(8):641-52. doi: 10.1111/j.1365-2842.2010.02094.x.
17. Sulaiman TA, Abdulmajeed AA, Shahramian K, Lassila LVJ. Effect of different treatments on the surface properties of zirconia. Materials (Basel). 2019;12(20):3213. doi: 10.3390/ma12203213.
18. Pjetursson BE, Sailer I, Zwahlen M, Hämmerle CH. A systematic review of the survival and complication rates of zirconia-based fixed dental prostheses. Clin Oral Implants Res. 2022;23 Suppl 6:152-162
19. Conrad HJ, Seong WJ, Pesun IJ. Current ceramic materials and systems with clinical recommendations: a systematic review. J Prosthet Dent. 2017;98(5):389-404. doi: 10.1016/S0022-3913(07)60124-3.
20. Denry I, Kelly JR. State of the art of zirconia for dental applications. Dent Mater. 2018;24(3):299-307. doi: 10.1016/j.dental.2007.05.007.
21. Sundh A, Sjögren G. A comparison of fracture strength of yttrium-oxide-partially-stabilized zirconia ceramic crowns with varying core thickness, shapes, and veneer ceramics. J Oral Rehabil. 2014;31(7):682-688

# Sustained-release delivery of antimicrobial drugs for the treatment of periodontal diseases: a narrative review

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## Abstract

The inflammatory condition known as periodontitis can seriously impair a patient's quality of life and the oral cavity if left untreated. Although there isn't a reliable, standardized treatment for periodontitis, there have been numerous attempts, including tissue regeneration methods, antibiotics, and subgingival instrumentation. Given the limitations of the aforementioned treatment, local drug delivery systems appear to be the way of the future. These systems have the potential to release both tissue regeneration inducers and antibiotics gradually over time.

**Keywords:** local drug delivery agents, periodontitis, antibacterial agents, biofilms

## INTRODUCTION

Pharmaceutical formulations that control the release rate of therapeutic substances over a predetermined length of time are known as sustained-release drug delivery systems. The terms sustained release, slow release, extended release, prolonged release, controlled release, time release, and delayed release are used interchangeably in the literature and in business to refer to these dose types [1]. The rate at which a medication is released from its pharmacological carrier determines its pharmacokinetics at a target site. The majority of pharmaceutical drug delivery systems are created to deliver the drug, not to regulate its release within the intended organ. Drug carriers in and of themselves include, for instance, tablets, capsules, gels, lotions, ointments, injections, and inhalers [2]. Furthermore, the majority of toothpastes, mouthwashes, and tablets used in the dentistry industry are merely drug carriers; they have no control over how quickly the active ingredients are released [1].

### *Aim and objectives*

This review aims to pinpoint the existing obstacles and potential areas for further investigation, specifically with the use of local drug delivery system (LDDSs) with different characteristics in the treatment of periodontitis, with or without accompanying systemic disorders.

## MATERIAL AND METHODS

To include articles in this review, we used the following search engines: PubMed and Google Scholar. We used the following keywords: local drug delivery, LDDS, slow-release, and periodontitis. The total number of articles found was 963 on PubMed and 1901 on Google Scholar, published from 1979 to 2024. Out of the total number of articles, specifically, 129 articles were chosen for the current review. This selection was made after removing duplicate papers and the ones that did not meet the criteria for item selection. Titles and abstracts were assessed by no less than two independent researchers for the purpose of inclusion. All items that successfully passed the initial screening were requested in their entirety. Two researchers assessed each complete article to determine if it should be included or excluded.

## RESULTS AND DISCUSSIONS

1 Local drug delivery systems

Systemic medication delivery has proven effective in treating periodontitis during the past 50 years [3,4]. However, the utilization of systemic administration for medications presents several drawbacks, including dysbiosis and insufficient drug concentrations at the desired region. Nevertheless, this can lead to gastrointestinal issues, medication resistance, and toxicity [5-7]. Over the past three decades, there has been a growing interest in studying local drug delivery systems (LDDSs) to explore the targeted usage of pharmaceuticals at specific sites and the regulation of their release. Polymers were found as medication carriers for this specific purpose. They possess the ability to protect the bioactive agents while being delivered into the body and also have the capability to control the rate at which they are released. The bioactive compound can either be encapsulated within the polymeric matrix or chemically bonded to the polymeric chain [8]. Drug delivery systems provide precise regulation and extension of drug release at an applied location and can also be encapsulated within multiple target agents concurrently. By doing so, it is feasible to decrease both the dosage and frequency of drug administration [9,10]. An LDDS offers more advantages

compared to systemic delivery. LDDS has the ability to circumvent gastrointestinal issues and the body's metabolic processes, allowing medications to directly reach the desired location. This results in increased effectiveness of the treatment [11,12]. Furthermore, LDDS enables the noninvasive administration of drugs in the subgingival pockets [13]. In addition, this method of drug administration enables the simultaneous delivery of two or more pharmaceuticals from distinct categories into the periodontal pockets. Twenty-three LDDS can have several forms, including fibers, irrigations, membranes, films, nanoparticles (NPs), and microparticles. The LDDS, which provides therapeutic benefits for periodontal problems, consists of three primary classes of medications: antibacterial, inflammation-modulating, and alveolar and bone regenerating agents [13].

## 2 Types of LDDSs in Periodontitis Treatment

1. Fibers

Fibers serve as a reservoir-type delivery system that contains a specific therapeutic substance. They are inserted into the periodontal pocket using an applicator and held in place by either a cyanoacrylate glue or a periodontal dressing [14]. Several polymers have been suggested and examined as fibers for localized drug delivery systems. These include both natural polymers, such as chitosan, zein, and gelatin, as well as synthetic polymers including poly(e-caprolactone), polyurethane, polypropylene, cellulose acetate propionate, and ethyl vinyl acetate [14,15]. Each of them, upon utilization and examination, was infused with antibacterial medications.

2. Matrix system: Strips and Films

Strips and films are small sections made of a matrix material in which pharmaceuticals are uniformly dissolved. Strips and films are highly effective in conforming to the shape and dimensions of the periodontal pocket, making them easy to insert with minimal patient discomfort. They are specifically put within the interproximal periodontal pocket region [16].

The most used producto is Periochip (Perio Products Ltd., Jerusalem, Israel) is a brownish orange coloured rectangular chip containing chlorhexidine gluconate (2.5 mg) embedded in a matrix of biodegradable polymer – gelatin. It is available in dimensions of 5 × 4 × 0.3 mm weighing about 7.4 mg (drug and polymer). Post-delivery, chlorhexidine (40%) is released (by diffusion) in the first 24 h showing an initial burst effect, following which constant drug release was noted for 7 days.

3. Gels

Gels are semi-solid systems with a low concentration of cross-linked particles, where the active drug molecules are evenly distributed in a solid medium that does not flow under steady conditions [17,18]. Gels are highly regarded in the field of general dentistry for their widespread usage as a carrier system to provide therapeutic drugs for many oral conditions, including oral ulcers, denture stomatitis, and desquamative gingival lesions. The wide range of applications is facilitated by qualities such as the ease of preparation and administration, sustained drug release pattern, minimal dose frequency, and low drug toxicity [19,20]. In the field of periodontics, therapeutic gels containing active agents are carefully administered into the subgingival pocket using syringes with wide port needles. This method ensures that the gel is evenly distributed throughout the affected area.

4. Irrigating systems

The effectiveness of locally administered antimicrobial medications in an irrigation system is contingent upon factors such as the extent of penetration, the severity of the infection, the flow of gingival crevicular fluid (GCF), the concentration of the drug, and the duration of time that an adequate amount of drug is accessible in the pocket region. The proficiency of irrigation devices is determined by the diffusion of the drug into deeper levels of the pocket and the duration of exposure to the antibacterial agent [21]. In supragingival irrigation devices, the irrigating agent reaches a depth of 29-71% in shallow pockets and 44-

68% in moderately deep and deep pockets. On the other hand, subgingival irrigation has a higher penetrability, ranging from 75-93% into deep pockets [21].

5. Microparticulate system

Microparticles are solid spherical structures made of polymers, with a diameter range of 1–1000 µm. They are designed to hold active therapeutic agents, which are evenly distributed throughout the polymer matrix. This design allows the drugs to be protected from the external environment, prevents incompatibility issues, masks unpleasant taste, and improves bioavailability and sustained therapeutic activity [22]. The polymers used for microencapsulation include of biodegradable synthetic polymers such as polyesters and polyanhydrides, as well as natural polymers including chitosan, hyaluronic acid, and alginic acid. Microencapsulation utilizes both water-soluble polymers such as gelatin and starch, as well as insoluble polymers such ethyl cellulose and polyethylene. Polymethacrylates, cellulose esters, and polyvinyl derivatives are examples of enteric coating polymers that are utilized for microencapsulation [22-25]. Microparticles can be administered using several carrier systems such as chips, dental pastes/gel systems, and direct injection into the pocket [25]. Several techniques for formulating microparticles include the solvent evaporation method (single and double emulsion), coacervation and phase separation, and the spray drying method [25–27]. Multiple clinical studies have proven the efficacy of drug-loaded microparticles for treating periodontitis. The utilization of solid lipid microparticles containing lycopene, in conjunction with SRP, has demonstrated favorable clinical outcomes [28]. The study utilized a double emulsion process to generate biodegradable microspheres loaded with Doxycycline. The microspheres had a mean particle size ranging from 90 to 200 µm. The combination of PLGA and PCL in varying percentages was used. The results indicated that both the medication and polymers were stable during the in-vitro release, which lasted for a duration of up to 11 days. The formulation shown substantial enhancement in both the clinical and microbiological aspects for a duration of up to 3 months, in comparison to the commercially available doxycycline gel [29]. A further investigation was conducted on micro-particles containing metronidazole benzoate, which had diameters of 31.0 and 74.5 µm. These micro-particles were then added to chitosan/PCL films. The study found that these films had a release rate of 64% over a period of 7 hours, and also shown strong mucoadhesive properties. This research was documented in reference [30]. A study was conducted on doxycycline hyclate loaded microspheres prepared using the solvent diffusion method of spherical crystallization technique. The study found that there was an initial burst release of 24% on the first day, followed by a sustained release of 52.25% over a period of 7 days. Additionally, the study showed that the microspheres led to a significant reduction in probing pocket depth and P.g. cell count compared to SRP [31].

6. Nanoparticulate drug delivery (NP) system

In the field of periodontics, researchers have conducted investigations on metallic and polymeric nanoparticles, nanofibers, liposomes, quantum dots, and nanocomposites/nanogels. These studies have been carried out both in laboratory settings (in-vitro) and in clinical trials [32]. Metallic nanoparticles (NPs) are produced by reducing metallic salts using chemical reducing agents or by employing green chemistry methods that involve the use of plant resources abundant in antioxidants. Additional biological methods involve investigating the capacity of algae, fungus, bacteria, and viruses to decrease metallic salts into nanoparticles (NP) [33,34]. The nanofiber-based scaffolds are created using several techniques such as electrospinning, emulsion method, mixing, coaxial process, and surface modification. These techniques are used to include therapeutic compounds into the scaffolds, with the goal of achieving certain clinical results in dentistry [35]. The drug release from the nanofibers is determined by the diameters of the fibers, drug diffusion rate, polymer degradation/erosion rates, drug dissolving rates, and drug physical desorption rates. Smart

electrospun nanofibers contain components that undergo physicochemical changes in response to various conditions such as pH value, temperature, light, electrical and magnetic fields. These changes can alter the pace at which drugs are released [36].

## CONCLUSIONS

Within its limitation, this research suggests that both in vitro and vivo studies show promising results regarding the use of LDDS in the treatment of periodontal disease. This application leads to an improvement in periodontal clinical parameters. This is attributed to the evolution and improvement of this administration approach over time, as well as the reduced occurrence of adverse effects compared to the systemic administration of other medications. Nevertheless, additional research is necessary to thoroughly evaluate the efficacy of these delivery methods in human subjects and to explore any potential adverse effects in patients, particularly those with systemic illnesses. Thus, future research should focus on how local drug delivery systems can be personalized in order to optimize future clinical protocols in periodontal therapy.

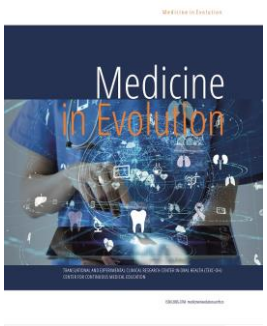
## REFERENCES


1. Adepu S, Ramakrishna S. Controlled Drug Delivery Systems: Current Status and Future Directions. Molecules. 2021 Sep 29;26(19):5905.
2. Amato M, Santonocito S, Polizzi A, Tartaglia GM, Ronsivalle V, Viglianisi G, Grippaudo C, Isola G. Local Delivery and Controlled Release Drugs Systems: A New Approach for the Clinical Treatment of Periodontitis Therapy. Pharmaceutics. 2023 Apr 21;15(4):1312.
3. Walker CB, Gordon JM, Cornwall HA, et al. Gingival crevicular fluid levels of clindamycin compared with its minimal inhibitory concentrations for periodontal bacteria. Antimicrob Agents Chemother 1981; 19: 867–871.
4. Genco RJ. Antibiotics in the treatment of human periodontal diseases. J Periodontol 1981; 52: 545–558.
5. Hau H, Rohanizadeh R, Ghadiri M, et al. A mini-review on novel intraperiodontal pocket drug delivery materials for the treatment of periodontal diseases. Drug Deliv Transl Res 2014; 4: 295–301.
6. Herrera D, Sanz M, Jepsen S, et al. A systematic review on the effect of systemic antimicrobials as an adjunct to scaling and root planing in periodontitis patients. J Clin Periodontol 2002; 29(Suppl. 3): 136–159.
7. Drisko CH. Non-surgical pocket therapy: pharmacotherapeutics. Ann Periodontol 1996; 1: 491–566.
8. De Rossi D, Suzuki M, Osada Y, et al. Pseudomuscular gel actuators for advanced robotics. J Intell Mater Syst Struct 1992; 3: 75–95.
9. Orive G, Hernández RM, Rodríguez Gascón A, et al. Drug delivery in biotechnology: present and future. Curr Opin Biotechnol 2003; 14: 659–664.
10. Kohane DS. Microparticles and nanoparticles for drug delivery. Biotechnol Bioeng 2007; 96: 203–209.
11. Kornman KS. Controlled-release local delivery antimicrobials in periodontics: prospects for the future. J Periodontol 1993; 64(Suppl. 8): 782–791.
12. Steinberg D, Friedman M. Sustained-release delivery of antimicrobial drugs for the treatment of periodontal diseases: fantasy or already reality? Periodontol 2000 2020; 84: 176–187.
13. Addy M, Martin MV. Systemic antimicrobials in the treatment of chronic periodontal diseases: a dilemma. Oral Dis 2003; 9(Suppl 1): 38–44.
14. Rajeshwari H.R., Dhamecha D., Jagwani S., Rao M., Jadhav K., Shaikh S., Puzhankara L., Jalalpure S. Local drug delivery systems in the management of periodontitis: A scientific review. J. Control. Release. 2019;307:393–409.

15. Wei Y., Deng Y., Ma S., Ran M., Jia Y., Meng J., Han F., Gou J., Yin T., He H., et al. Local drug delivery systems as therapeutic strategies against periodontitis: A systematic review. J. Control. Release. 2021;333:269–282.
16. Liao Y., Li H., Shu R., Chen H., Zhao L., Song Z., Zhou W. Mesoporous Hydroxyapatite/Chitosan Loaded with Recombinant-Human Amelogenin Could Enhance Antibacterial Effect and Promote Periodontal Regeneration. Front. Cell Infect. Microbiol. 2020;10:180.
17. Ruan H., Yu Y., Liu Y., Ding X., Guo X., Jiang Q. Preparation and characteristics of thermoresponsive gel of minocycline hydrochloride and evaluation of its effect on experimental periodontitis models. Drug Deliv. 2016;23:525–531.
18. Oliveira M.S., Goulart G.C.A., Ferreira L.A.M., Carneiro G. Hydrophobic ion pairing as a strategy to improve drug encapsulation into lipid nanocarriers for the cancer treatment. Expert Opin. Drug Deliv. 2017;14:983–995.
19. Lu H.D., Rummaneethorn P., Ristroph K.D., Prud'homme R.K. Hydrophobic Ion Pairing of Peptide Antibiotics for Processing into Controlled Release Nanocarrier Formulations. Mol. Pharm. 2018;15:216–225.
20. Holmkvist A.D., Friberg A., Nilsson U.J., Schouenborg J. Hydrophobic ion pairing of a minocycline/Ca(2+)/AOT complex for preparation of drug-loaded PLGA nanoparticles with improved sustained release. Int. J. Pharm. 2016;499:351–357. doi: 10.1016/j.ijpharm.2016.01.011.
21. W.S. Eakle, C. Ford, R.L. Boyd, Depth of penetration in periodontal pockets with oral irrigation, J. Clin. Periodontol. 13 (1986) 39–44.
22. A. Arsiwala, P. Desai, V. Patravale, Recent advances in micro/nanoscale biomedical implants, J. Control. Release 189 (2014) 25–45.
23. L. Bian, D.Y. Zhai, E. Tous, R. Rai, R.L. Mauck, J.A. Burdick, Enhanced MSC chondrogenesis following delivery of TGF-β3 from alginate microspheres within hyaluronic acid hydrogels in vitro and in vivo, Biomaterials 32 (2011) 6425–6434.
24. V.R. Sinha, A.K. Singla, S. Wadhawan, R. Kaushik, R. Kumria, K. Bansal, S. Dhawan, Chitosan microspheres as a potential carrier for drugs, Int. J. Pharm. 274 (2004) 1–33.
25. Y.Y. Yang, T.S. Chung, N.P. Ng, Morphology, drug distribution, and in vitro release profiles of biodegradable polymeric microspheres containing protein fabricated by double-emulsion solvent extraction/evaporation method, Biomaterials 22 (2001) 231–241.
26. J. Siepmann, N. Faisant, J. Akiki, J. Richard, J.P. Benoit, Effect of the size of biodegradable microparticles on drug release: experiment and theory, J. Control. Release 96 (2004) 123–134.
27. A. Supsakulchai, G.H. Ma, M. Nagai, S. Omi, Preparation of uniform titanium dioxide (TiO2) polystyrene-based composite particles using the glass membrane emulsification process with a subsequent suspension polymerization, J. Microencapsul. 20 (2003) 1–18.
28. M.S. Tawfik, K.A. Abdel-Ghaffar, A.Y. Gamal, F.H. El-Demerdash, H.A. Gad, Lycopene solid lipid microparticles with enhanced effect on gingival crevicular fluid protein carbonyl as a biomarker of oxidative stress in patients with chronic periodontitis, J. Liposome Res. (2019) 1–33.
29. R.C. Mundargi, S. Srirangarajan, S.A. Agnihotri, S.A. Patil, S. Ravindra, S.B. Setty, T.M. Aminabhavi, Development and evaluation of novel biodegradable R. H.R., et al. Journal of Controlled Release 307 (2019) 393–409 microspheres based on poly (d, l-lactide-co-glycolide) and poly (ε-caprolactone) for controlled delivery of doxycycline in the treatment of human periodontal pocket: in vitro and in vivo studies, J. Control. Release 119 (2007) 59–68.
30. A.H. El-Kamel, L.Y. Ashri, I.A. Alsarra, Micromatricial metronidazole benzoate film as a local mucoadhesive delivery system for treatment of periodontal diseases, AAPS PharmSciTech 8 (2007) 184–194.
31. S.K. Rao, S. Setty, A.B. Acharya, S.L. Thakur, Efficacy of locally delivered doxycycline microspheres in chronic localized periodontitis and on Porphyromonas gingivalis, J. Investig. Clin. Dent. 3 (2012) 128–134.
32. N.D. Thorat, R.A. Bohara, M.R. Noor, D. Dhamecha, T. Soulimane, S.A. Tofail, Effective cancer theranostics with polymer encapsulated superparamagnetic nanoparticles: combined effects of magnetic hyperthermia and controlled drug release, ACS Biomater. Sci. Eng. 3 (2016) 1332–1340.
33. K. Jadhav, D. Dhamecha, B. Dalvi, M. Patil, Green synthesis of silver nanoparticles using Salacia chinensis: characterization and its antibacterial activity, Part. Sci.Technol. 33 (2015) 445–455.

34. D. Dhamecha, S. Jalalpure, K. Jadhav, D. Sajjan, Green synthesis of gold nanoparticles using Pterocarpus marsupium: characterization and biocompatibility studies, Part. Sci. Technol. 34 (2016) 156–164.
35. X. Hu, S. Liu, G. Zhou, Y. Huang, Z. Xie, X. Jing, Electrospinning of polymeric nanofibers for drug delivery applications, J. Control. Release 185 (2014) 12–21.

# Fluorides effects on tooth structure

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## Abstract

Dental caries involve a complex process of demineralization and remineralization of tooth enamel due to the action of organic acids produced by the microorganisms found in the dental plaque. The purpose of this study was to demonstrate the importance of the action of fluoride products on tooth enamel and how to ensure protection against the appearance of dental caries. The main mode of action of fluorine, in general, is the topical effect on the enamel surface. Even small concentrations of fluoride around the tooth inhibit demineralization and promote remineralization of the tooth surface. Incorporating fluoride (such as fluorapatite) into the enamel surface will decrease solubility and increase tooth decay resistance. In the study, we used three randomly selected fluoride products that are of professional application, and we investigated which of them has the most effective cardioprotective effect, depending on the chemical composition, the concentration of fluorine, the application mode, the frequency of application, and the risk of overdose.

**Keywords:** tooth decay, mouthwash, fluoride gels, fluoride varnishes, remineralization

## INTRODUCTION

Dental practitioners spend their time treating dental caries; however, many dental practitioners have poor knowledge about the mechanisms of initiation of caries, how to identify at-risk patients, and how to draw up a management plan to ensure that the condition does not progress. Too often, the condition is treated, and not the cause itself [1].

When systemically ingested, fluoride helps develop tooth enamel. Initially, the researchers focused on the systemic effect of fluoride as a key factor in reducing tooth decay. However, the evidence of the systemic effect was replaced by the discovery of the fluoride reaction in the enamel micromedia, namely the stimulation of remineralization, which is of major importance in reducing tooth decay [2].

**Topical fluorides**

Lifetime protection against decay results from the continued presence of fluoride in low concentrations, which will enhance the remineralization of white spots, keep incipient invasive caries under control, and limit the occurrence of secondary decay for both children and children [1].

An optimal fluoride concentration in the enamel interface and saliva will help minimize the risk of decay.

**Fluoride varnishes**

They were developed many years ago in order to extend the contact time between fluoride and enamel. Fluorinated varnishes can be part of the prevention plan for individual patients, and indications for their use are hypersensitive areas of enamel and dentine, an alternative to sealants for the occlusal surfaces of permanent molars for receptive children until the sealant is applied, local remineralization for stains white enamel, as part of the program for the prevention of patients with active caries in temporary or permanent dentition, a routine preventive measure for medically compromised children or patients with special needs [3].

**Fluoride gels**

Concentrated fluoride gels are also used by clinicians for caries prevention and treatment. Studies show that concentrated fluoride gels are more effective in permanent dentition than temporary dentition, especially for first permanent molars [4].

Considerable amounts of fluoride gel during application, followed by swallowing, can lead to ingestion of large quantities of fluoride, a factor that contributes to the appearance of light fluorosis and the mineralization of permanent teeth. Therefore, these products should be used with care for patients over 10 years [3].

**Fluoride mouthwash**

There are two types of mouthwash: weekly and daily. The most popular is the one for daily use because it is easier to use than the one for weekly use, trying to remember the day when the product should be used. Mouthwash and brushing with a paste containing fluorine mustn't be used at the same time because their use together does not offer an additive effect. The best thing for a child to use mouthwash is when he returns from school because the plate will undoubtedly be present, where the fluoride will be incorporated and slowly released over time [4].

There are certain patients who are recommended to use daily mouthwash: children under orthodontic treatment, mouthwash can reduce demineralization around the dental apparatus; patients with hyposalivation due to medication or those with congenital absence of large salivary glands; children with medical problems due to which dental caries can be a severe problem (heart patients or patients with coagulation problems), children with active dental caries, some patients who find it difficult to brush [5].

*Aim and objectives*

To address the importance of preventing carious disease during childhood using fluoride-based products.

## MATERIAL AND METHODS

This study is a one-year research project done in the clinic of the faculty of dental medicine regarding a basic branch of dentistry: the importance of preventing carious disease during childhood by using fluoride-based products.

We examined 30 patients between the ages of 6 and 14, accompanied by caregivers, some more cooperative, others less cooperative. It is important to remember that those included in this study gave their written consent to participate in the research.

The following data was analyzed: the incidence of caries according to the way of hygiene, the incidence of caries after fluoride application, the incidence of caries after sealing, the incidence of caries according to food, the classification of patients according to the quality of the enamel structure.

## RESULTS

We examined thirty patients. Eight of them came from rural areas, presenting an increased number of caries compared to the twenty-two from urban regions. Following the anamnesis and the discussions with the caregivers, we found that patients from rural areas have minimal knowledge about prophylaxis compared to those from urban areas. depending on the way of hygiene

Of all examined patients, ten used the electric brush, and twenty used the classic (manual) brush. As a result of the examination, we found a greater number of caries processes in those who used the manual brush than in those who used the electric brush.

To demonstrate the importance of the action of fluoride products on tooth enamel and how to ensure protection against the appearance of tooth decay, we used three randomly selected fluoride products that are professionally applied and researched which of them has the most effective carioprotective effect, depending on the chemical composition, the fluoride concentration, the mode of application, the frequency of application and the risk of overdose.

An intensely fluoridated mouthwash with a high concentration of fluoride was chosen, and it is used only by specialized personnel because of the risk of overdose. It has a chemical composition similar to fluoride gels and contains the following: aqua, glycerine, propylene glycol, sorbitol, poloxamer 407, aroma, cetylpyridinium chloride, potassium sorbate, sodium fluoride, sodium saccharin, menthol, ci 42051. The chosen mouthwash is from the range of those who do not contain alcohol, mainly because the studied group is made up of children and can swallow the used substances. This product has a sodium fluoride concentration of 5%.

The fluoride gel that was selected for use in this study is also for professional applications, also due to the possibility of overdose. It has the following chemical composition: ascorbic acid, carbomer, citric acid, flavor, glycerine, triethanolamine, and stannous fluoride 1, 44% (14000 ppm).

The fluoride varnish that was chosen, as well as fluoride solutions or fluoride gels, is also used by specialized personnel. Still, it is to be remembered that it is not because of the overdose, as in the case of the first two, but because of the application method. The fluoride varnish that has been selected has a sodium fluoride concentration of 22.6 mg F / ml (22600 ppm) in a neutral natural resin base. It is, in fact, a viscous yellow material, an alcoholic solution of resins with a high concentration of fluorine.

Even though fluoride varnishes have the highest concentration of fluoride compared to solutions and gels, they have the lowest risk of overdose. Even if the varnish is swallowed, the film is very thin, and the amount of fluoride ingested is the minimum risk of partial overdose in this case. This is why fluoride varnishes can be used in children under 6 years of age.

Fluoride gels and solutions are contraindicated in children under 6 because of the risk of swallowing, which can lead to overdose. The technique of application for the three selected products is different. Thus, in the case of the first two, to increase the efficiency of the product, it is necessary to clean the teeth through professional brushing and the interdental spaces with dental floss, after which the dental arches with absorbent rollers and saliva aspirator are isolated, the teeth are spray dried, and the material is applied.

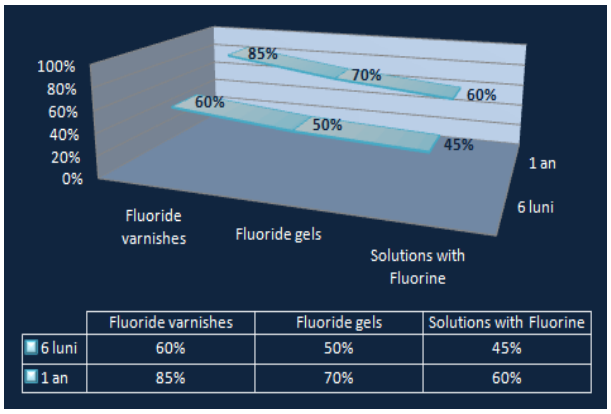
Fluoride solutions are applied by brushing on the surface of the teeth for about 4 minutes, after which the patient is not allowed to rinse his mouth, consume liquids, or eat for 30 minutes.

Fluoride gels are applied to the dental arches with the help of gutters. Approximately 2 - 2.5 ml of gel is applied to each gourd, and it stays between 4 and 30 minutes in contact with the teeth, depending on the patient's age and the degree of cooperation. After that, the patient cannot rinse the mouth or consume liquids or food for 30 minutes.

Fluoride varnishes can also be applied to unhygienic teeth (covered with bacterial plaque), which would allow even such a seizure, according to some researchers, considering that the varnish adheres to enamel even in the case of teeth that have not been perfectly dried and which they are covered with a film of saliva. In the case of this study, to increase the efficiency of the material, we have chosen that the teeth be hygiene and perfectly dry before applying the fluoride varnish, exactly as with the fluoride gels and solutions. After application, the fluoride varnish remains attached to the tooth surface between 4 minutes and 12 hours, ensuring prolonged contact with the tooth enamel, with which it performs ion exchanges for a long time (transforming the hydroxyapatite crystals into fluorapatite crystals), thus increasing the efficiency of the material. After applying the fluoride varnish, the patient is asked not to eat about 4 hours.

To investigate the efficacy of the three randomly selected fluoride materials, the studied group (30 patients) was divided into three groups of 10 patients. In each group, topical applications of fluorine with one of the three selected materials were made. The efficiency of the products was evaluated for 6 months and then after 1 year.

In the success rate of each of the products used, there is an increase in success over time. Fluoride solutions have a success rate of 45% over 6 months, but this increases if continued use for one year. Fluorine gels significantly improve over time and have a high efficiency in their use over time. The most significant increase in the success rate over time is achieved by fluoride varnishes, which accumulate a success rate of 25% over a year compared to the first 6 months.




| | Fluoride varnishes | Fluoride gels | Solutions with Fluorine |
|---|---|---|---|
| 6 luni | 60% | 50% | 45% |
| 1 an | 85% | 70% | 60% |

Figure 1. Success rate / Time depending on the type of material

Depending on the type of fluoride application, the incidence of dental caries has decreased in the total number of patients who have benefited from this treatment, which is actually the most important aspect.

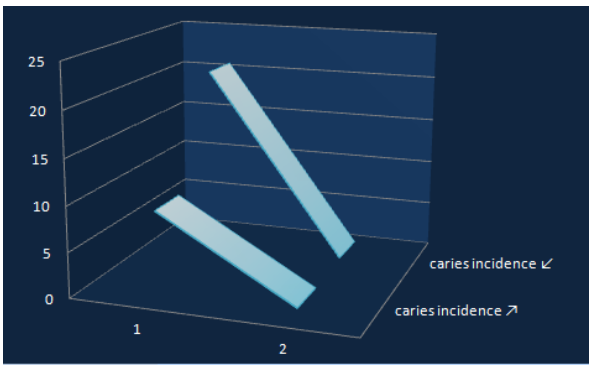



Figure 2. Caries incidence after topical fluoride application

After the patients were examined following the application of fluorine, 9 had an increased incidence of decay after fluoridation due to their diet rich in fermentable carbohydrates and poor oral hygiene. Twenty-one patients had a lower incidence of decay after fluoridation because they followed the advice regarding proper brushing and nutrition for each patient.

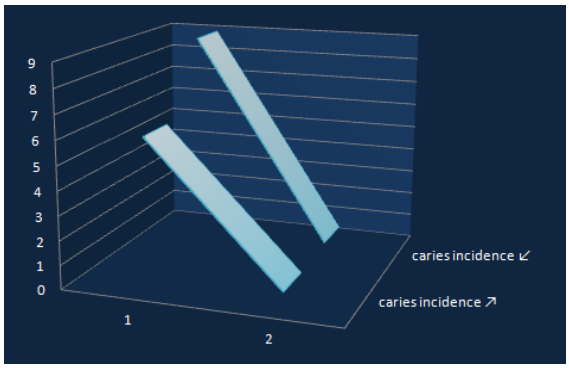



Figure 3. Caries incidence after sealing

In the treatment plan, we included sealing the molars for six years and twelve years for fifteen patients. Of these, six had an increased incidence of cavities because they did not show up for control after sealing and did not comply with the hygiene and nutrition advice

included in the treatment plan. Nine patients had a low incidence of caries. These patients showed up for control after sealing; for three of them, the sealant was applied again.

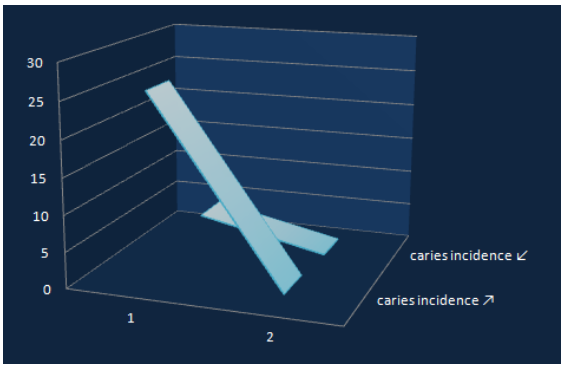



Figure 4. The incidence of caries depending on the diet mode

Of all the examined patients, twenty-six had a diet rich in fermentable carbohydrates, not respecting the diet plan made individually for each patient, thus increasing the incidence of caries. Four patients had a low carbohydrate diet, and we found decreased caries incidence. The child's diet is equally important, especially the intake of fluorine, which is made naturally through nutrition. Thus, after a brief interrogation, we concluded that of the children who participated in the study, the majority had a minimal intake of fluoride in this way, most of them lacking fluoride-rich foods such as tea and fish meat.

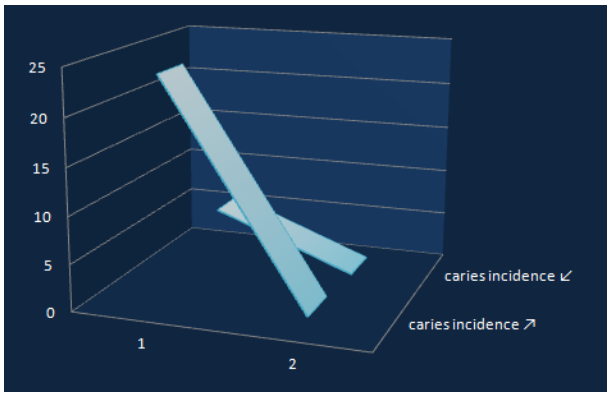



Figure 5. Classification of patients according to the quality of the enamel structure

## DISCUSSIONS

The study of the data results following the examination of the studied patients revealed that twenty-four present weak mineralized enamel, a risk factor in the decay of caries. We followed these patients closely, establishing an individual treatment plan to prevent the onset of caries. Only six of the thirty studied patients have well-mineralized enamel.

Fluoride application is a non-invasive method that does not require the sacrifice of the tooth. The available fluoride application methods allow for the most efficient choice for each patient. The application of fluorine can be used even in incipient cavities, whose process is slowed down by the contribution of fluorine, which combats the demineralization of tooth enamel [6]. Each method has a different indication of use and can only be established by specialized personnel. The success of fluoride applications can be seen over time, depending on the treatment method chosen, sooner or later. The effectiveness of the treatment also depends on the patient's oral hygiene, according to the directions given by the dentist [7].

The application of fluoride on the surfaces of the teeth plays an important role in the remineralization of the demineralized enamel, which transforms the hydroxyapatite crystals into fluorapatite crystals. However, in this case, the fluoridation plan must be individualized because fluorine in large quantities is toxic [8].

Knowledge of the child's mental development is also important to enable him to cooperate during dental treatments and to establish good doctor-patient cooperation [9].

Dental doctors who work with children have to use different approaches and techniques, depending very much on the personality type of each child [10]. A child with a mild temperament may be flexible to treatment changes, and a child with a mild temperament needs more time to adapt. Difficult children respond best to a dentist who is sensitive to the child's mental needs and, at the same time, confident [11].

Risk factors such as nutrition, hygiene, and genetic substrate must be identified in each patient, and a nutrition, prevention, and treatment plan must be established [12].

## CONCLUSIONS

In the success rate of each of the materials used for topical fluoride applications, we see a significant increase in their efficiency over time and a reduction in the frequency of dental caries. Fluoride solutions have a 45% success rate over 6 months, but this increases if continued use for one year (60% success rate). Fluoride gels have a success rate of 50% over 6 months, but this increases if continued use for one year (70% success rate). Significant growth over time is achieved by fluoride varnishes, which have a high efficiency in their use over time (success rate is 60% at 6 months and 85% at one year). The most significant increase in the success rate over time is the fluoride lakes that accumulate a success rate of 25% higher over a year, compared to the first 6 months.

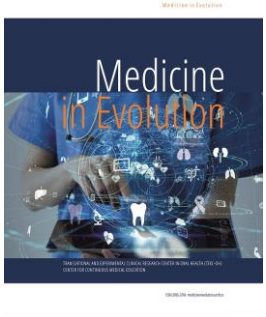
Fluoride varnishes are the most effective, the easiest to handle and apply, the least sensitive to the presence of bacterial plaque and moisture, and have the lowest risk of overdose.

## REFERENCES

1. Chankanka O, Levy SM, Warren JJ, Chalmers JM, A literature review of aesthetic perceptions of dental fluorosis and relationships with psychosocial aspects/oral health-related quality of life, Community Dent Oral Epidemiol, 2010, p 84 - 91
2. Cury JA, do Amaral RC, Tenuta LMA, Del BelCury AA, Tabchoury CPM, Low-fluoride toothpaste and deciduous enamel demineralization under biofilm accumulation and sucrose exposure, Eur J Oral Sci, 2010, p 177 - 185
3. De Almeida BS, da Silva Cardoso VE, Buzalaf MAR, Fluoride ingedestin from toothpaste and diet in 1-to-3-year-old Brazilian children, Community Dent Oral Epidemiol, 2007, p 91 - 97
4. Domen Kanduti, Petra Sterbenk, and Barbara Artnik, Fluoride: A Review of Use and Effects on Health, Articles from Materia Socio-Medica are provided here courtesy of The Academy of Medical Sciences of Bosnia and Herzegovina, 2016, p 315 – 319
5. Ekshand KR, Bakhshander A., Martignon S., Treatment of proximal superficial caries lesions on primary molar teeth with resin infiltration and fluoride varnish versus fluoride varnish only, efficacy after 1 year, Caries Research, 2010, p 243 - 250
6. Joe Mullen, History of Water Fluoridation, British Dental Journal, BDJ volume 199, 2005, p 1–4
7. Livia Maria Andaló TenutaI; Jaime Aparecido Cury, Fluoride: its role in dentistry, Braz. oral res. vol.24 supl. 1 São Paulo, 2010, p 233 - 237
8. Milsom, K.M., Blinkhorn, A.S., Walsh, T., et al., A cluster randomized controlled trial. Fluoride varnish in school children, Journal of Dental Research 90(11), 2011, p 298 - 305

9. LORENZ K., BRUHN G., HEUMANN C., NETUSCHIL L., HOFFMANN T., How to select study designs and parameters to investigate the effect of mouthrinses Part I: rationale and background, Journal of Physiology and Pharmacology, 60, no 8, 2009, p. 77-83
10. Mayuri Bhikaji Nepale, Siddhartha Varma, Girish Suragimath, Keshava Abbayya, Sameer Zope, Vishwajeet Kale., A prospective case-control study to assess and comparethe role of disclosing agent in improving the patient compliance in plaque control. Journal of Oral Research and Review Vol. 6, Issue 2, July-December 2014, p 197 - 204
11. Sheiham, Aubrey; Moysés, Samuel Jorge; Watt, Richard G.; Bönecker, Marcelo., Promoting the Oral Health of Children: Theory and Practice, Second Edition, Quintessence Publishing USA, 2014, 449 - 456
12. Tănase, Mihaela; Zmarandache, Daciana şi Luca, Rodica (2016), Experienţa carioasă a molarului unu permanent la un lot de copii trataţi într-un serviciu de specialitate, Revista română de stomatologie, Vol. LXII, nr.4, Ed. Medicală Amaltea, 2016, p 211 – 217
13. Ilyes I., Lile I.E., Berari A., Marian D., Freiman P.C., Olariu I., Stana O.L., Stana A., Flueras R., Hosszu T. The role of fluoride in the prevention of tooth decay. Medicine in Evolution Volume XXIX, No. 4, 2023

# Coronary reconstruction after endodontic treatment

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## Abstract

Endodontic treatments, known as root canals, are essential for saving teeth severely damaged by deep decay or infection by removing infected pulp and cleaning the root canal system. This process prevents the spread of infection and eliminates pain, allowing the natural tooth to be preserved. After root canal treatment is completed, the tooth becomes more fragile and vulnerable to fracture, making crown reconstruction crucial. A simple endodontic treatment, which only involves cleaning and sealing the root canals without subsequent coronal reconstruction, has a success rate of about 85-93% over a period of 2-3 years. Coronal reconstruction involves restoring the structure of the tooth using materials such as dental crowns, which cover and protect the tooth, restoring its functionality and aesthetics. Together, endodontic treatments and crown reconstruction provide a complete solution for preserving the health and integrity of affected teeth.

**Keywords:** endodontic treatment, success rate, coronary reconstruction

## INTRODUCTION

Endodontic treatments, also known as root canals, are procedures used to remove the infection from inside the tooth and save the natural tooth, preventing the need for extraction. After endodontic treatment, crown reconstruction is essential to restore the structure and functionality of the tooth, using materials such as dental crowns or other restorations to protect and strengthen the treated tooth.

Comparing the success rates of simple endodontic treatments with those followed by a coronary reconstruction shows significant differences, depending on the protection offered to the treated tooth and the prevention of future complications [1].

A simple endodontic treatment, which only involves cleaning and sealing the root canals without subsequent coronal reconstruction, has a success rate of about 85-93% over a period of 2-3 years, according to clinical studies. The main risks associated with endodontic treatments unaccompanied by coronal reconstruction are tooth fractures and canal re-infection, due to weakened tooth structure exposed to external factors [2].

When endodontic treatment is followed by an appropriate coronal reconstruction, for example by using a dental crown, the success rate increases significantly, reaching approximately 95-98% over a similar period. Coronary reconstruction provides additional protection by preventing fractures and ensuring a good seal against microbes, thus reducing the risk of re-infection. Studies have shown that teeth treated endodontically and protected with a crown are much more likely to remain functional in the long term [3,4].

Thus, endodontic treatments followed by a coronary reconstruction offer a significantly higher success rate compared to simple endodontic treatments. Coronal reconstruction protects the fragile structure of the treated tooth and prevents complications, thus contributing to its longevity and functionality [5,6].

### *Purpose and objectives*

The aim of the present study is to highlight the methods of reconstruction using endodontic treatments through various adjacent dental restoration elements such as inlay elements, dental crowns and replacement crowns represented by coronary root devices.

## MATERIAL AND METHODS

To examine and evaluate different types of reconstructions at the level of devital teeth, 196 patients were entered into the study. Each participant was asked to consent to participate in the study of patients who were endodontically treated and prosthetically restored, in a dental clinic in Timişoara, between November 2022 and April 2024.

The protocol began with a specialist consultation, a well-established treatment plan analyzed on the basis of a dental radiograph and with the informed consent of the patient on the entire treatment plan. Therefore, after a prior, objective consultation, the necessary endodontic treatments and fillings were performed using the lateral condensation technique. Then followed the verification of the treatments through a control radiograph, and then each endodontically obturated tooth was coronally restored.

The parameters followed in this study were the type of tooth treated, the type of endodontic treatment performed (per primam/endodontic retreatment), reinforcement or not, with glass fiber pivot, the type of reconstruction, the presence or not of a failure after the completion of the reconstruction.

Regarding the types of coronal reconstructions performed on these devitalized teeth, they were: direct reconstruction with composite resins; composite resin or ceramic inlay;

composite resin or ceramic overlay; covering crown made of composite resins, metal-ceramic or all-ceramic; indirect veneer and fixed partial denture.

The cases were kept under observation, following the appearance of changes at their level over time. To observe the events that occurred, from cementation to the moment of the end of the study, the patients' files were analyzed, in which the status of the reconstructions was recorded at the periodic sanitation visits, through clinical and radiological examinations. At the end of the study, the collected data were organized and then highlighted by graphs to better highlight the follow-up aspects.

At the level of the studied group, we registered a total of 566 non-vital teeth on which endodontic treatments were applied per primam or retreatments. We present in Fig. 1 and 2 the distribution of non-vital teeth at the level of the upper and lower arches and in figures 3 and 4 the percentages of treatments per primam respectively of retreatments performed.

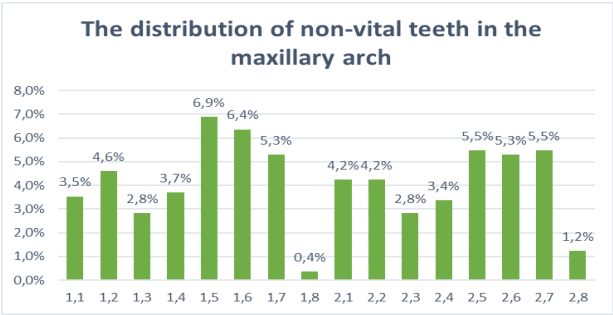



Figure 1. The frequency of the presence of non-vital teeth in the maxillary arch

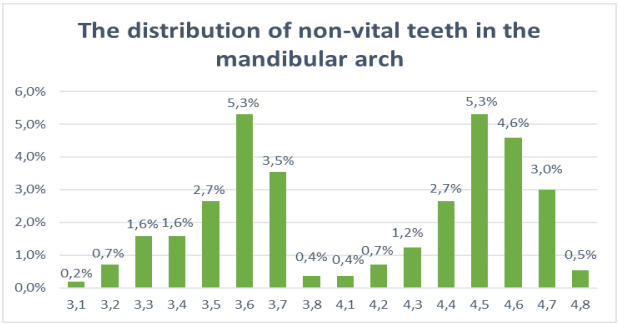



Figure 2. The frequency of the presence of non-vital teeth in the mandibular arch

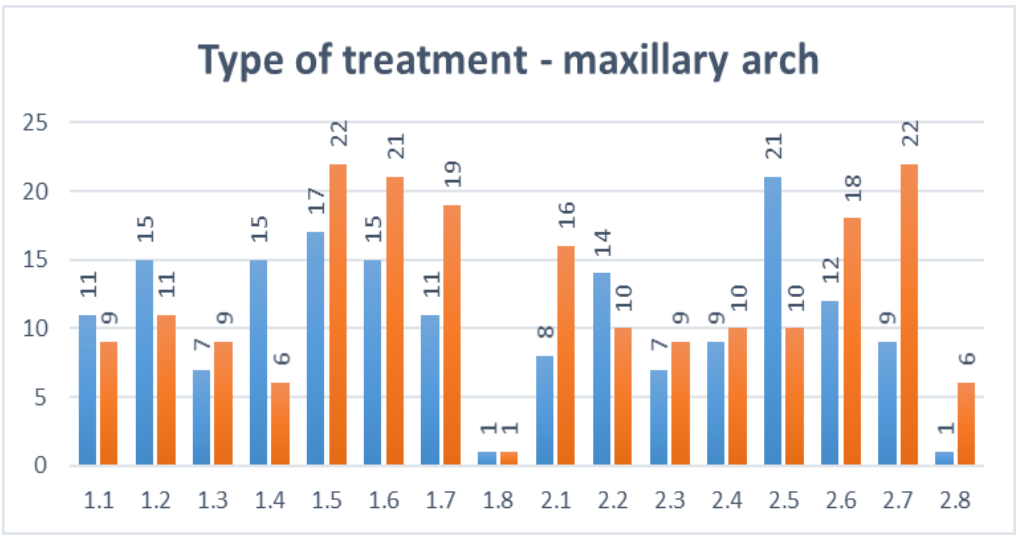



Figure 3. Distribution of treatments per primam ■ versus retreatments ■- maxillary arch

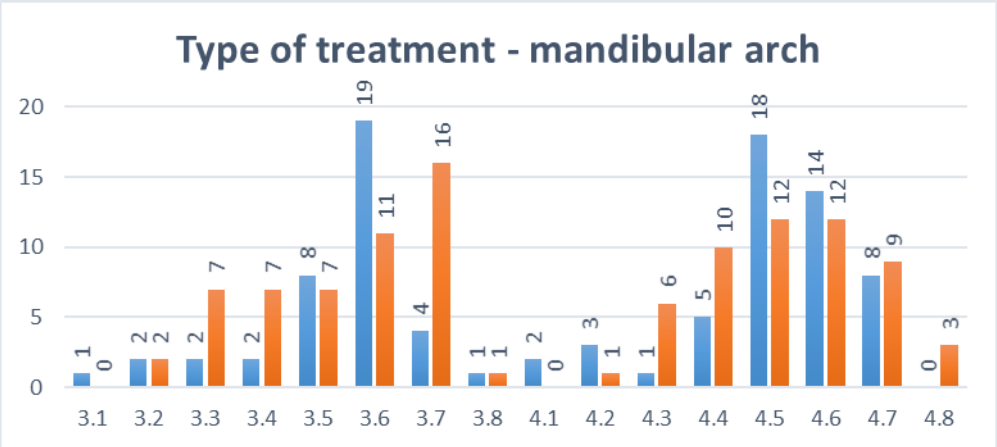



Figure 4. Distribution of treatments per primam ■ versus retreatments ■ - mandibular arch

Analyzing the data from the graphs above, we can see that most situations related to endodontic treatments were registered at the level of the lateral teeth (413 out of 566; 73%) and among them, the 2nd premolars and 1st molars have a high predisposition to endodontic treatment (237 teeth; 42% of total teeth and 57% of lateral teeth). At the same time, of the 566 treated teeth included in the study, 263 (46.5%) represent retreatments and 303 treatments per primam (53.5%).

In Figure 5 we present a distribution of the reinforcement types chosen for each tooth. For 469 teeth (82.9%) the doctor opted for reinforcement with a pivot, for 6 situations it was decided to use a DCR made in the dental laboratory and for 91 of the cases (16.1%) it was considered that reinforcement is not necessary.

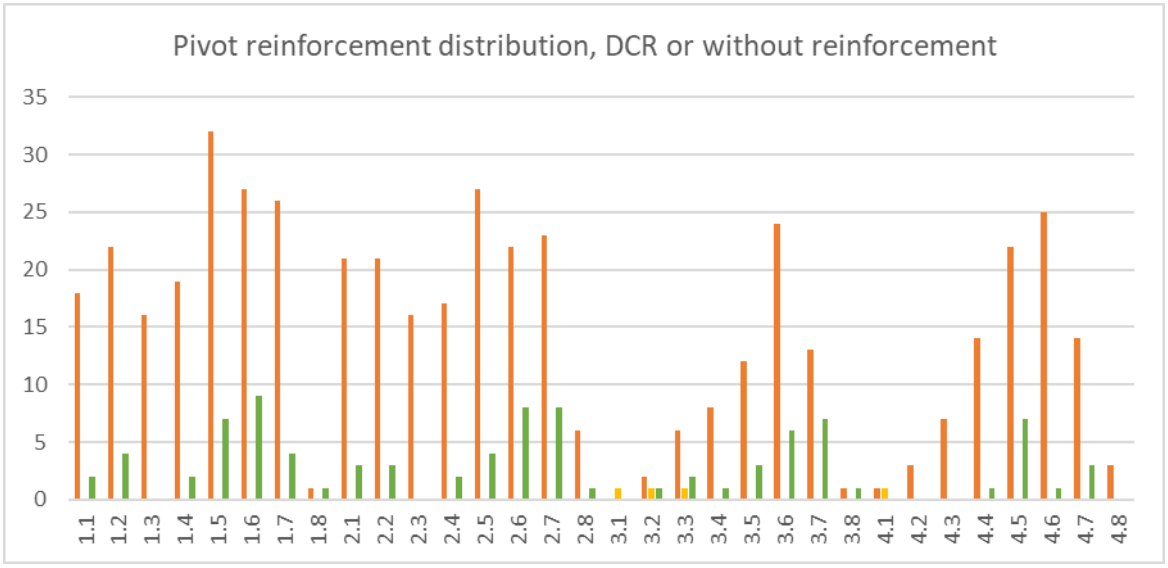



Figure 5. Pivot reinforcement distribution ■, DCR reinforcement ■ or without reinforcement ■

After the endodontic treatment, 427 of the treated teeth were chosen for coronal reconstruction and 139 for direct reconstruction. I summarized in table no. 1 the types of reconstruction chosen by doctors as well as the failure rates measured at intervals of 6 months, 1 year and 2 years respectively after the treatment.

Table 1. Distribution of failure rates of endodontic treatments between direct and coronary reconstruction

| | Direct reconstruction | | | Coronary reconstruction | | | Total cases | | |
|---|---|---|---|---|---|---|---|---|---|
| | Per primam | Retreat-ment | Total | Per primam | Retreat-ment | Total | Per primam | Retreat-ment | Total |
| **Number of cases** | 81 | 58 | 139 | 222 | 205 | 427 | 303 | 263 | 566 |
| **6-month failure** | 2 | 1 | 3 | 0 | 0 | 0 | 2 | 1 | 3 |
| | 2,47% | 1,72% | 2,16% | - | - | - | 0,66% | 0,38% | 0,53% |
| **1 year failure** | 2 | 1 | 3 | 2 | 1 | 3 | 4 | 3 | 7 |
| | 2,47% | 1,72% | 2,16% | 0,90% | 0,49% | 0,70% | 1,32% | 1,14% | 1,24% |
| **2 years failure** | 1 | 1 | 1 | 4 | 2 | 6 | 5 | 2 | 7 |
| | 1,23% | 1,72% | 1,44% | 1,80% | 0,98% | 1,41% | 1,65% | 0,76% | 1,24% |
| **Failure - total** | 5 | 3 | 8 | 6 | 3 | 9 | 11 | 6 | 17 |
| | 6,17% | 5,17% | 5,76% | 2,70% | 1,46% | 2,11% | 3,63% | 2,28% | 3,00% |

Analyzing the data obtained, we can state that the direct reconstruction of the endodontically treated tooth has a failure rate of more than 2.5 times higher compared to an endodontic treatment followed by a coronal reconstruction. Also, in situations of retreatment of the tooth, the failure rate of a direct reconstruction is even 3.5 times higher than that of the coronal reconstruction. Another conclusion that can be drawn from the measurements made is that using the coronal reconstruction the failure of the endodontic treatment is significantly delayed, of the 2.11% cases of failure none were registered in the first 6 months and only 0.7% in the first year after endodontic treatment. We present in the graph in figure 6 the evolution of failure rates over time.

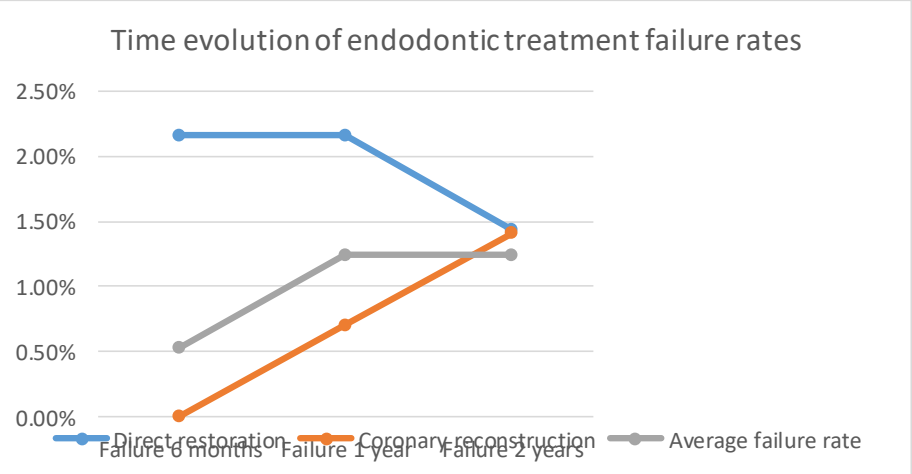



Figure 6. Time evolution of endodontic treatment failure rates

From the total number of 427 cases for which the coronal reconstruction of the endodontically treated tooth was chosen, inlay/onlay/overlay was chosen for 64 of the cases, for 174 the coronal restoration took the form of a composite or ceramic construction on a metal support, for 2 cases opted for a temporary skin-type reconstruction and 187 of the patients received an all-ceramic or zirconium-supported reconstruction. We present in the graph in figure 7 the percentages of the coronary reconstruction variants adopted.

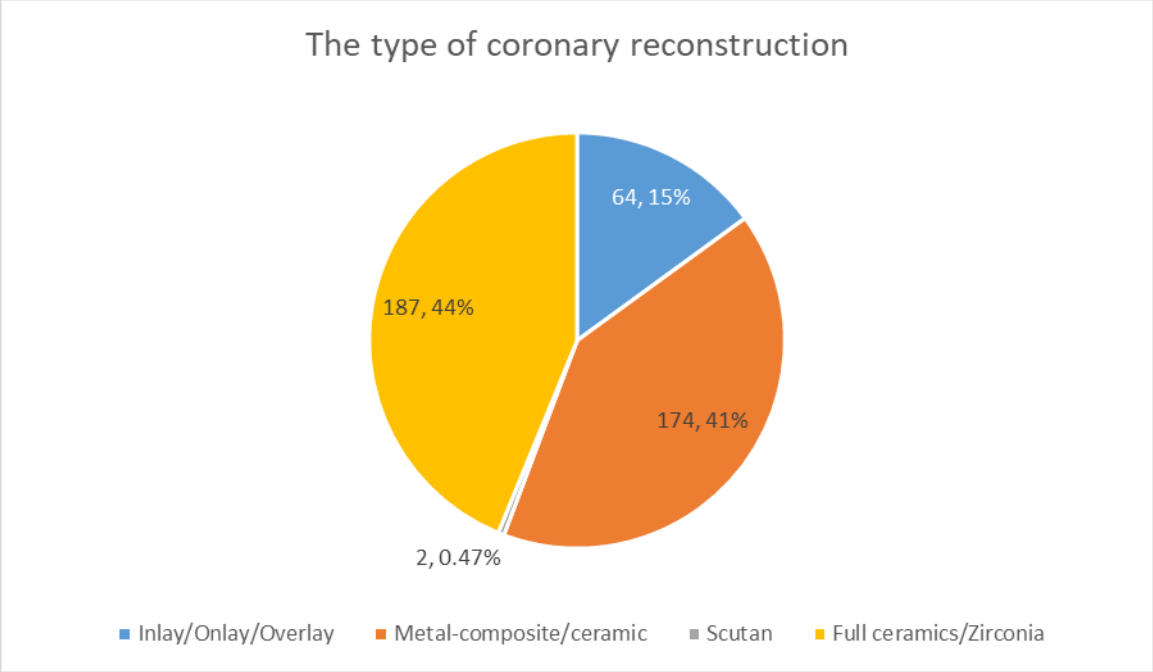



Figure 7. The type of coronary reconstruction opted for

In table no. 2 we present a distribution of the failure rates of endodontic treatments recorded according to the type of coronary reconstruction chosen, followed over time at intervals of 6 months, 1 year and 2 years respectively. It should be noted that the inlay, onlay or overlay reconstructions had a 0% failure rate and the SCUTAN ones, even if they were used less, a 100% failure rate 2 years after implementation. It can also be observed that all-ceramic or zirconium crown restorations have a much higher success rate than metal-ceramic ones, mainly due to a much more precise closure at the level of the tooth.

Table 2. Distribution of failure rates of endodontic treatments among different types of coronary reconstruction

| | **Inlay/Onlay / Overlay** | | | **Metal-composite/ceramic** | | | **Full ceramic** | | | **Scutan** | | | **Total cases** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Per primam | Retreatment | Total | Per primam | Retreatment | Total | Per primam | Retreatment | Total | Per primam | Retreatment | Total | Per primam | Retreatment | Total |
| **Number of cases** | 42 | 22 | 64 | 84 | 90 | 174 | 88 | 99 | 187 | 2 | 0 | 2 | 222 | 205 | 427 |
| **6-month failure** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **1 year failure** | - | - | - | 1 | 1 | 2 | - | - | - | 1 | 0 | 1 | 2 | 1 | 3 |
| | - | - | - | 1,19% | 1,11% | 1,15% | - | - | - | 50% | - | 50% | 0,90% | 0,49% | 0,70% |
| **2 years failure** | - | - | - | 3 | 2 | 5 | 1 | - | - | 1 | - | 1 | 4 | 2 | 6 |
| | - | - | - | 3,57% | 2,22% | 2,87% | 1,14% | - | - | 50% | - | 50% | 1,80% | 0,98% | 1,41% |
| **Failure - total** | - | - | - | 4 | 3 | 7 | 1 | - | - | 2 | - | 2 | 6 | 3 | 9 |
| | - | - | - | 4,76% | 3,33% | 4,02% | 1,14% | - | - | 100% | - | 100% | 2,70% | 1,46% | 2,11% |

## RESULTS

After carrying out this study, we were able to observe the fact that most of the situations related to endodontic treatments were registered at the level of the lateral teeth (413 out of 566; 73%) and of these the 2nd premolars and 1st molars have the largest share (237

teeth; 42% of total teeth and 57% of lateral teeth). Of the 566 treated teeth, 263 (46.5%) represent retreatments and 303 per primam treatments (53.5%), which underlines the fact that most endodontic treatments have a high success rate, even if to strengthen this conclusion, more research or even repetition of the present study is needed.

For 469 teeth (82.9%) the doctor opted for reinforcement with a pivot directly in the dental office, for only 6 cases it was decided to use a DCR made in the dental laboratory and for 91 of the cases (16.1%) it was considered that no reinforcement is required. We believe that the reinforcement of devital teeth with pivots is of increased importance, in order to restore their strength lost following endodontic treatment.

After the endodontic treatment, for 427 (75.44%) of the treated teeth, coronal reconstruction was chosen and only for 139, direct reconstruction was chosen. Due to the evolution of science and technology, in the last decade a multitude of techniques, materials and medical equipment have appeared, which makes the reconstruction of devital teeth an essential and common operation in dental practice, almost all patients resorting to it, thanks to the various solutions to who can opt to solve their problems.

Based on the analyzed data, it can be stated that the direct reconstruction of an endodontically treated tooth has a probability of failure more than 2.5 times higher compared to endodontic treatment followed by a coronal reconstruction. In retreatment scenarios, the failure rate for direct reconstructions is as much as 3.5 times higher than for coronary reconstructions. Data also suggest that the use of coronal reconstruction considerably delays endodontic treatment failure; of the 2.11% failure cases observed, none occurred within the first 6 months, and only 0.7% were reported within the first year after endodontic treatment.

If we have sufficient dental structure, which is also healthy, we prefer reconstruction by means of inlays, onlays or overlays, based on the principle of minimally invasive dentistry, the failure rate in their case being 0% in the range analyzed. At the same time, modern materials such as full-ceramic or zirconium crowns are preferable to metal-ceramic or metal-composite ones, having a much higher success rate. Regardless of the type of coronal reconstruction chosen, it is a much better option to cover the endodontically treated tooth than that of the direct restoration.

## DISCUSSIONS

Coronal reconstruction after endodontic treatment is a critical aspect in dentistry, directly influencing the long-term success and functionality of the treated tooth. There are several important discussions in the literature and in clinical practice regarding this procedure, including materials used, timing of reconstruction, and application techniques.

After an endodontic treatment, the tooth becomes more fragile due to the loss of natural tooth structure and dehydration. Coronal reconstruction provides structural support, preventing fractures that are common in untreated teeth afterward. An adequate coronal reconstruction completely seals the root canal, preventing the entry of bacteria and other pathogens, which can lead to endodontic treatment failure through reinfection [7].

Dental crowns are considered the "gold standard" for post-endodontic protection, providing complete coverage of the tooth and distributing bite forces evenly. Materials used may include ceramic, porcelain fused to metal, and all-ceramic crowns, each with advantages and disadvantages in terms of aesthetics and durability [8].

For cases where the structural loss is not that severe, these partial restorations may be enough to restore function and protect the tooth. Composites are frequently used for temporary coronal reconstructions or in cases where extensive protection is not required and are preferred due to their superior esthetics [9,10].

Some studies suggest that coronary reconstruction should be performed as soon as possible after endodontic treatment to reduce the risk of fracture and reinfection. The ideal recommended time is generally a few days to a few weeks after endodontic treatment is completed. Other approaches allow for a delay if there are signs of complications, such as persistent pain or infection. These cases may require further monitoring before definitive reconstruction [11,12].

Posterior teeth (molars) are subjected to greater occlusal forces, requiring additional protection, usually by full crowns. The anterior teeth, being more visible and under lower forces, may require more aesthetic and conservative restorations. Teeth with extensive loss of tooth structure are more susceptible to fracture and would benefit from crowns or onlays. Teeth with minimal loss can be reconstructed with composites. The presence of other dental or periodontal conditions may influence the decision to reconstruct. For example, in patients with active periodontal disease, it may be necessary to manage this condition before coronary reconstruction [13].

In teeth with massive loss of tooth structure, the use of posts can provide additional support for crowns. However, there is debate about their necessity and the risk of root fracture associated with their excessive use. The choice of canal obturation materials and how they interact with coronary restorative materials is an evolving topic, with research continuing to evaluate the biocompatibility and durability of various combinations [14].

Coronal reconstruction after endodontic treatment is essential for the long-term success of the treatment. The choice of appropriate materials and techniques must be based on the individual assessment of each case, considering the protection of the tooth structure, the prevention of reinfection and the restoration of function and aesthetics. Continued discussions and research in this area help to refine and improve treatment protocols, thus ensuring the best possible care for patients [15].

## CONCLUSIONS

Coronal reconstruction after endodontic treatment offers numerous benefits that contribute to the long-term success of the treated tooth. First, it provides structural support and additional protection to the endodontically treated tooth, preventing fractures and further damage. This is especially important because teeth become more fragile and more susceptible to fracture after the loss of the pulp and a significant part of the tooth structure.

Coronal reconstruction completely seals the tooth and prevents bacteria and other pathogens from entering the treated root canal. Thus, the risk of reinfection is reduced, and the long-term prognosis of endodontic treatment is improved. Also, through coronal reconstruction, the tooth regains its normal functionality in chewing and speaking, allowing the patient to use the tooth effectively and without discomfort. This contributes to maintaining a balanced occlusion and preventing functional problems in the temporomandibular joint.

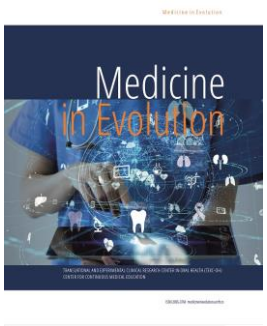
The dental crown restores the natural appearance of the tooth, providing a satisfactory aesthetic result. This is important not only for the patient's psychological comfort, but also for ensuring the integrity of the smile and facial expression.

Studies show that teeth treated endodontically and protected with adequate crown reconstruction have a significantly higher survival rate compared to untreated ones. Coronal reconstruction is essential in treatment planning and to ensure long-term clinical, functional and esthetic success, providing fracture protection, preventing reinfection and restoring tooth function and aesthetics.

## REFERENCES


1. Pratt I, Aminoshariae A, Montagnese T, Williams KA, Khalighinejad N, Mickel A. Eight-year retrospective study of the critical time lapse between root canal completion and crown placement: Its influence on the survival of endodontically treated teeth. J Endod. 2016;42(11):1598-1603. doi: 10.1016/j.joen.2016.07.018
2. Gillen BM, Looney SW, Gu LS, Loushine BA, Weller RN, Loushine RJ, et al. Impact of the quality of coronal restoration versus the quality of root canal fillings on success of root canal treatment: a systematic review and meta-analysis. J Endod. 2011;37(7):895-902. doi: 10.1016/j.joen.2011.04.002.
3. Ng YL, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of non-surgical root canal treatment: part 1: periapical health. Int Endod J. 2011;44(7):583-609. doi: 10.1111/j.1365-2591.2011.01872.x
4. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature - part 2. Influence of clinical factors. Int Endod J. 2008;41(1):6-31. doi: 10.1111/j.1365-2591.2007.01323.x.
5. De Oliveira JA, Pereira JR, Lins do ValleA, Zogheib LV, (2008), Fracture resistance of endodontically treated teeth with different heights of crown ferrule restorated with prefabricated carbon fiber posts and composite resin core by intermittent loading. 2008; 106:52-70
6. Al-HaszaimehN, Gutteridge DL. (2001),An in vitro study into the effect of the ferrule preparation on the fracture resistance of crowned teeth incorporating prefabricated post and composite core restorations. Int Endod J 2001;34:40-6
7. Aquilino SA, Caplan DJ. Relationship between crown placement and the survival of endodontically treated teeth. J Prosthet Dent. 2002;87(3):256-63. doi: 10.1067/mpr.2002.122014.
8. Nagendrababu V, Duncan HF, Bjørndal L, Kvist T, Priya E, Jayaraman J, et al. Preferred Reporting Items for RCTs in Endodontics 2020 guidelines: explanation and elaboration. Int Endod J. 2020;53(6):761-803
9. Bitter K, Kielbassa AM. Post-endodontic restorations with adhesively luted fiber-reinforced composite post systems: a review. Am J Dent. 2007;20(6):353-60
10. GJ, Mount. and WR, Hume. (1999). Conservarea şi restaurarea structurii dentare. Bucureşti: Editura All Education
11. C, Zhi. and C, Binwen. (2015). Decision-making of restorations for endodontically treated teeth. Pubmed, Apr;33(2), pp.115-20.
12. AM, Ibrahim., LC, Richards. and TL, Berekally.(2016).Effect of remaining tooth structure on the fracture resistance of endodontically-treated maxillary premolars:An in vitro study. J Prosthet Dent, Mar;115(3),pp.290-5
13. McCracken MS., Louis DR., Litaker MS., (2016). Treatment recommendations for single-unit crowns: Findings from The National Dental Practice-Based Research Network. J Am Dent Assoc., 2016 Nov;147(11), pp.882-890
14. Monaco C., Arena A., Scotti R., Krejci I., (2016). Fracture Strength of Endodontically Treated Teeth Restored with Composite Overlays with and without Glass-fiber Reinforcement. J Adhes Dent, 2016;18(2), pp.143-9
15. McReynolds D., Duane B (2016). Insufficient evidence on whether to restore root-filled teeth with single crowns or routine fillings. Evid Based Dent., 2016 Jun;17(2), pp.50-1

# Parental awareness and attitudes towards children's bad oral habits in Oradea, Romania

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## Abstract

Aim and Objectives: This study aimed to investigate the knowledge and attitudes of parents in Oradea, Romania, regarding common bad oral habits among children, which are critical for dentofacial development. Material and Methods: A cross-sectional study was conducted using an online questionnaire distributed via Google Forms, comprising 20 items across three sections: socio-demographic data, presence of bad oral habits, and parental attitudes. The study included parents or guardians of children under 18. Results: Out of 121 respondents, 82.6% were female, and the majority were aged 18-30 years. Most parents (74%) were aware of the negative effects of bad oral habits, but uncertainties remained, particularly regarding habits like thumb sucking (36%) and nail biting (42%). Furthermore, 45% of all parents lacked knowledge about the appropriate age to intervene, and 52% were unsure about effective methods to discourage these habits. This indicates a need for targeted information and support strategies. Conclusions: The findings highlight the need for enhanced parental education on the impact of bad oral habits on children's dentofacial development. Targeted educational initiatives and early interventions are crucial.

**Keywords:** bad oral habits, parental knowledge, dentofacial development

## INTRODUCTION

Malocclusions are defined as any irregular relationship between the dental arches, with or without accompanying changes at the dental level. They are regarded as developmental disorders and represent a significant oral public health issue [1]. Malocclusions can manifest in several ways: vertically (e.g., deep bite, open bite), transversely (e.g., crossbite), and sagittally (e.g., Class II and III malocclusions) [2]. Despite various classification systems, Angle's classification remains the most widely used [3]. This classification encompasses three categories: Class I, characterized by a neutral relationship of the permanent first molars; Class II, marked by distalization of the permanent first molars; and Class III, where the permanent first molars are mesialized [4]. Specialized treatment is essential for malocclusions [5], as untreated malocclusions can significantly impact the quality of life for children and their families [6].

The etiology of malocclusions is multifaceted and not fully understood. However, hereditary factors, unknown developmental causes, trauma, physical agents, bad oral habits, and various local or systemic diseases play crucial roles in their development [7]. Bad oral habits can adversely affect the development of the jawbones and teeth [8]. Common bad oral habits observed in children and adolescents include mouth breathing, thumb sucking, tongue thrusting, and nail biting [9].

Mouth breathing, which frequently results from upper airway obstruction, is highly prevalent among pediatric patients [10]. Thumb sucking, akin to pacifier use or sucking other fingers, serves as a source of stimulation and self-soothing [11]. Tongue thrusting refers to a swallowing pattern where the tongue is positioned on or between the teeth, with higher prevalence in early childhood and between 5% and 15% in adolescents and adults [12,13]. Nail biting, a habit exacerbated by nervousness, stress, hunger, boredom, or anxiety, can also contribute to the development of malocclusions [14]. If left untreated, these harmful habits can worsen or initiate malocclusions, leading to increased overjet, reduced overbite, posterior crossbite, and increased facial height, among other issues [10-14].

Early intervention is critical when dentofacial changes or adverse general effects begin to appear, or when there are indications that an oral habit may negatively impact the permanent dentition [15]. Treatment options may include myofunctional trainers, removable orthodontic appliances [15], and fixed orthodontic appliances [16]. In some cases, such as with mouth breathing, consultation with an otolaryngologist is recommended prior to starting myofunctional or orthodontic therapy [8]. Psychosocial interventions may also be beneficial for habits such as thumb sucking and nail biting [17].

### *Aim and objectives*

In Romania, there is a paucity of studies examining parental knowledge and attitudes towards children's bad oral habits. Given the importance of early intervention for preventing adverse effects on dentofacial development, this study aims to investigate the knowledge and attitudes of parents in Oradea, Romania, regarding common bad oral habits among the pediatric population.

## MATERIAL AND METHODS

The cross-sectional study employed an online questionnaire distributed via the Google Forms platform. The questionnaire consisted of 20 items, organized into three distinct sections.

Section 1 comprised the first 7 questions (items 1 to 7), which aimed to gather socio-demographic information from the respondents. The variables assessed included:

- Gender: Female, Male
- Age category: 18-30 years, 31-40 years, over 40 years
- Ethnicity: Romanian, Hungarian, Roma, Other
- Civil status: Single, Married, Divorced, Widowed
- Living environment: Urban, Rural
- Highest level of education completed: Gymnasium, High School, Faculty, Master's, Doctorate
- Number of children: 1, 2, 3, 4 or more.

Section 2 contained 7 questions (items 8 to 14) focused on identifying the presence of bad oral habits and parafunctions as reported by the parents. The response options for these questions were: "Yes," "No," and "I don't know."

Section 3 included 6 questions (items 15 to 20) that explored parents' attitudes towards specific bad oral habits in children. These questions utilized a Likert scale with the following response options: "Strongly agree," "Agree," "I don't know," "Disagree," and "Strongly disagree."

The questionnaire was accessible from April 19, 2022, to May 19, 2022. Prior to accessing the questionnaire, respondents were informed that participation was voluntary and anonymous. The respondents were parents or guardians of children and adolescents under the age of 18.

Descriptive statistics were performed using Microsoft Office Excel 2013 and Microsoft Office Word 2013 (Microsoft, Redmond, WA, USA). The specific questions included in the questionnaire are detailed in Table I.

Table I. Items

| | | |
|---|---|---|
| **Socio-demographic aspects** | 1. | Gender |
| | 2. | Age |
| | 3. | Ethnicity |
| | 4. | Marital status |
| | 5. | Living environment |
| | 6. | Level of education |
| | 7. | Number of children |
| **Bad oral habits in children and adolescents** | 8. | My child used to breathe/breathes only through their mouth. |
| | 9. | My child used to sometimes breathe/breathes through their mouth, sometimes through their nose. |
| | 10. | My child used to grind/grinds their teeth while sleeping. |
| | 11. | My child used to place/places their tongue between their teeth when swallowing. |
| | 12. | My child used to bite/bites their nails. |
| | 13. | My child used to use/uses a pacifier. |
| | 14. | My child used to suck/sucks their thumb. |
| **The attitude of parents towards bad oral habits and parafunctions** | 15. | I believe that oral breathing can cause dental issues, as well as problems with the facial structure. |
| | 16. | I believe that teeth grinding can cause dental issues, as well as problems with the facial structure. |
| | 17. | I believe that swallowing with the tongue between the teeth can cause dental issues, as well as problems with the facial structure. |
| | 18. | I believe that onychophagia (nail-biting) can cause dental issues, as well as problems with the facial structure. |
| | 19. | I believe that using a pacifier can cause dental issues, as well as problems with the facial structure. |
| | 20. | I believe that thumb sucking can cause dental issues, as well as problems with the facial structure. |

The study was conducted in accordance with the Declaration of Helsinki (1964) and its subsequent amendments. All parents, guardians, and participants provided informed consent prior to their involvement in the study.

## RESULTS

Socio-Demographic Characteristics

A total of 121 individuals completed the questionnaire. The majority of respondents were female (82.6%, n=100). The predominant age group was 18-30 years (40.5%, n=49). Most participants identified as Romanian (93.4%, n=113), were married (25.6%, n=81), and resided in an urban environment (76%, n=92). Additionally, 41.7% (n=51) of the respondents reported having completed higher education, and the majority had only one child (50.9%, n=62). Socio-demographic details of the study population are summarized in Table II.

Table II. Socio-demographic characteristics

| Items | Answers | No. | Percentage |
|---|---|---|---|
| ***Gender*** | Female | 100 | 82.6% |
| | Male | 21 | 17.4% |
| ***Age*** | 18-30 years | 49 | 40.5% |
| | 31-40 years | 48 | 39.7% |
| | Over 40 years | 24 | 19.8% |
| ***Ethnicity*** | Romanian | 113 | 93.4% |
| | Hungarian | 8 | 6.6% |
| | Roma | 0 | 0% |
| ***Marital status*** | Married | 81 | 66.9% |
| | Not married | 31 | 25.6% |
| | Divorced | 8 | 6.6% |
| | Widow | 1 | 0.9% |
| ***Living environment*** | Urban | 92 | 76% |
| | Rural | 29 | 24% |
| ***Level of education*** | Gymnasium | 1 | 0.5% |
| | High School | 34 | 28.3% |
| | Faculty | 51 | 41.7% |
| | Master's | 31 | 25.8% |
| | Doctorate | 4 | 3.7% |
| ***Number of children*** | 1 | 62 | 50.9% |
| | 2 | 53 | 43.8% |
| | 3 | 5 | 4.3% |
| | 4 or more | 1 | 1% |

### Presence of bad oral habits

Items 8 and 9 of the questionnaire assessed the type of breathing in children. The majority of parents reported that their children did not exclusively breathe through the mouth (82.7%, *n*=100). However, a significant portion of parents observed that their children exhibited a mixed breathing pattern (66.1%, *n*=80) (Figures 1 and 2).

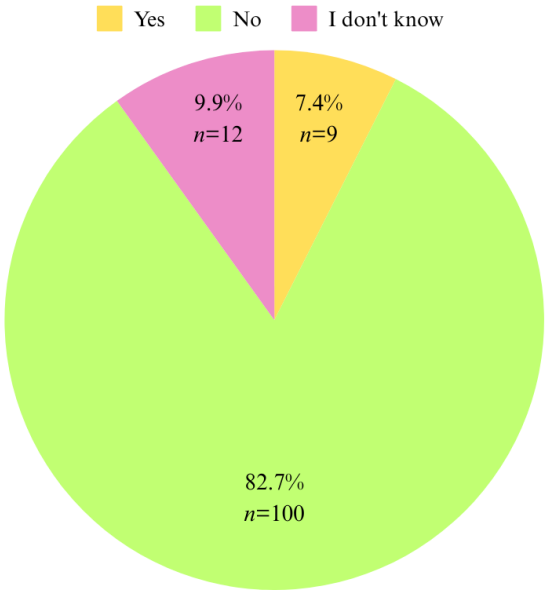


Figure 1. Answers for Item 8

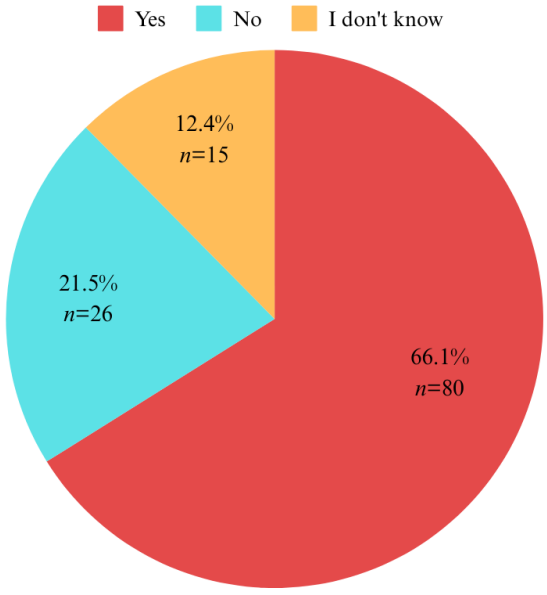


Figure 2. Answers for Item 9

Items 10, 11, and 12 of the questionnaire investigated the presence of bad oral habits such as teeth grinding, tongue thrusting, and nail biting. The data presented in Table III reveal that most children were not reported to grind their teeth during sleep (65.5%, *n*=79). However, nearly a quarter of the children (21.2%, *n*=26) were reported to exhibit this habit. With respect to tongue thrusting, while the majority of parents reported that their children did not place their tongue on or between their teeth during swallowing (61.4%, *n*=74), approximately one-third of parents were uncertain about recognizing this habit (30.7%, *n*=37). Concerning onychophagia, a quarter of the respondents (25.4%, *n*=31) identified this habit in their children.

Table III. Answers for Items 10,11 and 12

| | **Item 10** | | **Item 11** | | **Item 12** | |
|---|---|---|---|---|---|---|
| **Answers** | No. | % | No. | % | No. | % |
| Yes | 26 | 21.2% | 10 | 7.9% | 31 | 25.4% |
| No | 79 | 65.5% | 74 | 61.4% | 85 | 70.2% |
| I don't know | 16 | 13.3% | 37 | 30.7% | 5 | 4.4% |

Items 13 and 14 investigated the use of pacifiers and the habit of thumb sucking. Figure 3 presents the responses regarding pacifier use (Item 13). Nearly a quarter of the respondents reported that their children currently use or have used a pacifier (24.8%, *n*=30). Additionally, Figure 3 illustrates the responses concerning thumb sucking (Item 14). The majority of respondents did not observe this habit in their children (81.6%, *n*=99).

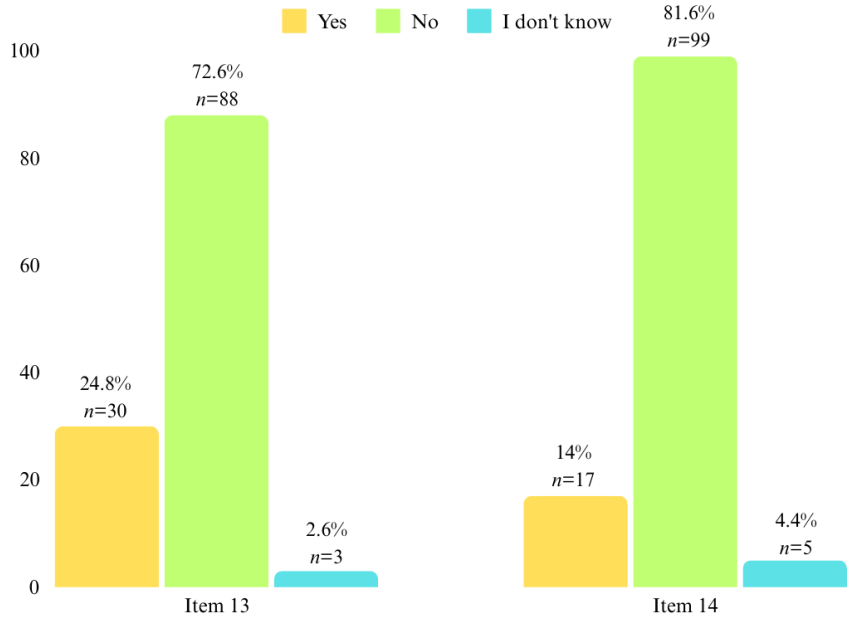


Figure 3. Answers for Items 13 and 14

**Attitude of parents towards bad oral habits**

Regarding the respondents' attitudes and knowledge about the impact of oral breathing on dentofacial development (Item 15), it was found that a significant portion of participants (37.8%, *n*=46) were unsure whether oral breathing could lead to changes in dental and facial structures. Conversely, a substantial number of respondents (30.3%, *n*=37) strongly agreed that this habit could indeed result in such changes (Figure 4).

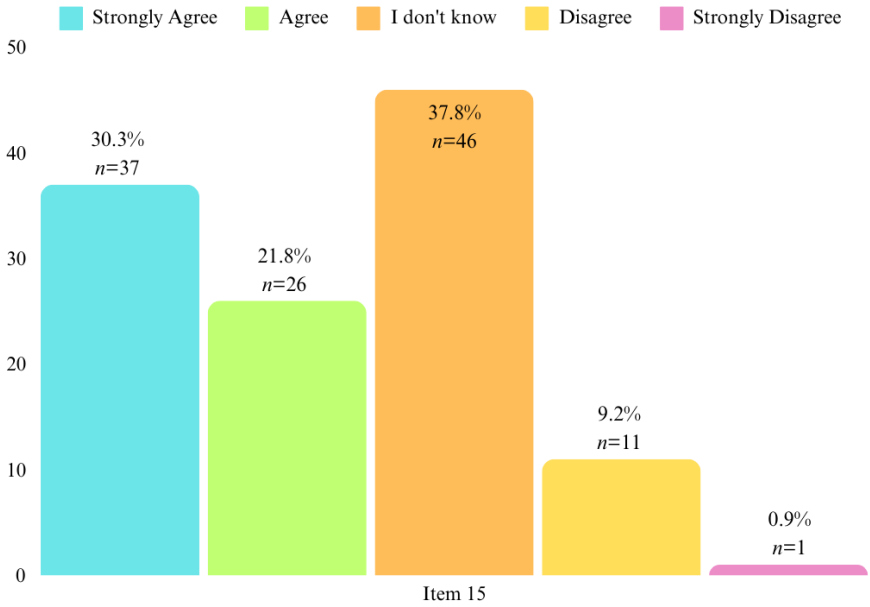


Figure 4. Answers for Item 15

According to Table IV, the majority of respondents (48.3%, *n*=58) agreed that teeth grinding can lead to changes in dental and facial structures. However, regarding the interposition of the tongue between the teeth during swallowing, most respondents (54.2%,

*n*=66) indicated uncertainty about its potential effects. For items 18 and 19, most participants agreed that onychophagia (34.5%, *n*=42) and pacifier use (42.5%, *n*=52) could cause alterations in the teeth and facial structures.

Table IV. Answers for Items 16,17,18 and 19

| | Item 16 | | Item 17 | | Item 18 | | Item 19 | |
|---|---|---|---|---|---|---|---|---|
| **Answers** | No. | % | No. | % | No. | % | No. | % |
| Strongly Agree | 38 | 31.7% | 27 | 22.5% | 32 | 26.9% | 38 | 31.7% |
| Agree | 58 | 48.3% | 24 | 20% | 42 | 34.5% | 52 | 42.5% |
| I don't know | 19 | 15.8% | 66 | 54.2% | 34 | 27.7% | 19 | 15.8% |
| Disagree | 4 | 3% | 4 | 3.7% | 13 | 10.9% | 12 | 10% |
| Strongly Disagree | 2 | 1.2% | 0 | 0% | 0 | 0% | 0 | 0% |

Regarding thumb sucking, the majority of respondents either strongly agreed (31.7%, n=39) or agreed (45.8%, n=55) that this habit can negatively impact dentofacial development (see Figure 5).

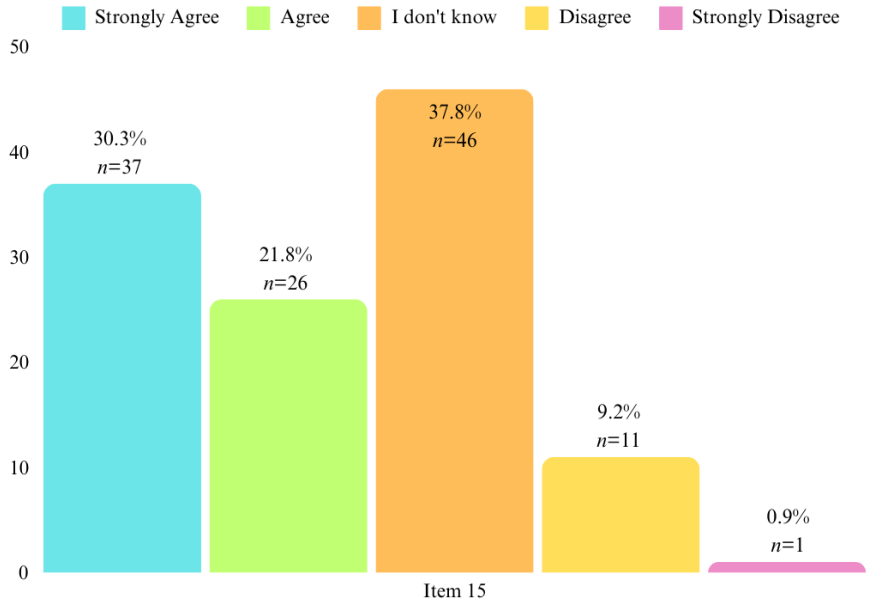


Figure 5. Answers for Item 20

## DISCUSSIONS

The aim of this study was to identify bad oral habits in children and to assess parental attitudes and knowledge regarding the effects of these habits. The research was conducted using questionnaires, which are an effective method for data collection from participants [18]. Questionnaires can be administered online [19], in a combined online and paper format [20], or exclusively on paper [21]. We chose the online method to maximize respondent reach and data collection efficiency.

Malocclusions can significantly affect a child's psychological well-being, making their treatment and the elimination of factors contributing to the anomaly crucial. Damage to dento-facial aesthetics, self-perception, and social relationships are primary motivations for parents seeking orthodontic care for their children [22]. Enhancing facial aesthetics often encourages compliance with orthodontic treatment, which has been shown to benefit children and adolescents [23, 24].

Oral breathing, which can occur due to airway obstructions, varies in incidence from 5% to 75% according to some studies [25]. This condition can adversely affect craniofacial development, making early detection essential [26]. Despite the potential harm, 66.4% of respondents reported that their children's breathing is not exclusively nasal, but mixed. Furthermore, less than one-third of respondents were aware that mouth breathing can lead to structural changes.

Among the less frequently identified oral habits were onychophagia, pacifier use, and thumb sucking. Onychophagia, which affects 20-30% of the population regardless of age, can lead to psychosocial issues and adverse effects on oral health [27]. While pacifier use can have analgesic benefits and may reduce the risk of sudden infant death syndrome, prolonged use beyond two years can result in malocclusions [28]. Thumb sucking, if persistent beyond the age of four and during the eruption of permanent teeth, often causes significant dento-maxillary anomalies [29]. Most respondents acknowledged that onychophagia, pacifier use, and thumb sucking can negatively impact dento-maxillary structures.

Tongue thrusting is a common myofunctional issue in the pediatric population [30]. We aimed to assess parental awareness regarding this parafunctional habit. Most respondents were unsure whether tongue thrusting, which involves interposing the tongue between the teeth, could have detrimental effects on the dento-maxillary apparatus.

The responses highlight the need for increased parental education regarding bad oral habits and parafunctional behaviors. Emphasis should be placed on the importance of regular dental visits to facilitate the early detection and management of these issues. Early diagnosis is crucial for preventing the development of dento-maxillary anomalies.

This study faced several limitations that may impact the interpretation and generalizability of the findings. Firstly, the use of an online questionnaire may have introduced selection bias, excluding parents without internet access or those less familiar with digital technology, potentially affecting the diversity of the sample. Additionally, the varying levels of awareness and knowledge among parents about malocclusions and bad oral habits could have influenced the accuracy of their responses. The questionnaire itself, while structured to gather specific information, may not have fully captured the complexity and diversity of bad oral habits and their effects, and different interpretations of the questions by respondents might have affected the consistency of the data. Furthermore, although the study included a substantial number of respondents, it is unclear whether the sample is representative of the entire parent population in Oradea, Romania, which could limit the generalizability of the results. These limitations suggest that the results should be interpreted with caution and highlight the need for future research to address these issues for a more comprehensive understanding of parental awareness and attitudes regarding children's harmful habits.

## CONCLUSIONS

In summary, this study highlights the need for improved parental education regarding the impact of bad oral habits on dentofacial development. While there is a general awareness of the negative effects of some habits, uncertainty remains about others. Addressing these knowledge gaps through targeted educational initiatives and early intervention strategies is crucial for preventing and managing dentofacial anomalies in children. Early diagnosis and informed management of bad oral habits can significantly enhance the effectiveness of orthodontic treatments and improve overall dental health outcomes.

## REFERENCES


1. Devi LB, Keisam A, Singh HP. Malocclusion and occlusal traits among dental and nursing students of Seven North-East states of India. J Oral Biol Craniofac Res. 2022; 12(1):86-89.
2. Saghiri MA, Eid J, Tang CK, Freag P. Factors influencing different types of malocclusion and arch form-A review. J Stomatol Oral Maxillofac Surg. 2021; 122(2):185-191.
3. Alhazmi A, Alshehri M, Alrefai A, Alattas O, Arif F, Hakami S, Dowiry R. Assessment of Severity of Malocclusion and Orthodontic Treatment Need Using the Dental Esthetic Index and Angle's Classification: A Retrospective Study. J Contemp Dent Pract. 2021; 22(10):1167-1170.
4. Angle EH. Treatment of Malocclusion of the Teeth; SSW: Philadelphia, PA, USA, 1907.
5. Bilgic F, Gelgor IE, Celebi AA. Malocclusion prevalence and orthodontic treatment need in central Anatolian adolescents compared to European and other nations` adolescents, Dental Press J Orthod. 2015; 20(6):75-81.
6. Silva LF, Thomaz EB, Freitas HV, Pereira AL, Ribeiro CC, Alves CM. Impact of Malocclusion on the Quality of Life of Brazilian Adolescents: A Population-Based Study. PLoS One. 2016; 11(9):e0162715.
7. Rapeepattana S, Thearmontree A, Suntornlohanakul S. Etiology of Malocclusion and Dominant Orthodontic Problems in Mixed Dentition: A Cross-sectional Study in a Group of Thai Children Aged 8-9 Years. J Int Soc Prev Community Dent. 2019; 9(4):383-389.
8. Grippaudo C, Paolantonio EG, Antonini G, Saulle R, La Torre G, Deli R. Association between oral habits, mouth breathing and malocclusion. Acta Otorhinolaryngol Ital. 2016; 36(5):386-394.
9. Joelijanto R. Oral habits that cause malocclusion problems. IDJ. 2012; 1(2).
10. Lin L, Zhao T, Qin D, Hua F, He H. The impact of mouth breathing on dentofacial development: A concise review. Front Public Health. 2022; 10:929165.
11. Ferrante A, Ferrante A. Il problema del succhiamento del dito. Nuove interpretazioni e implicazioni terapeutiche [Finger or thumb sucking. New interpretations and therapeutic implications]. Minerva Pediatr. 2015; 67(4):285-97.
12. Shah SS, Nankar MY, Bendgude VD, Shetty BR. Orofacial Myofunctional Therapy in Tongue Thrust Habit: A Narrative Review. Int J Clin Pediatr Dent. 2021; 14(2):298-303.
13. Garde JB, Suryavanshi RK, Jawale BA, Deshmukh V, Dadhe DP, Suryavanshi MK. An epidemiological study to know the prevalence of deleterious oral habits among 6 to 12 year old children. J Int Oral Health. 2014; 6(1):39-43.
14. Sachan A, Chaturvedi TP. Onychophagia (Nail biting), anxiety, and malocclusion. Indian J Dent Res. 2012; 23(5):680-2.
15. Majorana A, Bardellini E, Amadori F, Conti G, Polimeni A. Timetable for oral prevention in childhood--developing dentition and oral habits: a current opinion. Prog Orthod. 2015; 16:39.
16. Zhou C, Duan P, He H, Song J, Hu M, Liu Y, Liu Y, Guo J, Jin F, Cao Y, Jiang L, Ye Q, Zhu M, Jiang B, Ruan W, Yuan X, Li H, Zou R, Tian Y, Gao L, Shu R, Chen J, Liu R, Zou S, Li X. Expert consensus on pediatric orthodontic therapies of malocclusions in children. Int J Oral Sci. 2024; 16(1):32.
17. Woods DW, Houghton DC. Evidence-Based Psychosocial Treatments for Pediatric Body-Focused Repetitive Behavior Disorders. J Clin Child Adolesc Psychol. 2016; 45(3):227-40.
18. Cagetti MG, Cairoli JL, Senna A, Campus G. COVID-19 Outbreak in North Italy: An Overview on Dentistry. A Questionnaire Survey. Int J Environ Res Public Health. 2020; 17(11):3835.
19. Schmidt J, Waldova E, Balkova S, Suchanek J, Smucler R. Impact of COVID-19 on Czech Dentistry: A Nationwide Cross-Sectional Preliminary Study among Dentists in the Czech Republic. Int J Environ Res Public Health. 2021; 18(17):9121.
20. Habib MA, Dayyab FM, Iliyasu G, Habib AG. Knowledge, attitude and practice survey of COVID-19 pandemic in Northern Nigeria. PLoS ONE. 2021; 16:e0245176.
21. Mtaya M, Brudvik P, Astrøm AN. Prevalence of malocclusion and its relationship with socio-demographic factors, dental caries, and oral hygiene in 12- to 14-year-old Tanzanian schoolchildren. Eur J Orthod. 2009; 31(5):467-76.
22. Samsonyanová L, Broukal Z. A systematic review of individual motivational factors in orthodontic treatment: facial attractiveness as the main motivational factor in orthodontic treatment. Int J Dent. 2014; 2014:938274.

23. Pachêco-Pereira C, Pereira JR, Dick BD, Perez A, Flores-Mir C. Factors associated with patient and parent satisfaction after orthodontic treatment: a systematic review. Am J Orthod Dentofacial Orthop. 2015; 148(4):652-9.
24. Yassir YA, McIntyre GT, Bearn DR. The impact of labial fixed appliance orthodontic treatment on patient expectation, experience, and satisfaction: an overview of systematic reviews. Eur J Orthod. 2020; 42(3):223-230.
25. De Menezes VA, Leal RB, Pessoa RS, Pontes RM. Prevalence and factors related to mouth breathing in school children at the Santo Amaro project-Recife, 2005. Braz J Otorhinolaryngol. 2006; 72(3):394-9.
26. Musseau D. Mouth Breathing and Some of Its Consequences. Int J Orthod Milwaukee. 2016; 27(2):51-54.
27. Halteh P, Scher RK, Lipner SR. Onychophagia: A nail-biting conundrum for physicians. J Dermatolog Treat. 2017; 28(2):166-172.
28. Sexton S, Natale R. Risks and benefits of pacifiers. Am Fam Physician. 2009; 79(8):681-5.
29. Stricker JM, Miltenberger RG, Anderson CF, Tulloch HE, Deaver CM. A functional analysis of finger sucking in children. Behav Modif. 2002; 26(3):424-43
30. Maspero C, Prevedello C, Giannini L, Galbiati G, Farronato G. Atypical swallowing: a review. Minerva Stomatol. 2014; 63(6):217-27.

# Esthetics of the maxillary frontal group in dental prosthetics


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## Abstract

The esthetics of the maxillary front group is a crucial aspect in dental prosthetics, having a significant impact on the patient's smile and confidence. Modern prosthodontics offer various treatment options, including all-ceramic crowns, dental veneers, and dental bridges made of esthetically superior materials such as zirconia and feldspathic ceramics. The article highlights the importance of the multidisciplinary approach in the restoration of the maxillary frontal group, involving the collaboration between dentists, dental technicians and, in some cases, specialists in plastic surgery and orthodontics. Particular attention is paid to minimally invasive techniques, which allow the preservation of the natural tooth structure, while maintaining long-term aesthetics and functionality.

**Keywords:** interdisciplinary approach, fixed prosthesis, CAD/CAM technology, oral rehabilitation

## INTRODUCTION

For a complete and correct oral rehabilitation, all the functions of the dento-maxillary apparatus must be perfectly restored. In addition to the masticatory function, which is the most important for the patient, the phonation function plays an important role as well as the aesthetic function. In recent years, physiognomic function has received increased attention, both from doctors and patients who are increasingly concerned with how their teeth look or how they smile. The demands of dental aesthetics are increasing from patients, and the possibility of achieving the requirements is in full development, due to the acceleration of technology and the development of the dental materials industry [1].

The esthetics of the maxillary front group is a crucial aspect in dental prosthetics, having a significant impact on the patient's smile and confidence. This area is directly visible in social interactions, which is why prosthetic restorations in this region must meet strict aesthetic criteria in addition to optimal functionality. Modern prosthodontics offer various treatment options, including all-ceramic crowns, dental veneers, and dental bridges made of esthetically superior materials such as zirconia and feldspathic ceramics [2].

In order to achieve successful aesthetic results, a detailed analysis of the shape, color and alignment of the teeth, as well as the harmony between the dental restorations and the surrounding soft tissues, is essential. Advanced ceramic modeling and layering techniques, together with the use of CAD/CAM technologies, allow obtaining restorations that faithfully imitate the optical characteristics of natural teeth. Also, the integration of aesthetic principles, such as tooth proportions, symmetry and smile dynamics, play a crucial role in patient satisfaction [3].

The aesthetics of the maxillary frontal group in dental prosthetics is essential for the aesthetic and functional rehabilitation of patients. A combination of theoretical knowledge, clinical skills and the use of cutting-edge technologies can ensure optimal results that meet both the aesthetic and functional expectations of patients.

### *Purpose and objectives*

The aim of this study is to explore and analyze the factors that influence the aesthetics of dental restorations in the maxillary frontal group, considering the major importance of this region in smile perception and in patients' social interactions. Aesthetic dental restorations in this area must meet both aesthetic and functional criteria, given the complexity of the elements involved, including the shape, color, texture and alignments of the teeth, as well as their interaction with the surrounding soft tissues.

## DENTAL AESTHETICS – BASIC PRINCIPLES

The term *aesthetics* was introduced by Alexander Gottlieb Baumgarten in the work "Aesthetica" in 1750, it defines aesthetics as "*the science of sensory knowledge*". According to Baumgarten, sensory knowledge is differentiated from that of thinking by the objective opposition of logic and aesthetics. The first pursues the truth and the second the beautiful. The present is lived in a world where the personality and the examples chosen by man determine his clothing, behavioral and social life criteria. Many people want to modify their appearance to resemble their idol or strive for perfection. Society decides what should be considered beautiful. The desire to look good, or better, has become a true necessity, imposed by economic, social and sexual relationships [4].

The face is the most representative part of the body, and the lips are prominent formations, that's why the teeth, when exposed, attract attention in an obvious way. Facial

physiognomy recognizes three factors: dento-facial, dento-gingival and facial. The first two are of direct interest to the dentist. Every physician must know the psychological importance of the mouth. He must acquire the fundamental aspects of aesthetic treatment, as well as the problems they can raise or aggravate in the patient. Any dentist who performs changes in the appearance of the face must be aware of both the psychological and the purely physical consequences. Not only the consequences of the treatment must be considered, but also the reasons that lead the patient to undergo a treatment with an aesthetic background [5].

Personality, desires, motivation, self-esteem, expectations, the ability to accept the change and the desire to cooperate, are very important factors for the completion of the treatment to have a successful end. Conflicts can arise from the patient's unrealistic expectations, a different perception of beauty (the results from an aesthetic and technical point of view are correct), the patient has the expectation that through the dental treatment his psychological problems will diminish or even be solved, or the situation in which the patient he may be satisfied with the result, but his family and relatives are not. Very rare, but still encountered, is the situation where the patient does not want to improve his aesthetics, and only the dentist does. In this case the aesthetic appearance is only a defense mechanism, the patient has got used to it and it helps him.

The lips are a real help in evaluating the dentofacial structure and establishing a concept of the smile. The lips define the space that is separated by the arrangement of the teeth. For this reason, the lips require special aesthetic care from the dentist. By diminishing or accentuating the visible components of the teeth, harmony with the other components of the oral region can be obtained or destroyed. The main lip shapes are curved, straight, arched, elliptical, inverted and rectangular. Of these, curved, straight and elliptical shapes are found more often. By fullness, lips can be classified as medium, full and thin. The morphological aspects of the lip that must be considered are width, symmetry and fullness. In general terms, a smile that is at least half the width of the face at that level is considered aesthetic [6].

The smile line is established by the relationship between the gingival tissues, teeth and the position of the lower edge. The first authors, who published the notion of the smile line, were Frush and Fisher. Hulsey reported the smile line to the lower lip and revealed that it is quite an important factor influencing the aesthetics of the smile. From the point of view of the position of the upper lip, the smile line can be medium, low or high. The most difficult cases to restore prosthetics in the frontal area are those cases in which the patients have a high smile line, any mistake has a direct impact on the aesthetic area. If the smile line is high, more gum tissue is exposed. This situation is recognized in the specialized literature under the name of gummy smile [7,8,9].

The gingival contours must be symmetrical, the line of the parcels on the anterior teeth must be in an imaginary straight line from canine to canine. The bundle of the upper lateral incisors should be positioned below this line, by 1-2 mm, while the bundles of the central incisors, and of the canines, should be positioned approximately at the same level. Consistent with aesthetic parameters, the presence of a pale pink papilla plays an important role in the composition of the smile, even in the circumstance where it is exposed to a lesser extent [10].

The gingival zenith represents the highest point of the free gingival margin placed in the long axis of the tooth. The highest gingival zenith must be placed at the level of the maxillary canine. In the upper lateral incisors, the mandibular incisors, the zenith coincides most of the time with the longitudinal axis of the teeth. In the case of central and lateral incisors, the axis of inclination of the teeth is achieved by joining the highest point of the tooth bundle, with the middle of the incisal edge. A mesially inclined shaft is usually obtained. In canines and lateral teeth, the axis of inclination is established by joining the highest point of the tooth bundle with the tip of the cusp. In correspondence with the norms of ideal aesthetics, these axes are parallel to each other. They are also parallel to the axis formed by

connecting the external angle of the palpebral fissure with the buccal commissure. The long axis of the anterior maxillary teeth must necessarily follow a gradual inclination starting from the interincisive line, towards the distal. Within an aesthetic smile, the degree of axial inclination varies, depending on different groups of teeth. Starting from the upper central incisors, as we move away from the interincisor line, distally, the degree of mesial tipping must progress [11,6].

The anatomy of the tooth is disclosed by means of the vestibular face, the apparent face of the tooth, is that area of the vestibular face, bounded by the rounded transitional edges, as they can be seen from the vestibular face. Transition lines mark the transition from vestibular to mesial, distal, cervical and incisal. The shadows of the vestibular face of the tooth highlight, start at the transition lines. These shadows delimit the boundaries of the apparent face [12].

The law of the face requires that, for the purpose of working out the similarity between the disharmonious teeth and the apparent faces, they must be made so that they are equal. The equal composition of the apparent faces, in the case of two adjacent disharmonic teeth, imposes areas that are not similar, except for passing backs. Secondary anatomy, such as gloss and texture, vertical or horizontal on the vestibular face of the tooth, makes up different visual characteristics. One of its characteristics is the fact that natural teeth are polychromatic. Saturation, lightness and hue are the three appreciable dimensions used in tooth color characterization. In geometric terms, according to their shape, the teeth are divided into ovoid, square and triangular. The teeth can still retain a contour: convex, flat or concave. All this gives individuality to the patient's smile. The vestibular face of the anterior teeth presents three planes, viewed from the lateral norm. The profile of the vestibular face, of the central incisor, presents three distinct planes: middle, gingival, incisal. The lack of adequate contouring of these plans will give a flat appearance [13].

Tooth length has been recognized, extensively documented and researched. According to studies, the central incisor has an average length of 10mm, a minimum of 8mm and a maximum of 12mm. The central incisor is approximately one-sixteenth of the bizygomatic width, and the width of the central incisor is between 75%-80% of the length. The width of the central invisibles is approximately equal to the width of the nasiogenian groove [14].

In order to obtain the ideal width of maxillary front teeth, several methods can be used such as measuring the dimensions of the similar tooth, using the Bolton analysis (ratio between maxillary and mandibular teeth - 0.78), using the golden ratio (the ratio of 1:1.681 between width and length of the tooth), using the recurring dental proportion or using the length-to-width ratio (between 75-80%) [15].

Female teeth are round in shape, demonstrated by both the transition lines and the incisal edge. The incisal embrasures are more prominent. In order to create the illusion of delicacy, the incisal edge can be obtained more translucent, and with white hypoplastic striations. At the level of the incisal edge, of the vestibular face, the translucency appears as a gray line. Male teeth are much more irregular and angled. As the years go by, the saturation of the teeth in men is greater, the color of the tooth body extending to the incisal edge. The incisal embrasure is more square, and not very pronounced. Individualization is strong incorporating dark fissures [16].

Regarding the age of the patients, the teeth in the elderly are dark in color, lack texture, are short, the color has a higher saturation and are abraded, they are more individualized, they have a large and wider clinical crown, with open cervical abrasions. In young people, the teeth are more textured, have a low saturation, are bright, the gingival margin corresponds to the enamel-cementum junction, the lateral incisors appear shorter due to the rounded incisal margin, compared to the centrals and canines. Embraces are reduced, with lower individualization, usually with hypoplastic spots and lines [17].

Perceptions about the size, dental shape, color or gender and age of the patient are based on certain prejudices, which are part of the cultural area of each patient. Perceptual preconceptions are divided into two categories: artistic and cultural. The manipulation and use of these preconceptions allow esthetic dentistry to deceive the eye of the beholder when dealing with prosthetic restorations.

## FRONTAL GROUP AESTHETIC RESTORATION THROUGH MINIMALLY INVASIVE TECHNIQUES

The first stage of the patient's examination is the extraoral examination that looks at the proportionality of the facial floors, the facial symmetry that is evaluated according to the median line. In the case of patients who require the restoration or improvement of aesthetics, special attention should be paid to the smile line, the degree of exposure of the teeth during speech and smiling, the symmetry or deviation of the smile line and the nasolabial or lipo-chin grooves. During the smile, the evaluation of the oral corridor and the degree of exposure of the teeth [10].

The patient is female, oval face shape, facial symmetry, the floors of the face are proportional, the lips have a normal appearance, normotonic. The perioral furrows are normally represented, the opening of the oral cavity is within normal limits, there are no lesions with plus or minus of substance at the level of the facial integuments and the color of the integuments is normal. Reason for presentation: Disturbance of aesthetic function. (Fig. 1)

Figure 1. The initial case at the presentation in the dental office

During the endobucal examination, the mucous membranes were examined: the tongue has a normal color and the absence of pathological changes at the level of the taste buds on the dorsal side of the tongue, the floor of the mouth has a medium insertion without pathological formations, the mucosa of the hard palate, the palatine veil and the uvula with appearance normal, without pathological formations, buccal mucosa, vestibule, buccal and labial floor with normal appearance. No pathological formations are present in the oral mucosa.

The teeth were called from the oral cavity where 1.8, 4.8, 2.8 and 3.6 were not present and 1.4 OCL-M, 1.5 MD, 1.6 MOD, 1.7 D, 2.1 M, 2.2 MD, 2.4 M, 2.5 D, 2.6 MOD, 2.7 MOD featured obturations. Low tartar deposits were present. M1.6 had endodontic treatment.

The radiological examination was subsequently performed (Fig. 2). After this stage, the treatment plan was developed: descaling, air flow and professional brushing in a first stage, after which 1.1, 1.2, 1.3, 1.4 – pressed ceramic dental veneers, 2.1, 2.2 – threshold grinding for individual dental crowns on the support of zirconium and ceramic application and on 2.3,2.4 – pressed ceramic dental veneers.

We present in Fig. 3 the result of oral rehabilitation with a significant improvement in aesthetic function.

Figure 2. OPG Radiography

Figure 3. Pressed ceramic veneers and zirconium-supported crowns with ceramic application. Final aspect

## THE CHALLENGES OF AESTHETIC RESTORATIONS

Esthetic prosthetic restorations in the maxillary frontal group represent a major challenge in restorative dentistry, given the importance of the smile in the aesthetic perception and confidence of patients. Although modern technologies and materials have considerably improved esthetic results, there are still numerous obstacles and factors that can compromise the success of an esthetic prosthetic restoration [18].

Natural teeth have subtle variations in color, translucency and opacity that are difficult to replicate in prosthetic materials. Metameria is the phenomenon where two colors that appear identical under one type of light can appear different under another light. This phenomenon can make it difficult to ensure a perfect match between natural teeth and prosthetic restorations. Although modern materials such as ceramics and composites offer superior esthetics, achieving a perfect color match remains a challenge [19].

Any discrepancy between the restoration and the tooth structure can lead to visible margins, thus compromising aesthetics. If the restorations are not fitted correctly or if there

are rough edges, gingival recession can occur, exposing the edges of the restoration and creating unpleasant esthetics [20,21].

Improper prosthetic materials or ill-fitting edges can lead to gingival irritation and inflammation, affecting the aesthetics and general health of the oral cavity. Lack of adequate gingival papillae support around prosthetic restorations can lead to the formation of unsightly black triangles between the teeth [22].

Esthetic materials such as ceramics are fragile and may be susceptible to fracture, especially in strong occlusions or parafunctional habits such as teeth grinding (bruxism). Incorrect occlusion can lead to tension and stress on the restorations, resulting in damage or compromised esthetics [23,24].

Obtaining accurate impressions is essential to making well-fitting restorations. Any error in the impression process can result in restorations that do not fit properly. The quality of the work depends largely on the skills of the dentist and the dental technician. Ceramic layering and prosthetic material processing techniques require considerable experience and skill [25].

Loss of bone support from tooth extractions or other conditions can compromise aesthetics, making it difficult to restore the natural proportions of the teeth. Congenital dental anomalies, as well as incorrect positioning of the teeth, can create difficulties in achieving aesthetic restorations.

Last, but certainly not least, a constant challenge in dental aesthetics is patient expectations. Patients' aesthetic expectations can vary significantly, and differences between patient and dentist perceptions can lead to dissatisfaction if not properly managed. Patients must be informed about the technical and biological limitations that may influence the final aesthetic results [26].

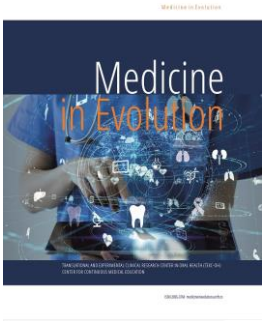
In conclusion, the success of an esthetic prosthetic restoration depends on an integrated approach that takes into account all these factors. Close collaboration between dentist, dental technician and patient is essential to overcome these obstacles and ensure long-lasting esthetic and functional results. Patient education and the use of advanced technologies and materials play a crucial role in achieving successful esthetic restorations.

## REFERENCES


1. Azimi M, Dinparvar M, Teimourian H, Farhadian M. Evaluating Recurring Esthetic Dental Proportion (RED) andGolden Proportion in Natural Dentition. Avicenna J Dent Res.InPress Davis NC. Smile design. Dent Clin North Am. 2007
2. Popa S., Protetica Dentara, Volumul I si II, Editura Medicala, Bucureşti, 2001
3. Ackerman MB, Ackerman JL. Smile analysis and design in the digital era. Journal of clinical orthodontics. 2002
4. Baumgarten AG. Aesthetica. Vol. 1. Frankfurt: Kleyb; 1750.
5. Kenneth W. Aschheim. Esthetic Dentisry. A clinical approach to techniques and materials. Editura: Elsevier 2015
6. Mancuso A. Esthetic dentistry and the golden proportion. Oral Health 2004.
7. Frush JP, Fisher RD. The age factor in dentogenics. The Journal of Prosthetic Dentistry. 1957
8. Frush JP, Fisher RD. The dynesthetic interpretation of thedentogenic concept. The Journal of Prosthetic Dentistry.1958
9. Hulsey CM. An esthetic evaluation of lip-teeth relationshipspresent in the smile. American journal of orthodontics. 1970
10. Florin Lăzărescu – Incursiuni în estetica dentară, Bucureşti 2013
11. Lombardi RE. The principles of visual perception and theirclinical application to denture esthetics. J Prosthet Dent 1973

12. Jefferson Y. Facial beauty – establishing a universal standard. Int JOrthod Milwaukee 2004
13. Levin E.I. Dental eshtetics and the dental proportion. J Prosthet Dent1978
14. Zagar M., Zlataric D.K. Influence of esthetic dental and facial measurements on the Caucasian patients' satisfaction. J Esthet Restor Dent 2011
15. Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. Angle Orthod. 1958;28(3):113-130.
16. Rufenacht CR. Fundamentals of Esthetics. Chicago: Quintessence Publishing Co.; 1990.
17. Coachman C, Calamita MA. Digital Smile Design: A Tool for Treatment Planning and Communication in Esthetic Dentistry. Quintessence Dent Technol. 2012;35:103-111.
18. Sarfati A, Mortier E, Rignon-Bret C, Soenen A, Cortasse F, Peth S. CAD/CAM Ceramic Restorations in the Anterior Area. Int J Esthet Dent. 2018;13(3):290-304.
19. Kolakarnprasert N, Kaizer MR, Kim DK, Zhang Y. New multi-layered zirconias: Properties, strength and translucency. Dent Mater. 2019;35(5):797-806.
20. Swain MV, Coldea A, Bilkhair A, Guess PC. Interpenetrating network ceramic-resin composite dental restorative materials. Dent Mater. 2016;32(1):34-42.
21. Almeida e Silva JS, Erdelt K, Edelhoff D, Araújo E, Stawarczyk B. Marginal and internal fit of four-unit zirconia fixed dental prostheses based on digital and conventional impression techniques. Clin Oral Investig. 2020;24(1):281-288.
22. Zafar MS, Amin F, Fareed MA, Ghabbani H, Riaz S, Khurshid Z. Biomimetic aspects of restorative dentistry biomaterials. Biomimetics. 2020;5(3):34.
23. Homaei E, Farhangdoost K, Tsoi JK, Matinlinna JP, Pow EH. Static and fatigue mechanical behavior of three dental CAD/CAM ceramics. J Mech Behav Biomed Mater. 2016;59:304-313.
24. Guess PC, Zavanelli RA, Silva NR, Bonfante EA, Coelho PG, Thompson VP. Monolithic CAD/CAM lithium disilicate versus veneered Y-TZP crowns: comparison of failure modes and reliability after fatigue. Int J Prosthodont. 2019;32(3):235-238.
25. Fasbinder DJ. Digital Dentistry: Innovation for Restorative Treatment. Compend Contin Educ Dent. 2020;41(3):168-177.
26. Zarone F, Russo S, Sorrentino R. From porcelain-fused-to-metal to zirconia: Clinical and experimental considerations. Dent Mater. 2019;35(3):346-352.

# Rehabilitation of an edentulous patient using combined fixed and removable prosthodontic treatment. Case report.

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## Abstract

Edentulism, the complete loss of teeth, significantly impacts oral function, aesthetics, and quality of life. Proper rehabilitation of edentulous patients requires a comprehensive approach that addresses both functional and aesthetic concerns. This case report presents the successful rehabilitation of an edentulous patient using a combination of fixed and removable prosthodontic treatment modalities. The treatment plan incorporated dental implants, fixed implant-supported prostheses, and removable overdentures to restore masticatory function, speech clarity, and facial aesthetics. The multidisciplinary approach resulted in significant improvements in the patient's oral health and overall well-being.

**Keywords:** edentulousness, implants, fixed prosthodontics, cantilever, overdentures

## INTRODUCTION

Total edentulism, characterized by the complete loss of teeth, is a prevalent dental condition worldwide, particularly among the elderly population [1]. The primary factors contributing to the development of edentulism are dental caries and periodontal disease, although its etiology is multifaceted, involving chronic systemic illnesses, socio-economic factors, and demographic influences [2]. The absence of teeth impacts speech and nutrition, leading to masticatory dysfunction and promoting an inadequate diet. Furthermore, it affects various psychological and cognitive aspects of life [3]. In these conditions, the treatment of total edentulousness becomes imperatively necessary for the rehabilitation of the functions of the oral-maxillary apparatus, and implicitly for the improvement of the patient's quality of life [4].

In terms of prosthetic rehabilitation for edentulism, the primary therapeutic approach recommended is the use of removable dental prostheses [5]. With technological advancements, additional treatment options have emerged, such as fixed prosthetic dentures through the use of dental implants or the fabrication of overdenture prostheses supported by implants [6].

The aim of this article is to underline the significance of a multidisciplinary approach in managing complex dental rehabilitations, providing valuable insights and broadening the treatment options available for edentulous patients through a customized treatment plan that incorporates both fixed and removable prosthodontic techniques.

## CASE REPORT

A multidisciplinary treatment approach was adopted. All surgical procedures were performed by one experienced oral and maxillofacial surgeon. The prosthetic procedures were conducted by two experienced prosthodontists, and manufacturing of the superstructure was done by a single experienced dental laboratory.

A 72-year-old Caucasian female patient presented in a private dental clinic, in Oradea, with the chief problem of discomfort and the impossibility of masticatory function due to the de-cementation of the mandibular prosthesis leading to the destruction of dental abutments.

A comprehensive medical and dental history were obtained and they did not present with any pathological findings. Intraoral examination revealed a poorly adapted, and aesthetically compromised maxillary denture, a partial prosthesis, and a metal-ceramic bridge supported by 11, 21, 25, and 26. The lower jaw with no teeth, just residual root fragments in the anterior region. Figure 1 presents the initial status, an intraoral view, and a radiograph image.

Figure 1. Initial status-clinical view, and radiograph

Based on the clinical and radiographical examinations, it was decided the remove of inappropriate maxillary prostheses and the extraction of all the remaining teeth from the two arches. The prosthetic treatment plan included rehabilitation using an implant-supported maxillary overdenture retained with two bilateral milled bars and implant-supported fixed prostheses for the lower jaw.

After obtaining the patient's consent for this treatment plan, it was scheduled the appointment for the surgical stage.

The surgical treatment was divided into two parts: extractions and implant insertion for the upper jaw and three weeks later, extractions and implant insertion for the lower jaw.

The patient received a prophylaxis antibiotic 1 day before the surgery (clindamycin, 300 mg) to reduce the risk of postoperative infection. Surgery was carried out under local anesthesia.

All the existing teeth in the upper jaw were extracted and a split bone procedure was made at the site of the canine region for both sides. In the same session, four dental implants (SWISS Implant Systems, Switzerland) with a diameter of 3.5 and 10 mm in length were placed according to the bone situation at the region of 13, 23, 11, and 21.

During the healing period, the implants were left in a submucosal position. Two weeks after implant placement, a follow-up visit was scheduled for suture removal and a review of the healing process.

One week later, the surgical intervention for the lower jaw took place, with the extraction of all mandibular teeth (32, 31, 41, 42, 43) and the insertion of four dental implants (SWISS Implant Systems, Switzerland). With a diameter of 3,7 and 10 mm in length, according to the bone situation, all implants were placed axially at regions 44, 34, 42, and 32.

Seven days later, the patient came for suture removal and also to begin the intermarry prosthetic treatment: bimaxillary complete dentures for the period of the implant osteointegration.

In this regard, starting with a preliminary impression, the patient came for several visits ending with the final mobile prostheses, in two weeks. This intermarry prosthetic treatment was necessary to cover aesthetic and functional needs.

Six months after the implant placement, second-stage surgery was performed, and healing abutments were placed. All implants achieved a final torque of 45 Ncm, indicating good implant stability, and the healing caps were then positioned.

Figure 2. Intraoral image with the healing caps

To maintain the mobile prostheses over the healing cups, it was used a direct relining procedure using Elite Soft Relining Zhermack.

Figure 3. Temporary mobile prosthesis over the healing cups

**Prosthetic intervention (for the final prosthesis)**

For the first session, using standard trays and alginate, an impression was taken to obtain individual trays, both for the maxillary and mandibular arch. The next step was the implanting impression, used for transferring the intra-oral spatial relationship of the implants to the working casts. The implants were exposed by removing the healing abutments. It was chosen the direct open tray technique, uses a custom tray that contains windows exposing the impression on copings. Four impression copings were placed on the maxillary implants after removing the gingival formers. Figure 4 represents the exposure of maxillary implants, the transfer rods in the implants, and the maxillary impression.

Figure 4. Exposure of maxillary implants, the transfer rods in the implants, and the maxillary impression

Customized acrylic resin trays were fabricated on the gypsum casts delivered by the alginate impressions. A pick-up coping impression was made with the addition silicone impression material (Elite Zhermack) in a double mixing technique. After the setting of the impression material, all the screws were loosened, and the impression was carefully removed from the mouth to avoid damage.

The same procedure was applied for the mandibular jaw (Fig. 5). It used the same direct technique also called the pickup impression technique and the impressions were sent to the laboratory to obtain the final casts.

Figure 5. Exposure of mandibular implants, transfer rods in the implants, and mandibular impression

The horizontal and vertical maxillomandibular records were initially obtained with the old relined dentures and found suitable for about the thirds of the face. The soft-pogonion and subnasale were marked with a dot and the distance was measured. This situation of vertical dimension was recorded with a putty condensation silicone material (Zeta Zhermack) covering both dental arches Based on this provisional jaw relation, the casts were mounted on the articulator. A customized maxillary registration tray with wax bite blocks was ordered to the dental lab so that in the next visit, the final horizontal and vertical maxillomandibular records were established safely because the bite block was held in place by screws secured into two implants, and the adjustment was achieved according to the lip support. For the next step, the wax-up try-in was done in the patient's mouth to check for function and aesthetics, and for the proper alignment of the anterior teeth before the maxillary milled bar retainer was designed**.** The occlusion plane was verified, and the shade of the tooth was selected. A bilateral balanced occlusion scheme was followed for teeth arrangement.

**Metal frame checking**

For the upper jaw were used multi-unit abutments, to support the bar retainer divided into two portions due to the angulation of the posterior implants. For the lower jaw, were

used straight implant abutments. In the same session, it was verified the metal frame for the mandibular implant-supported fixed prostheses and the maxillary separated milled bar. The bilateral bars were screwed over the implant abutments. (fig. 6)

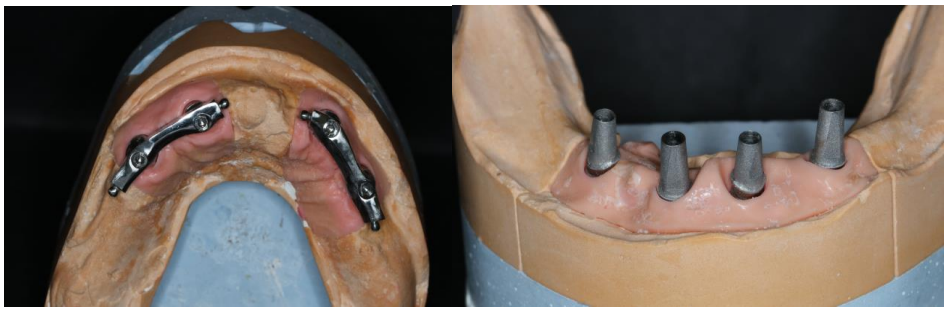


Figure 6. Bar retainer and mandibular abutments on the definitive cast

The Sheffield test was performed on the milled bar, and the fitting was optimum. In this test, the framework is seated onto the implants and one screw is tightened lightly and discrepancies are observed at the other terminal screw. The screw should not resist the tightening process.

For the next visit, the fitting of the framework try-in prosthesis with cobalt chromium reinforcement structure was evaluated in the patient's mouth and the mandibular metal framework was covered with ceramic. (fig. 7)

Figure 7. Wax try-in with the metal frame attached and the ceramic covering the metal framework for the lower prosthesis

The upper occlusion plane was checked on both sides and parallel to the Camper plane. The upper anterior teeth were marked for needed modification according to the smile line.

**Delivery Appointment**

In this session, upper multi-unit abutments were screwed on the implants with a torque (30 Ncm) applying 1% chlorhexidine gel into the screw channel, and two separated milled bars were screwed on implant abutments. The removable maxillary overdenture was then accurately and rigidly adapted to the bar. Lower standard abutments were also screwed with a torque (30Ncm), and the fixed prostheses were cemented.

Figure 8 presents the final appliances on the casts, the mandibular fixed metal-ceramic prostheses, and the maxillary overdenture, with full coverage of the alveolar process, but without palatal coverage and the internal fitting surface of the overdenture.

Figure 8. Mandibular fixed prostheses and maxillary overdenture

A radiograph CT was made to see the implants, the maxillary metallic bars, and the mandibular fixed metal-ceramic prosthesis. (Fig. 9)

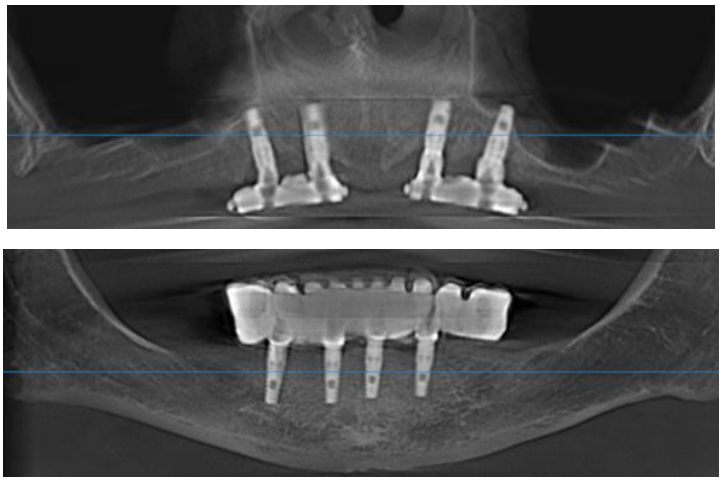


Figure 9. Radiograph image with the appliances

Figure 10 presents the aesthetic smile zone of the patient with the appliance, and the intraoral frontal view of the maxillary and mandibular appliance in occlusion.

Figure 10. Aesthetic smile zone and appliances in occlusion

Postdelivery instructions were given to the patient regarding prosthesis placement, removal, and cleaning. Specifically, the cleaning of the milled bars with super floss and the surfaces of the overdenture with a toothbrush. At the 1-week check-up visit, the prosthesis was evaluated, and the patient had no complaints. No plaque was detected on the bar or

prosthesis. The patient was informed to maintain the hygiene measures and to show up for a recall visit after 3 months.

The patient was delighted with the implant-retained maxillary overdentures and mandibular fixed implant-retained prosthesis.

## DISCUSSIONS

Since the introduction of osteo-integrated implants, implant-supported overdentures have emerged as a favorable treatment choice for fully edentulous individuals [8].

Additionally, it decreases bone resorption, ensuring the long-term stability and durability of prosthetic restorations, while also improving masticatory function, thereby enhancing patient satisfaction [7].

In this case, the final superstructure was supported by four implants in both arches. For the upper part, comprised an implant-supported overdenture retained by two bilateral milled bars with an integrated cobalt-chromium reinforcement structure. For the mandible, it included an implant-supported one-piece cross-arch fixed denture with bilateral cantilever segments, featuring cobalt-chromium alloy frameworks covered with ceramics.

The strategy for an overdenture in the upper arch should reduce the surgical efforts. Another treatment alternative would involve fixed implant-retained prostheses. However, achieving this treatment would necessitate the placement of a minimum of six implants in the maxilla, along with an extensive surgical procedure, such as a sinus lift in the area of the first upper molars. Furthermore, a fixed restoration in the maxilla, would not allow sufficient support of the upper lip and sophisticate the hygiene measures for the patient.

The implant-retained milled bar overdenture presents two milled bars. The removable overdenture is then accurately adapted to the bar, limiting rotational and lateral movements.

The rigid anchorage system distributes the stresses due to different forces along with the implant-overdenture complex. The retention is achieved by friction between the bar and counter bar in the overdenture and the fastenings [7].

One of the considerable challenges for screw-retained multi-unit implant prostheses is achieving a passive fit of the prosthesis' superstructure to the implants. This is supposed to be one of the most vital requirements for the maintenance of the osseointegration. Minimizing the misfit and optimizing the passive fit should be a prerequisite for implant survival. This misfit sometimes can be tolerated by the surrounding bone without adverse biomechanical complications [9].

Ideal restorative space for bar-clip overdentures should accommodate the denture base, the acrylic teeth, and the bar-clip attachment system. Therefore, a minimum of 13–14 mm space is required between the implant platform and the incisal plane. 4 mm of this space should be arranged for the bar attachment, with a hygiene space of 1 mm under the bar [10]. Another requirement is adequate inter-implant distance, which should be a minimum of 10–12 mm. If the inter-implant distance is less, a milled bar is indicated with frictional fit components, to increase the retention [10].

The implant impression accuracy also plays a key role and depends on several factors. These include the impression material, impression technique, the implant angulations, and the number of implants [9]. Several impression materials have been used for multi-unit implant impression; the most commonly described were addition silicone and polyether impression materials.

In the lower jaw, rehabilitation was performed using an implant-supported 1-piece cross-arch fixed prostheses with bilateral cantilever segments. The cantilever extension measured approximately 16.5 mm in length from the most distal implant for the left side of the patient, and about 10 mm in length for the right side.

According to one of the most common prosthetic protocols, in totally edentulous patients treated with full-arch implant–supported fixed prostheses, the implants are more often surgically positioned in the inter foraminal region for anatomical and surgical reasons and the prosthetic superstructure designed with cantilever distal extensions [11]. The full-arch fixed prostheses (FFPs) supported by implants have been reported with a high success rate and patient satisfaction [12]. Rehabilitation of a single, completely edentulous arch with implant-supported prostheses should consider the situation of the opposing arch. Least peri-implant strains were observed when forces simulating conventional complete dentures [11]

Regarding the relationship between peri-implant stress and the length of distal extensions in prosthetic rehabilitations using four implants, studies indicate that with the same inclination of distal implant, the peri-implant bone stress increased as the length of the cantilever increased. Also, the influence of the cantilever on stress distribution was greater than the influence of implant inclination. [13]

However, when a vertical load was applied to the axial implant, no matter a solitary implant or the distal implant of All-on-4, it showed that the highest stress was concentrated at the apical region of the implant [13]

In this case, four axial implants were placed in the mandibular jaw, according to the bone situation, all implants were placed axial at region of 44, 42, 32, and 34. The four implants were splinted by wrought cobalt-chromium alloy frameworks covered with ceramics, with bilateral cantilever segments.

## CONCLUSIONS

The clinical and laboratory procedures in implant prosthodontics are many and demanding. Each stage may lead to a positional distortion and misfit.

Utilizing multi-unit abutments in bar-retentive overdenture systems offers the benefit of stress absorption and distribution, which in turn leads to low tensile stress values in both the implants and the surrounding bone [14]. The multi-unit abutment is a prosthetic component that facilitates the implant rehabilitation of edentulous patients. The short height design and the wide margin of the element provide ease in seating the framework and restoration. These components also have the advantage of solving the inclination problems with angulated choices [14].

Rehabilitation of the edentulous maxilla using the treatments described is effective in the medium to long term, and the patient expressed high levels of satisfaction with the overdentures. For a completely edentulous mandibular arch, fixed implant-supported prostheses with a cantilever, might be a good option but should always consider the situation of the opposing arch.

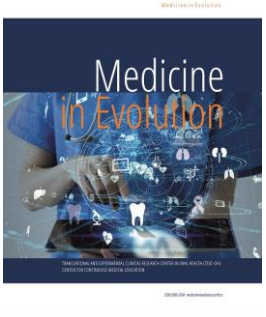
In this case, using a one-piece cross-arch fixed implant prosthesis with bilateral cantilever segments was possible, considering that, for the opposing arch, an overdenture was made.

The results demonstrated the importance of a customized treatment plan and how this integrated approach significantly improves the patient's functional and aesthetic outcomes and enhances his overall quality of life.

## REFERENCES

1. Lee DJ, Saponaro PC. Management of Edentulous Patients. Dent Clin North Am, 2019, 63(2):249-261.
2. Pengpid S, Peltzer K. The prevalence of edentulism and their related factors in Indonesia, 2014/15. BMC Oral Health, 2018, 18(1):118.
3. Dioguardi M, Di Gioia G, Caloro GA, Capocasale G, Zhurakivska K, Troiano G, Lo Russo L, Lo Muzio L. The Association between Tooth Loss and Alzheimer's Disease: a Systematic Review with Meta-Analysis of Case Control Studies. Dent. J. 2019, 7(2):49.
4. Friel T, Waia S. Removable Partial Dentures for Older Adults. Prim Dent J, 2020, 9(3):34-39.
5. Zhurakivska K, Luciano R, Caponio VCA, Lo Russo L, Muzio LL, Mascitti M, Troiano G. Cost/effectiveness analysis of treatment options for the rehabilitation of the total edentulous mandible. J Oral Rehabil, 2023, 50(5):400-409.
6. Bandiaky ON, Lokossou DL, Soueidan A, Le Bars P, Gueye M, Mbodj EB, Le Guéhennec L. Implant-supported removable partial dentures compared to conventional dentures: A systematic review and meta-analysis of quality of life, patient satisfaction, and biomechanical complications. Clin Exp Dent Res, 2022, 8(1):294-312.
7. Almadani AM, Huettig F. Rehabilitation of a maxillary partial edentulous patient using an implant-supported overdenture retained with two bilateral milled bars. BMJ Case Rep, 2020, 13(8):e235530.
8. Mericske-Stern R. Treatment Outcomes with Implant-Supported Overdentures: Clinical Considerations. J. Prosthet. Dent, 1998, 79(1):66–73.
9. Buzayan MM, Yunus NB. Passive Fit in Screw Retained Multi-unit Implant Prosthesis Understanding and Achieving: A Review of the Literature. J Indian Prosthodont Soc, 2014, 14(1):16-23.
10. Phillips K, Wong KM. Space requirements for implant-retained bar-and-clip overdentures. Compend. Contin. Educ. Dent, 2001, 22(6):516–8, 520, 522.
11. Brånemark PI, Zarb G, Albrektsson T. Tissue Integrated Prosthesis. Osseointegration in Clinical Dentistry. Plast. Reconstr. Surg., 1986, 77(3):496–497.
12. Mohamed LA, Khamis MM, El-Sharkawy AM, Fahmy RA. Evaluation of immediately loaded mandibular four vertical versus tilted posterior implants supporting fixed detachable restorations without versus with posterior cantilevers. Oral Maxillofac Surg, 2022, 26(3):373-381.
13. Wang Q, Zhang ZZ, Bai SZ, Zhang SF. Biomechanical analysis of stress around the tilted implants with different cantilever lengths in all-on-4 concept. BMC Oral Health. 2022 Nov 5;22(1):469. doi: 10.1186/s12903-022-02520-8. PMID: 36335327; PMCID: PMC9636816.
14. Kümbüloğlu Ö, Koyuncu B, Yerlioğlu G, Al-Haj Husain N, Özcan M. Stress Distribution on Various Implant-Retained Bar Overdentures. Materials (Basel). 2022 Apr 30;15(9):3248. doi: 10.3390/ma15093248. PMID: 35591581; PMCID: PMC9101733.

# Maintenance of periodontal health during adult orthodontic treatment

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## Abstract

In dental medicine, preventive measures combined with both classic and aesthetic orthodontics appliances resulted in an increase of adult patients seeking orthodontic treatment to improve their appearance and social acceptance as well as function and oral health. Adult patients bring distinctive characteristics like tooth mobility and periodontal disease that might interfere with the treatment and call for a multidisciplinary approach. This observational study aimed to evaluate the degree of collaboration with periodontologists and the approach implemented by orthodontists in periodontal affected patients. Material and methods: A questionnaire was designed and electronically submitted to orthodontic specialists and postgraduates in orthodontics from Romania. The answers gathered were compared to current literature on the topic. Conclusion: An interdisciplinary treatment of orthodontic and periodontal therapies is effective for adult patients with periodontal disease as long as the periodontium is healthy, and hygiene well maintained throughout treatment with orthodontic appliances.

**Keywords:** orthodontic treatment, adult patients, periodontal health

## INTRODUCTION

For many adult patients undergoing orthodontic treatment, a stable and aesthetically acceptable outcome cannot be achieved without adjunctive periodontal procedures. Any orthodontic intervention must take into consideration the periodontal status of the patient because the biomechanics used to change the position of the teeth are determined by periodontal aspects like alveolar bone height and width, length of roots, gingival health and biotype.

In the absence of adequate oral hygiene, plaque accumulates around the orthodontic appliance inducing gingivitis and potentially further progress to chronic periodontitis. The literature (1) underlines the importance of patient's oral hygiene as a must for the success of orthodontic therapy along with other factors such as genetics, age, correct diagnostic, treatment plan and execution (2).

To prevent such cases, the orthodontist has the responsibility to examine the periodontium of the patient before placing appliances (3) and to offer advice regarding methods of plaque prevention.

Orthodontic and periodontic disciplines are intricately linked through the dynamic processes of bone remodelling and periodontal health maintenance (3). Orthodontic tooth movement is facilitated by the alveolar bone's capacity for remodelling, a delicate balance of bone resorption and deposition influenced by mechanical forces during orthodontic treatment (4,5). Central to this process is the periodontal ligament (PDL), which transmits these forces to the alveolar bone. Through orthodontic teeth movement, the alveolar bone goes through significant resorption and apposition, directly proportional to the duration, volume and direction of the applied forces (6–8).

The theories regarding orthodontic tooth movement have changed from tissue / cell levels to the molecular one. Remodelling of the bone is controlled by the osteoblasts/osteoclasts including interactions between cells, mediated by hormones, growth factors and cytokines. Research on signalling pathways showed that the first response of the cells to mechanical stress is the production of prostaglandins and secondary messengers cyclic adenosine monophosphate (9,10) and inositol phosphates (11). Changes have also been observed in calcium levels after stretching of the ion channels (12,13).

Existing evidence shows that that cytokines (inflammation mediators) and neurotransmitters are implicated in bone remodelling, suggesting that teeth movements are inflammatory processes (14). Mechanical stress causes in cells inflammatory responses resembling the ones caused by inflammatory factors (15).

Patient age has a significant impact on the proprieties of the PDL's structure and according to research studies it greatly influences the rate of tooth movement during orthodontic treatment (6,16). Research indicates that older patients experience decreased cellular proliferation and differentiation, affecting the efficiency of orthodontic treatments. Understanding these age-related changes is crucial for optimizing orthodontic care across different age groups.

The role of microbial colonization on teeth and orthodontic appliances further complicates the orthodontic-periodontic interface (17). Biofilms forming on dental and artificial surfaces can disrupt oral health, leading to enamel demineralization, caries, and gingival inflammation. The changes in oral microbiota during orthodontic treatment underscore the importance of rigorous oral hygiene practices to mitigate these risks. Oral bacteria have the predisposition to adhere to hard dental tissues and to form polymicrobial biofilms communities called biofilms (18). The bacteria also attaches to artificial hard surfaces such as restorative materials, implants and orthodontic appliances (19).

Periodontal examination and management in orthodontic patients are essential for ensuring comprehensive care (20). Identifying signs of periodontitis, such as gingival inflammation and bone loss, and implementing a structured treatment plan that includes systemic management, initial therapy, and maintenance, are critical for maintaining periodontal health throughout orthodontic treatment. Regular follow-ups are necessary to monitor and sustain oral health, highlighting the need for an integrated approach to orthodontic and periodontal care.

### *Aim and objectives*

The aim of this observational study is to assess the approach that orthodontists have in periodontal affected patients, as well as to evaluate the degree of collaboration with periodontologists.

## MATERIAL AND METHODS

A questionnaire was designed and electronically submitted to orthodontic specialists and postgraduates in orthodontics from Romania.

The answers gathered were compared to current literature on the topic.

The inclusion criteria for the participants were:

- orthodontic specialists
- orthodontic residents
- general dentists providing clear aligners treatment were also accepted.
- full questionnaire had to be completed.

Exclusion criteria: specialties that do not perform any orthodontic treatment or orthodontists that did not fill in the whole questionnaire.

The questionnaire consisted of 15 questions divided into 5 categories. The participation in the study was voluntary and anonymous. The design of the questions was dichotomous (yes/no), open questions and/or single/multiple choice.

After the collection of the data ended, the answers were reviewed, evaluated and presented either as percentages or means of the answers.

## RESULTS

The questionnaire was web-based and an invitation to answer the questions was sent to orthodontists, orthodontic residents and general dentists providing clear aligner treatment from Romania. Seventy-six participants completed survey were obtained.

All the questions and the resulted outcomes can be found in Table 1.

Among the outcomes, it resulted a general consensus for periodontal health as an influencing factor for successful teeth movement and retention, orthodontic treatment improving periodontal health, the need for the examination of periodontal status during initial orthodontic appointment and for referral to a periodontologist before orthodontic treatment if periodontal disease is suspected and that instructions need to be provided on the management of oral health during orthodontic treatment. The questions that generated answers distributed in more categories con be found in Figure 1.

Table 1. Survey questions and outcome

| **Survey Questions** | **Outcome** |
|---|---|
| **Gender of participants** | Men - 42.1% (n=32)<br>Women - 57.9% (n=44) |
| **Age of participants** | <30 years old - 18.4% (n=14)<br>30 - 40 years old - 40.8% (n=31), |

| Survey Questions | Outcome |
|---|---|
| | 40 - 50 years old - 31.6% (n=24)<br>>50 years old - 9.2% (n=7) |
| **Dental speciality** | Orthodontic specialists - 55.3% (n=42)<br>Orthodontic residents - 30.3% (n=23)<br>General dentists providing clear aligner treatment - 14.5% (n=11) |
| **Experience in dentistry** | <5 years - 32.9% (n=25)<br>5 - 10 years - 11.8% (n=9)<br>10 - 20 years - 17.1% (n=13)<br>>20 years - 38.16% (n=29) |
| **Periodontal health as influencing factor for successful teeth movement and result maintenance** | All participants agree |
| **Does orthodontic treatment improve periodontal health?** | All participants agree |
| **Examination of periodontal status during initial orthodontic appointment** | All participants perform a basic periodontal examination |
| **Referral to periodontologist before orthodontic treatment if periodontal disease is suspected** | All clinicians refer the patient to the periodontal specialist |
| **Time between completion of periodontal treatment and placing orthodontic appliance** | Immediately - 5,2% (n=4)<br>3 - 6 months - 17.1% (n=13)<br>6 months - 64.5% (n=49)<br>6 - 12 months - 13.2% (n=10) |
| **Orthodontic treatment for patients with clinical health on a reduced periodontium** | 65 out of 76 clinicians offer treatment (85.5%) |
| **Orthodontic appliance used influenced by periodontal status of the patient** | 38 clinicians consider periodontal status when choosing the orthotodontic appliance (50%) |
| **Frequency of assessing periodontal status during orthodontic treatment** | Every 4 weeks - 56.5% (n=43)<br>Every 8 weeks - 2.63% (n=2)<br>Every 12 weeks - 15.7% (n=12)<br>4 - 12 weeks depending on the clinical status - 25.0% (n=19) |
| **Are instructions provided on management of oral health during orthodontic treatment?** | All participants provide instructions |
| **Frequency of hygiene appointments during treatment** | Every 3 months - 40.8% (n=31)<br>Every 4 months - 31.5% (n=24)<br>Every 6 months - 19.4% (n=15)<br>4 - 6 months - 1.3% (n=1)<br>Case-dependent (4 weeks to 4 months) - 6.6% (n=5) |
| **Who performs the professional cleaning?** | 52.6% perform cleaning themselves (n=40)<br>47.4% refer to general dentist or periodontologist (n=36) |

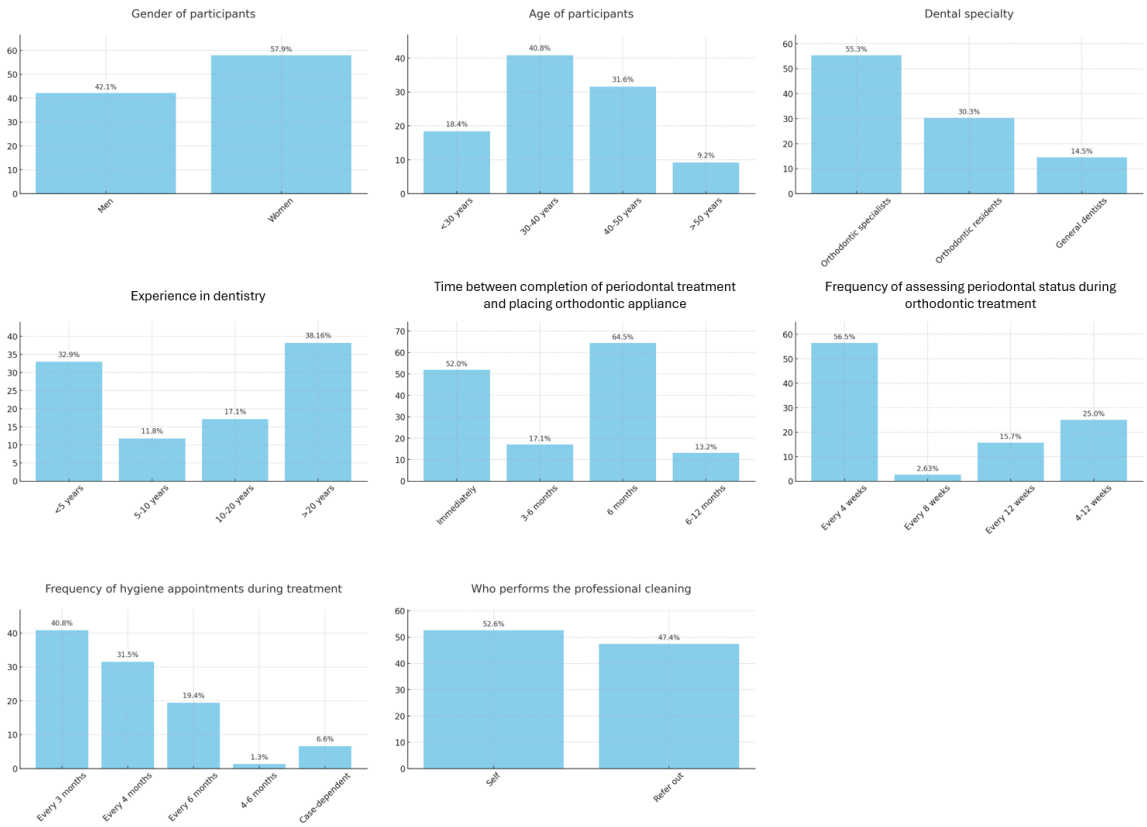


Figure 1. Graphical representation of outcomes distribution

## DISCUSSIONS

The study investigates participants' approaches to maintaining periodontal health during orthodontic treatment. The main objective of conducting a periodontal examination prior to treating adult patients with periodontal disease is to diminish and prevent the buildup of plaque and the resulting inflammation (21,22). This highlights the importance of educating patients about oral hygiene, selecting suitable dental tools, and scheduling regular check-up visits (23). The gender distribution of survey participants corresponds to the demographics of orthodontic practitioners, as literature indicates that 60% are female and 40% are male (24). Out of the total number of participants, 45 were below the age of 40. Recent updates to dental curricula may have resulted in younger dentists receiving more extensive training in periodontology. However, further research needs to be conducted to verify this hypothesis (25). All participants agree with the value of periodontal health in orthodontic planning, conducting initial periodontal examinations, and perceiving orthodontic therapy as beneficial for periodontal health. Orthodontic treatment improves periodontal health by correcting teeth malposition, which may interfere with proper oral hygiene (26). The majority of the participants (81.6%%) follow the literature's suggestion to wait 3-6 months or even 6 months after periodontal therapy before beginning orthodontic treatment.

Approximately 85.5% of clinicians provide treatment to patients who have a periodontium that is clinically healthy but reduced. Extensive research shows that having previously received treatment for periodontitis does not prevent or discourage orthodontic treatment. In fact, it may even enhance the chances of preserving and restoring the dentition. 50% of clinicians are influenced by the condition of the periodontal status when selecting orthodontic appliances, with preferences for vestibular fixed appliances and clear aligners. Four orthodontic specialists noted that self-ligating brackets aid in the removal of plaque. According to literature, orthodontic appliances should aim to reduce plaque buildup by

employing uncomplicated mechanics and avoiding components that are prone to attracting plaque (27–29). Clear aligners are preferred as are removable and easier to clean, and by doing so they promote optimal oral hygiene (30). A randomized controlled trial provides evidence in favour of utilizing aligners for periodontal health. However, further research is necessary to establish conclusive findings (31). Most participants (91.7%) follow guidelines to reassess the periodontal status every 3 months or less (4, 8 or 12 weeks), with some increasing the frequency if risk factors are present (32). All participants provide oral hygiene instructions during orthodontic treatment, with various suggestions regarding the frequency of professional cleaning. According to literature, it is recommended to have professional cleaning done every 1-3 months, particularly if there are additional risk factors like smoking or diabetes (33,34). Fifty percent of the participants perform professional cleanings themselves, while the remaining fifty percent direct patients to general dentists.

Adjunctive tools such as electric toothbrushes and interdental brushes are recommended during professional cleaning appointments (32,35). Eighteen participants advocate the use of electric toothbrushes, while 17 endorse fluoride mouthwash, aligning with literature evidence that electric toothbrushes are more effective in promoting gingival health (36). Nevertheless, a mere four participants advocate for the use of chlorhexidine mouthwash, highlighting the necessity for increased knowledge regarding its advantages. 94.7% of participants identified gingival recession as the most prevalent periodontal side effect of orthodontic treatment, followed by bone dehiscence at 73.7%. However, evidence indicates that these alterations are typically temporary (37) and that tissues recover to their initial condition after treatment (19). Only a small fraction of patients may experience persistent clinical attachment loss (21).

Upon completion of orthodontic treatment, 84.2% of the participants opt for lingual bonded wires as a means of retention, which aligns with the recommendations found in existing literature. Patients with severe periodontal disease require continued maintenance following orthodontic treatment (23). The preferred method of long-term retention for adults is a flexible wire bonded on the lingual surfaces of anterior teeth, acting as a periodontal splint while allowing physiological mobility (38,39).

We consider that the study offers a perspective into the interaction between periodontal health and orthodontic treatment, showing the importance of preserving periodontal health when seeking successful orthodontic results. It acts as a starting point to develop consistent periodontal care protocols in orthodontic treatment, resulting in more reliable and efficient patient care across various practitioners and settings. These results can provide helpful information for the development or improvement of clinical guidelines, as they help identify commonly used practices and their related outcomes, with the aim of improving patient care and increasing treatment success rates. The importance of patient awareness and engagement has been highlighted, indicating the necessity for clinicians to actively communicate with patients regarding oral hygiene and regular check-ups in order to prevent complications from occurring. Other measures that need to be taken based on the resulted data from this observational study may include carrying out longitudinal investigations to track the long-term effects of integrating periodontal and orthodontic care, designing tailored education initiatives for existing specialists and dental students, creating comprehensive care protocols that integrate periodontal assessments and treatments into the orthodontic treatment plan, promoting interdisciplinary cooperation among orthodontists, periodontists, and general dentists, and improving patient educational materials that explain the importance of periodontal health during orthodontic treatment.

## CONCLUSIONS

The results of our study suggests the importance of incorporating periodontal health management into orthodontic treatment protocols for adults. The consensus among practitioners is to postpone orthodontic treatment for 3-6 months after periodontal therapy, following recommended guidelines that prioritize a healthy periodontium before beginning the active phase of orthodontic treatment. Clear aligners and self-ligating brackets are preferred due to their ability to reduce plaque accumulation and simplify oral hygiene practices. However, the study identifies an educational gap in the use of antibacterial mouthwashes such as chlorhexidine, which are underutilized despite their potential benefits in maintaining periodontal health during orthodontic treatment. Gingival recession and alveolar dehiscence, while common, are usually transitory and manageable with proper care. The results also indicate how a proactive approach to periodontal evaluation and maintenance can improve orthodontic results and patient satisfaction. Interdisciplinary collaboration between orthodontists and periodontists plays an essential role for achieving desired outcomes, especially in adult patients presenting with periodontal issues. Effective communication and collaboration are essential for designing treatment plans to each patient's specific periodontal needs, preventing further complications and ensuring long-term oral health.

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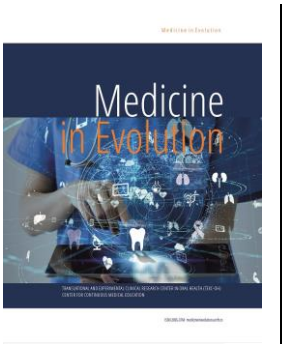
## REFERENCES

1. Sebbar M, Abidine Z, Laslami N, Bentahar Z, Sebbar M, Abidine Z, et al. Periodontal Health and Orthodontics. In: Emerging Trends in Oral Health Sciences and Dentistry [Internet]. IntechOpen; 2015 [cited 2024 Jul 27]. Available from: https://www.intechopen.com/chapters/47857
2. Guo J, Li L, Guan G, Bennani F, Mei L. Oral health knowledge and practice among orthodontic clients in China and New Zealand. Can J Dent Hyg CJDH J Can Hyg Dent JCHD. 2020 Oct 1;54(3):124–32.
3. Alsulaimani L, Alqarni H, Akel M, Khalifa F. The Orthodontics-Periodontics Challenges in Integrated Treatment: A Comprehensive Review. Cureus. 15(5):e38994.
4. Verna C, Dalstra M, Melsen B. The rate and the type of orthodontic tooth movement is influenced by bone turnover in a rat model. Eur J Orthod. 2000 Aug;22(4):343–52.
5. Reitan K. The initial tissue reaction incident to orthodontic tooth movement as related to the influence of function; an experimental histologic study on animal and human material. Acta Odontol Scand Suppl. 1951;6:1–240.
6. Shimpo S, Horiguchi Y, Nakamura Y, Lee M, Oikawa T, Noda K, et al. Compensatory bone formation in young and old rats during tooth movement. Eur J Orthod. 2003 Feb;25(1):1–7.
7. Tsolakis IA, Christopoulou I, Sitaras S, Lyros I, Rontogianni A, Dalampira M, et al. Molecular and Biological Aspects of Orthodontic Tooth Movement: Possibilities for Bioengineering Intervention: A Narrative Review. Bioeng Basel Switz. 2023 Nov 2;10(11):1275.
8. Jeon HH, Teixeira H, Tsai A. Mechanistic Insight into Orthodontic Tooth Movement Based on Animal Studies: A Critical Review. J Clin Med. 2021 Apr 16;10(8):1733.
9. Harell A, Dekel S, Binderman I. Biochemical effect of mechanical stress on cultured bone cells. Calcif Tissue Res. 1977 May;22 Suppl:202–7.

10. Yeh CK, Rodan GA. Tensile forces enhance prostaglandin E synthesis in osteoblastic cells grown on collagen ribbons. Calcif Tissue Int. 1984;36 Suppl 1:S67-71.
11. Sandy JR, Harris M. Prostaglandins and tooth movement. Eur J Orthod. 1984 Aug;6(3):175–82.
12. McDonald F, Somasundaram B, McCann TJ, Mason WT, Meikle MC. Calcium waves in fluid flow stimulated osteoblasts are G protein mediated. Arch Biochem Biophys. 1996 Feb 1;326(1):31–8.
13. Davidson RM, Tatakis DW, Auerbach AL. Multiple forms of mechanosensitive ion channels in osteoblast-like cells. Pflugers Arch. 1990 Aug;416(6):646–51.
14. Davidovitch Z, Nicolay OF, Ngan PW, Shanfeld JL. Neurotransmitters, cytokines, and the control of alveolar bone remodeling in orthodontics. Dent Clin North Am. 1988 Jul;32(3):411–35.
15. Dumont N, Lepage K, Côté CH, Frenette J. Mast cells can modulate leukocyte accumulation and skeletal muscle function following hindlimb unloading. J Appl Physiol Bethesda Md 1985. 2007 Jul;103(1):97–104.
16. Komatsu K, Shibata T, Shimada A, Viidik A, Chiba M. Age-related and regional differences in the stress-strain and stress-relaxation behaviours of the rat incisor periodontal ligament. J Biomech. 2004 Jul;37(7):1097–106.
17. Freitas AOA, Marquezan M, Nojima M da CG, Alviano DS, Maia LC. The influence of orthodontic fixed appliances on the oral microbiota: a systematic review. Dent Press J Orthod. 2014;19(2):46–55.
18. Bertolini M, Costa RC, Barão VAR, Cunha Villar C, Retamal-Valdes B, Feres M, et al. Oral Microorganisms and Biofilms: New Insights to Defeat the Main Etiologic Factor of Oral Diseases. Microorganisms. 2022 Dec 6;10(12):2413.
19. van Gastel J, Quirynen M, Teughels W, Coucke W, Carels C. Longitudinal changes in microbiology and clinical periodontal variables after placement of fixed orthodontic appliances. J Periodontol. 2008 Nov;79(11):2078–86.
20. Gyawali R, Bhattarai B. Orthodontic Management in Aggressive Periodontitis. Int Sch Res Not. 2017 Feb 16;2017:8098154.
21. Janakiram C, Dye BA. A public health approach for prevention of periodontal disease. Periodontol 2000. 2020 Oct;84(1):202–14.
22. Manresa C, Sanz-Miralles EC, Twigg J, Bravo M. Supportive periodontal therapy (SPT) for maintaining the dentition in adults treated for periodontitis. Cochrane Database Syst Rev. 2018 Jan 1;2018(1):CD009376.
23. Zachrisson BU, Alnaes L. Periodontal condition in orthodontically treated and untreated individuals. I. Loss of attachment, gingival pocket depth and clinical crown height. Angle Orthod. 1973 Oct;43(4):402–11.
24. Blasius JJ, Pae EK. Work-pattern differences between male and female orthodontists. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2005 Sep;128(3):283–90; discussion 290-291.
25. Lande A, Durge K, Rawat S, Reche A, Sonar PR. Perception of Undergraduates in the Field of Periodontology. Cureus. 15(11):e48308.
26. Klokkevold P. Carranza's Clinical Periodontology, 12th edition. 2015.
27. Farhadifard H, Soheilifar S, Bakhshaei A. Plaque Removal Efficacy of 3 Cleaning Methods for Removable Orthodontic Appliances: A Crossover Randomized Clinical Trial. Turk J Orthod. 2021 Sep 1;34(3):170–5.
28. Mulimani P, Popowics T. Effect of Orthodontic Appliances on the Oral Environment and Microbiome. Front Dent Med [Internet]. 2022 Jun 21 [cited 2024 Jul 28];3. Available from: https://www.frontiersin.org/journals/dental-medicine/articles/10.3389/fdmed.2022.924835/full

29. Kozak U, Lasota A, Chałas R. Changes in Distribution of Dental Biofilm after Insertion of Fixed Orthodontic Appliances. J Clin Med. 2021 Nov 29;10(23):5638.
30. Rouzi M, Zhang X, Jiang Q, Long H, Lai W, Li X. Impact of Clear Aligners on Oral Health and Oral Microbiome During Orthodontic Treatment. Int Dent J. 2023 Oct;73(5):603–11.
31. Lu H, Tang H, Zhou T, Kang N. Assessment of the periodontal health status in patients undergoing orthodontic treatment with fixed appliances and Invisalign system. Medicine (Baltimore). 2018 Mar 30;97(13):e0248.
32. Eliades T, Katsaros C. The ortho-perio patient: clinical evidence & therapeutic guidelines. Batavia, IL: Quintessence Publishing; 2019.
33. Jain A, Chawla M, Kumar A, Chawla R, Grover V, Ghosh S, et al. Management of periodontal disease in patients with diabetes- good clinical practice guidelines: A joint statement by Indian Society of Periodontology and Research Society for the Study of Diabetes in India. J Indian Soc Periodontol. 2020;24(6):498–524.
34. Kumar A, Grover V, Satpathy A, Jain A, Grover HS, Khatri M, et al. ISP good clinical practice recommendations for gum care. J Indian Soc Periodontol. 2023;27(1):4–30.
35. Worthington HV, MacDonald L, Poklepovic Pericic T, Sambunjak D, Johnson TM, Imai P, et al. Home use of interdental cleaning devices, in addition to toothbrushing, for preventing and controlling periodontal diseases and dental caries. Cochrane Database Syst Rev. 2019 Apr 10;4(4):CD012018.
36. Al Makhmari SA, Kaklamanos EG, Athanasiou AE. Short-term and long-term effectiveness of powered toothbrushes in promoting periodontal health during orthodontic treatment: A systematic review and meta-analysis. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2017 Dec;152(6):753-766.e7.
37. Gomes S, Varela C, Veiga S, Rösing C, Oppermann R. Periodontal conditions in subjects following orthodontic therapy. A preliminary study. Eur J Orthod. 2007 Nov 1;29:477–81.
38. Zhang Y, Kang N, Xue F, Duan J, Chen F, Cai Y, et al. Survival of nonsurgically splinted mandibular anterior teeth during supportive maintenance care in periodontitis patients. J Dent Sci. 2023 Jan;18(1):229–36.
39. Feu D. Orthodontic treatment of periodontal patients: challenges and solutions, from planning to retention. Dent Press J Orthod. 2020;25(6):79–116.

# Long-term performance of feldspathic ceramic veneers in anterior rehabilitation: A seven-year clinical case report

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## Abstract

The purpose of this case report is to discuss the use and the predictable prognosis of feldspathic ceramic veneers for the anterior dental rehabilitation, especially when the preparation is beyond the traditional indication. Feldspathic ceramics are preferred in terms of aesthetics such as translucence and shade that makes it almost similar to dental enamel. But there is the issue of mechanical strength that comes into play whenever they are applied over rather diminished tooth structures. The present clinical case describes the situation where feldspathic veneers were bonded to all the anterior teeth, including centrals, laterals, and canines to which more than 2 mm of unsupported dental hard tissue was prepared. The highly dense veneers with a thickness higher than that recommended for AO manufacturing revealed good levels of durability and stability in seven years of their implementation. The success of this case really lies in the great bonding procedures and the solid knowledge of the material properties. This paper argues against a hypothesis stating that feldspathic veneers are not suitable for extensive tooth reduction, while proving their success even in unfavorable circumstances. Thus, according to the present study, the use of feldspathic ceramics in complex restorative situations proved to be clinically and aesthetically effective and is worthy to be further investigated in challenging clinical conditions.

**Keywords:** Unsupported dental hard tissue, wear facets, feldspathic ceramic veneers

## INTRODUCTION

Feldspathic ceramic veneers are widely used for the reconstruction of the anterior teeth esthetics, because the material looks rather natural and is very similar to tooth enamel. These veneers are highly regarded for their ability to emulate the translucency and light-reflecting properties of natural teeth, a crucial factor in ensuring they blend seamlessly within the smile zone. (1,2). However, the mechanical strength of these restorations poses some problems more so in cases where there is loss of dental hard tissue and in cases of broken-down teeth, veneers on teeth with signs of attrition and discolouration (3,4).

In the case described, feldspathic ceramic veneers were placed on teeth 1. 1, 1. 2, 1. 3, 2. 1, 2. 2, 2. 3, and 2. 4, where the levels of wear of the enamel and dentine due to attrition and discoloration seemed to have been higher than the other groups (5).

These clinical conditions complicated cosmetic dentistry and required a dental preparation procedure more invasive than was otherwise traditional; the veneer thickness and the amount of dental tissue to be removed were beyond limits acknowledged as safe, with regard to mechanical retention and the predictability and longevity of the restorations (6,7).

In this paper, critical elaboration of clinical solutions to enhance the adhesion and stability of feldspathic veneers is provided with relation to case selection and application of high-level bonding techniques to deliver favourable outcomes even where conditions are less than ideal (8,9).

### *Aim and objectives*

This article's purpose is to measure the clinical efficiency and durability of feldspathic ceramic veneers in restoring anterior teeth with severe attrition and discoloration. It particularly addresses instances where traditional prepping guidelines are exceeded. The aims include evaluating aesthetic outcome and functional outcomes of these veneers, especially in difficult situations involving severe wear of enamel and dentin. Moreover, it also examines how advanced bonding techniques can affect adhesions and stability of the veneer and finally offers some practical recommendations for getting the best results when they are used in complex restorative scenarios.

## MATERIAL AND METHODS

Lack of attrition and discoloration of several anteriors particularly the maxillary 1. 1, 1. 2, 1. 3, 2. 1, 2. 2, 2. 3 and 2. 4 was a major concern of the patient who required functional and aesthetic rehabilitation. Due to the clinical state of erosion of the teeth, feldspathic ceramic veneers were chosen because of its high esthetic characteristics and its capability of matching closely the characteristics of the enamel. However, more importance was paid into the degree of the loss of dental tissue and the unsupported enamel. Before running to the final decision of accepting feldspathic ceramics, functional tests with regards to the enamel retain on the concerned teeth were made. By periodontal status, the unsupported enamel areas of the teeth were evaluated by the periodontal probe; these were measured according to the periodontal charting criteria that are commonly used. As per the said protocol, in case of unsupported enamel that was more than 2mm, then a more robust material such as lithium disilicate should have been used (10). Subsequently, it was found that the unsupported enamel on the incisors was below the recommended thickness for feldspathic veneers; the maximum being 1. Their thickness should be kept at a minimal of 3mm on one side of the veneer; the labial side. This extra reduction made the feldspathic ceramic capable of concealing the staining

whilst at the same time preserving the durability of the restoration (11). As much as it was the objective to have good esthetics in the visible zone, it was agreed to reconstruct the whole anteriors from canine to canine. Despite the initial dark shade of the abutment teeth (A4), the shade was not lightened beyond A3. This decision was made to achieve a natural, rather than artificial, aesthetic effect for the teeth, in line with best practices for ensuring a harmonious appearance in restorative dentistry (12-14).

a) b)

Figure 1. a), b) Appearance of Dental Units with Attrition Veneers Before Prosthetic Restorations

a) b)

Figure 2. a), b) Appearance of Dental Units with Attrition Veneers – Intraoral View

a) b)

Figure 3. a), b) Observation of Attrition Veneers in Oral and Frontal Norms with Associated Substance Loss

Figure 4. a) Fixing the Mock-Up in the Oral Cavity

Figure 5. a) Appearance of The Teeth After Fixing the Mock-Up in the Oral Cavity

a) b)

Figure 6. a) Guided Preparation Using a Mock-Up and Finishing of Restorations b) Finishing The Preparations with Discs: (3M™ Sof-Lex™ Finishing and Polishing Disc, United States)

Figure 7. a) Appearance of Dental Units After Guided Preparation

Figure 8. a) Appearance of Restorations in the Oral Norm After Preparation

Figure 9. a) Restorations on the Study Model

Figure 10. a) The fixation phase of feldspathic veneers to the prepared abutments

Figure 11. a) The Immediate Intraoral Result After Fixation

Figure 12. a) Final Appearance of the Restorations Fixed in the Patient's Oral Cavity

## RESULTS

These feldspathic ceramic veneers done on the patient's anterior teeth in 2017 (1. 1, 1. 2, 1. 3, 2. 1, 2. 2, 2. 3, 2. 4) are still functional and strong after seven years of wear. The patient is now 72 years of age and the restorations have retained both the esthetic and the functional properties required. Interestingly, the broad aims of returning normal function and appearance have been met, and maintained long-term. In functional terms the treatment successfully re-established the capacity of the anterior group to effectively incise foods which was radically eroded by the subject's severe dental wear. Restablishment of the anterior guidance was the part of the treatment and the new guidance is fully functional with all the necessary characteristics of the anterior guidance. This has culminated in the enhancement of the patient's masticatory efficiency, and therefore functions of the mouth (15). From an esthetic point of view the defects created by the previous discoloration have been corrected and the anterior teeth have been shaped in the appropriate form. Feldspathic veneers resulted in a substantial enhancement of the patient's smile esthetics, in both, shade and form. If any veneers were to be done, it was done professionally to complement the newly whitened natural teeth of the patient. The density of the restorations has not significantly changed within the years, thus their color correction has highly satisfied the patient (16). In the same respect, the occlusal parameters were seen to improve after the restoration process had been completed. That fact that proper anterior guidance has now been regained has not only enhanced the function but also provided a much needed balance in the occlusion. These veneers have been bearing occlusal forces for the years and the treatment plan seems to be worthwhile (17). Altogether, the feldspathic ceramic veneers have given a long-term and appropriate rehabilitation concerning both the functional and esthetic aspects in this case. The patient has had positive changes in dental function, esthetics, and general oral health; the restorations are sill functional after seven years of usage (18).

## DISCUSSIONS

This case demonstrates the possibility of employing feldspathic ceramic veneers in explaining the presence of marked dental tissue loss and discoloration. This appears in contrast with the historical preoccupations connected with the use of feldspathic ceramics, particularly as regards to their mechanical resistance when meeting the unsupported enamel. Based on these clinical findings made over seven years, it can be concluded that better enhance preparation and bonding now give feldspathic veneers quite promising and esthetic and reliable restorative solutions even for some complicated cases. Another important feature

of this case was a considerable amount of dental attrition under which incisal edges are worn out and masticatory function is affected. One of the main issues is an attrition, particularly localized to the anterior area, because the loads applied to restorations in this segment of the dentition are higher (19). However, the application of feldspathic veneers was able to rehabilitate incisal function and the patient was again able to incise the food. This is in agreement with other researches that have established that feldspathic ceramics resistance to functional forces in previously proven when well bonded to enamel was performed (20). Another significant aspect was the restoration of the discolouration that was severe in the patient's teeth. Feldspathic ceramics have the advantage in esthetic properties, mainly, translucency and the one that imitates the enamel. When a tooth is significantly discolored, selecting a material that matches the client's existing tooth color while providing sufficient opacity is crucial, especially when the goal is to achieve a natural-looking restoration (21). The feldspathic veneers used in this case helped meet the requirement for the discoloration and the outcome remains both functional and esthetic. This is in concordance with other authors who advocate for the use of feldspathic veneers in situations where severe discoloration is present and which may be difficult to provide the desired esthetic solution using the traditional ceramic materials (22). Another accomplishment of this treatment was the reestablishment of the anterior guidance. Therefore, it is crucial to have the correct anterior guidance in order to have balanced occlusion and reduce the amount of wear that might occur at posterior teeth. Although this case concerns only maxillary anterior teeth, the restoration of the anterior guidance also enhanced this patient's mastication efficiency and the stability and the longevity of the veneers (23). Such outcome is justified by the literature that stresses the potential role of a precise construction of anterior occlusion in the restoration of lost tooth structure to ensure functional occlusion as a key factor in place when a restoration is placed in the anterior zone of the dental arch (24). In addition, the long lasting of the feldspathic veneers in this case has been supported by the good affinitive between the enamel and the ceramic. It has been established that adhesive restorations are highly dependent on the bond formed and this is anchored on the preparation of the substrate, the bonding process and the properties of the adhesive-bonded system (25). In this case, when the veneers were bonded directly to the enamel there was a strong base which has withstood the pressure form occlusion for more than seven years. This is in conformity with other studies showing that bonding of enamel provides significant improvement in the mechanical retention and durability of feldspathic veneers. The successful outcome of this case suggests that using veneers alongside careful patient selection and precise clinical application can prove to be a highly efficient solution even, in situations where the usual tooth preparation standards are not straightforward. This case affirms the idea that despite being delicate in nature feldspathic ceramics can offer lasting and functional restorations for the front teeth when bonded correctly. The clinical observations detailed here add to the mounting evidence supporting the use of veneers as a choice in cosmetic dentistry even under less-than-ideal circumstances.

## CONCLUSIONS

In summary, this case demonstrates the effectiveness of veneers as a solution for patients with significant wear and discoloration on their front teeth. Over seven years, these veneers have shown resilience and aesthetic quality, addressing cosmetic issues while restoring incisal function and enhancing chewing efficiency and bite stability. The ceramic materials used have withstood pressure and maintained their aesthetic appeal, even when traditional tooth preparation norms were adjusted, highlighting their adaptability in complex clinical scenarios. The strong bond between enamel and ceramic, combined with precise

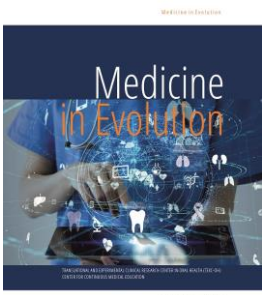
preparation and bonding techniques, has ensured the longevity of the restorations. This case supports the use of veneers in treating severe discoloration and dental wear, affirming their role as a practical choice in cosmetic dentistry. Furthermore, the research underscores the functional and aesthetic benefits of feldspathic ceramics when carefully selected and applied, emphasizing the importance of advanced adhesion techniques and thoughtful decision-making in achieving successful prosthetic outcomes.

**REFERENCES**


1. Magne P, Belser U. Bonded porcelain restorations in the anterior dentition: a biomimetic approach. Quintessence Publishing Co Inc; 2002.
2. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers: a review of the literature. J Dent. 2000 Mar;28(3):163-77.
3. Della Bona A, Van Noort R. Ceramic surface preparations for resin bonding. Am J Dent. 1995 Aug;8(4):197-201.
4. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation--a retrospective study. Int J Periodontics Restorative Dent. 2005 Feb;25(1):9-17.
5. Christensen GJ. The use of porcelain-fused-to-metal crowns, porcelain veneers, and all-ceramic crowns. J Am Dent Assoc. 1991 Aug;122(8):65-6, 68, 70-1.
6. Giordano R, McLaren EA. Ceramics overview: classification by microstructure and processing methods. Compend Contin Educ Dent. 2010;31(9):682-4, 686, 688 passim.
7. Sorensen JA, Kang SK, Torres TJ, Knode H. In-Ceram fixed partial dentures: three-year clinical trial results. J Calif Dent Assoc. 1998 May;26(5):355-63.
8. Della Bona A, Van Noort R. Ceramic surface preparations for resin bonding. Am J Dent. 1995 Aug;8(4):197-201.
9. Magne P, Perroud R, Hodges JS, Belser UC. Clinical performance of bonded porcelain veneers over 2 decades. Int J Periodontics Restorative Dent. 2000 Feb;20(1):10-21.
10. McLaren EA, Giordano R. Zirconia-based ceramics: material properties, esthetics, and layering techniques of a new veneering porcelain, VM9. Quintessence Dent Technol. 2005;28:99-111.
11. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation--a retrospective study. Int J Periodontics Restorative Dent. 2005 Feb;25(1):9-17.
12. Kugel G, Perry RD, Hoang E, Gallagher RS. Treatment planning in esthetic dentistry. J Calif Dent Assoc. 2003;31(7):551-7.
13. Joiner A. Tooth colour: A review of the literature. J Dent. 2004;32(Suppl 1):3-12.
14. Dietschi D, Ardu S, Krejci I. Exploring the layering concepts for anterior teeth. J Adhes Dent. 2001;3(1):71-81.
15. Giordano R, McLaren EA. Ceramics overview: classification by microstructure and processing methods. Compend Contin Educ Dent. 2010;31(9):682-4, 686, 688 passim.
16. Burke FJ, Lucarotti PS. Ten-year outcome of porcelain laminate veneers placed within the general dental services in England and Wales. J Dent. 2009 Jan;37(1):31-8.
17. Christensen GJ. The use of porcelain-fused-to-metal crowns, porcelain veneers, and all-ceramic crowns. J Am Dent Assoc. 1991 Aug;122(8):65-6, 68, 70-1.
18. Friedman MJ. A 15-year review of porcelain veneer failure--a clinician's observations. Compend Contin Educ Dent. 1998 Apr;19(4):625-8.
19. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers: a review of the literature. J Dent. 2000 Mar;28(3):163-77.

20. Calamia JR. Etched porcelain facial veneers: a new treatment modality based on scientific and clinical evidence. N Y J Dent. 1983 Nov;53(9):255-9.
21. Pippin DJ, Mixson JM, Soldan-Els AP. Clinical evaluation of etched porcelain veneers over a period of 18 to 42 months. J Prosthet Dent. 1995 Oct;74(4):301-6.
22. Dumfahrt H. Porcelain laminate veneers. A retrospective evaluation after 1 to 10 years of service: Part II--Clinical results. Int J Prosthodont. 1999 Sep-Oct;12(5):408-13.
23. Simonsen RJ. The clinical significance of tooth color. Dent Clin North Am. 1988 Oct;32(4):779-89.
24. Magne P, Belser U. Bonded porcelain restorations in the anterior dentition: a biomimetic approach. Quintessence Publishing Co Inc; 2002.
25. Peumans M, Van Meerbeek B, Lambrechts P, Vanherle G. Porcelain veneers

# Aesthetic rehabilitation for anterior edentulous spaces: The techniques and rationale for the use of temporary acrylic resins supported by CAD/CAM techniques in aesthetic emergencies

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## Abstract

The present case report describes our approach to the management of the anterior edentulism treating the patient with the provisional PMMA made with the CAD/CAM technique at the aesthetic emergency. The patient's problem meant that tooth 1 had to be removed. 3 from the upper anterior arch and, with regard to the aesthetics, a custom provisional restoration option was selected. The restoration was designed with retention arms provided with retention holes sufficiently to provide adequate extent of fixation of the adhesive composite and was maintained in sterile condition for three weeks until the dental implant was done. Stressing that although adhesion problems are inherent to PMMA materials, CAD/CAM technology and the use of innovative adhesive systems ensure that esthetic and functional solutions can be achieved in cases of emergency esthetic rehabilitation, it states that it can be a reliable and esthetic provisional restoration in a short time. Based upon the findings of the present study, a combination of modern techniques can be seen to be beneficial for using PMMA as a provisional material in certain clinical situations.

**Keywords:** temporary crowns and bridges, anterior teeth, computer-aided design/computer aided manufacturing

## INTRODUCTION

In the field of restorative dentistry, the application of CAD/CAM technology for the fabrication of provisional prosthetic restorations has become popular because it is precise and time saving especially when used in anterior partially edentulous patients where esthetics are important. Apart from simple clinical cases, conditions like external root resorption are best addressed promptly and with high efficiency, so that form and function can be regained. An example is the tooth 1. 3 from the upper anterior arch, which are pathologically shaped and, due to the intensive external resorption, had to be extracted [1,2].

Due to the esthetic convenience of the anterior tooth a successor immediately was placed after extraction, with an indirect TEMP-PMMA crown and bridge made by CAD and CAM [3]. Thus, for retention of this restoration, two specially designed retention arms were placed, whose holes allow the penetration of the adhesive composite to resin-tag the adjacent teeth [4,5]. Despite the fact that PMMA is has particular shortcomings in terms of adhesion it was possible to apply this fixation method and this simple yet effective contextual aesthetics was very important in such cases [7]. Also, the provisional restoration was eliminated from the static and dynamic occlusion for precautions and the implant was placed as soon as possible after the extraction to maintain optimal site preservation [7,8].

We also wanted to demonstrate how CAD/CAM technology can be applied to provide special provisional prosthetic restorations and consequently stress on the necessity to develop adhesive techniques to overcome the problems of the material [9,10]. Therefore, the present work can be further enriched with the existing knowledge about the potentials of modern dentistry regarding quick and efficient aesthetic treatment outcomes.

### *Aim and objectives*

It involves an attempt to assess the suitability of CAD/CAM produced PMMA indirectly adhesive provisional restorations for the treatment of anterior dental edentulism. The aims are thus to evaluate the clinical performance and longevity of such provisional restorations in an urgent aesthetic scenario, especially when established preparation parameters are crossed. Further, the article aims at assessing the effect of adapted retention procedures, including retention arms having opening for perforation by adhesive on the sturdiness and functionality of the restorations. It also seeks to find out the extent to which CAD/CAM technology can be put in the achievement of the optimal adaptation and aesthetically fulfilling results. In the last section of the article, the authors describe how PMMA has the possibility of being used as a long-term material for providing provisional restorations in complex clinical cases, as well as the relation of this to future trends in aesthetic and restorative dentistry.

## MATERIAL AND METHODS

The patient attended the clinic with external resorption of tooth 1. 3 from the upper anterior arch out of which 3 were severely impacted were that had to be extracted. That is why, taking into consideration the aesthetic sensitivity resulting from the absence of an anterior tooth, it was planned to use an adhesive temporary restoration made by means of CAD/CAM technology and made of PMMA – a material, which is known to be suitable for temporary restorations from the point of view of both aesthetic characteristics and mechanical properties [11,12]. Thus, two retention arms were created at the oral level in order to maintain stability and prevent disintegration of the restoration; they were made small in order to be distinctive. These were incorporated to permit the adhesive composite to interlock effectively

and bond with adjacent teeth; to address the adhesion factors that are characteristic of PMMA [13,14]. The holes were placed in such a manner that it was possible to retain as much as possible while pulling nice looks as the retention arms were all hidden at the oral side of the teeth. While the operation, an implant was also installed in the post-extraction socket to preserve the bone tissue and to prepare for future definitive prosthesis [15]. To avoid overloading and potential complications the function of provisional restoration was eliminated from static and dynamic occlusion [16]. The restorative work was completed with the aid of CAD/CAM technology which allowed to achieve the greatest accuracy when reproducing the relationship of the restoration to the arch morphology of the patient. CAD/CAM technology not only ena-LES for quick fabrication of provisional restorations, but also enable fine individualisation which is important in many difficult aesthetic cases including the one illustrated [17]. Raw PMMA material was appropriately processed and finished to provision an acceptable esthetic characteristically adapted to blend with the patient's natural dentition. It was then bonded to the restoration under a strict bonding procedure which involved the usage of adhesive composite system which has the best penetration and fixation in the holes produced on retention arms [18]. This method was very efficient in the situation of provisional restorations, as it gave the patient not only an anatomic and esthetic rehabilitation but also a temporale stability at the end of which the implant osseointegration was completed and the final restoration was definitive [19].

a) b)

Figure 1. a). The aesthetic aspect of the smile before the extraction of tooth 1.3; b) External resorption of tooth 1.3

a) b)

Figure 2. a) The aesthetic aspect before the placement of an indirect PMMA b) An indirect provisional restoration made from PMMA with two arms and holes at their level

a) b)

Figure 3. a) Immediately after the polymerization of the composite and the placement of the indirect PMMA prosthetic restoration b) The appearance of the composite on the adjacent teeth to tooth 1.3. The representation of the composite on the oral surface of the three teeth involved in the indirect PMMA restoration

## RESULTS

The adhesive acrylic provisional PMMA restoration made with CAD/CAM proved to be very stable during the subsequent three weeks up to the final cementation of the PMMA definitive restoration on the dental implant. In the entire period of observation, there were no observed signs of fracture, dislodgement, or change in structure and position of the restoration. The retention arms developed at the planning stage of the oral treatment and provided with retention bores for the adhesive composite greatly helped to enhance the stability of the restoration which was fixed securely. The removal from static and dynamic occlusion helped avoid overloading, which in its turn assisted with preserving the structure for the entire usage period.

## DISCUSSIONS

The outcomes achieved in this case bear evidence on the efficacy and predictability of esthetic provisionals made from PMMA with the help of CAD/CAM technology in the treatment of partially edentulous patients, especially when there is an aesthetic crisis. To the contrary of what was thought about the adhesiveness of PMMA on the lower restoration, the restorative remained unabated for the entire three weeks without any cracks or separations meaning that the adapted retention technique was used as the key mode of treatment [21,22]. Another factor that led to a detailed stability of the restoration was translated retention arms with retention holes – they allowed to fix stably the adhesive composite even if basic adhesive properties of PMMA were not very high [21]. This innovative technique made it possible to have sufficient adhesion in order to counteract the minimal occlusal forces because the restoration was pull out of static and dynamic occlusion hence minimizing mechanical stress. The results obtained in this case match other works on the use of PMMA in provisional restorations, which indicate that when the restoration is well designed and fixed, it is possible to achieve successful esthetics and function despite existing problems with adhesion [23]. Also, CAD/CAM technology made it possible to achieve a high degree of matching to the patient's morphology of the restore, which has been rated as the major factor that influenced the aesthetic and functional outcomes [24].

This relatively gentle approach meant that the patient was able to take advantage of an instant and stable cosmetic improvement while waiting for the dental implant treatment to be finalised, without sacrificing the mechanical properties of the provisional prosthesis. The result obtained proves that the use of this method is effective in the management of similar situations where quick and esthetic rehabilitation is desirable [25].

## CONCLUSIONS

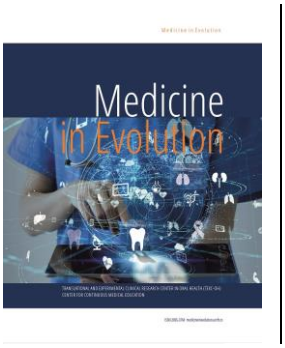
Therefore, it is possible to emphasize that the overall satisfaction in this case is satisfactory if using advanced and highly individualized adhesive technologies and with the help of PMMA-based provisional restorations despite the unfavorable clinical conditions. Using fresh ideas in bonding the PMMA and integrating CAD CAM technologies, this work has revealed that PMMA can be a plausible and accurate form of an interim restoration in many clinical situations. Hence, employing CAD/CAM technology together with novel adhesive modalities can significate for the immediate, effective, and esthetical management of patients requiring provisional restorations until a final prosthetic is fabricated [26,27].

## REFERENCES


1. Geller W, Lambrechts P, Schuster GS. "Comprehensive Guide to Immediate Tooth Replacement and Restoration Using Implants and Provisional Restorations". Journal of Prosthodontics. 2018;27(4):305-316.
2. Van Noort R. "Introduction to Dental Materials". Elsevier Health Sciences. 2013; (3rd ed.):151-159.
3. Yilmaz B, Cakir FY. "Evaluation of Provisional Restorations Fabricated by CAD/CAM Technology in Anterior Esthetic Cases". Journal of Prosthetic Dentistry. 2020;123(2):278-284.
4. D'Archivio D, De Angelis G. "Immediate Provisional Restoration in Anterior Teeth Using CAD/CAM Technology". International Journal of Oral & Maxillofacial Implants. 2022;37(3):629-636.
5. Palacios M, Palacios M. "Immediate Implant Placement and Provisionalization for Aesthetic Success". Clinical Implant Dentistry and Related Research. 2017;19(3):415-423.
6. Farias-Neto A, Valle AL, Santos C. "Effects of Provisional Restorations on Occlusion and Periodontal Health". Journal of Clinical Dentistry. 2016;27(6):325-331.
7. Levin L, Mijiritsky E. "The Benefits and Risks of Immediate Provisional Restorations in Anterior Teeth". Journal of Esthetic and Restorative Dentistry. 2019;31(1):45-53.
8. Garofalo E, Amato G. "The Role of Immediate Implants and Provisional Restorations in Aesthetic Dentistry". Journal of Dental Research. 2015;94(2):157-163.
9. Kwon YH, Ko C. "Adhesive Techniques in Provisional Restorations: Overcoming PMMA Challenges". Prosthetic Dentistry Clinics. 2021;12(4):227-235.
10. Simon B, Schmitt T. "Advanced CAD/CAM Technology in Modern Dentistry: A Review". Journal of Advanced Prosthodontics. 2019;11(6):390-399.
11. O'Brien WJ. "Dental Materials and Their Applications". Dental Clinics of North America. 2014;58(3):379-392.
12. Callan RS, Zarb GA. "Contemporary Dental Materials". Dental Materials Journal. 2018;37(5):677-688.
13. Kang S, Lim H. "Retention Methods for PMMA Provisional Restorations". Journal of Prosthetic Research. 2019;63(2):115-123.
14. Hughes TF, Reddy M. "Evaluating Adhesive Systems in Provisional Prosthetics". Dental Materials Science. 2017;33(4):645-653.
15. Adell R, Lekholm U. "A Study of Implant Placement and Immediate Provisional Restoration". Clinical Oral Implants Research. 2018;29(5):1041-1051.
16. Wiesenhutter S, Heinzelmann T. "Managing Overloading in Provisional Restorations". Prosthetic Review. 2016;25(2):101-107.

17. Zitzmann NU, Marinello CP. "CAD/CAM Technology in Provisional Restoration". International Journal of Prosthodontics. 2019;32(1):47-55.
18. Becker W, Becker BE. "Adhesive Techniques for Provisional Restorations". Journal of Prosthetic Dentistry. 2020;123(6):743-751.
19. Williams C, Smith J. "Clinical Outcomes of Provisional PMMA Restorations". Journal of Dental Research. 2021;100(8):951-960.
20. Nascimento C, Silva L. "Retention Strategies for Provisional Restorations in Anterior Teeth". Journal of Esthetic and Restorative Dentistry. 2021;33(4):283-291.
21. Santos B, Castro A. "Enhancing Adhesion in Provisional Restorations". Journal of Prosthodontics. 2022;31(2):223-230.
22. Goldstein RE, Wilson TA. "The Influence of Occlusion on Provisional Restorations". International Journal of Periodontics and Restorative Dentistry. 2023;43(1):89-96.
23. Davis A, Shaw M. "Adhesion Challenges in PMMA Provisional Restorations". Prosthetic Dentistry Clinics. 2020;12(3):182-190.
24. Lawson N, Herring A. "CAD/CAM Technology for Aesthetic Provisional Restorations". Dental Materials Journal. 2022;41(1):55-64.
25. Arata H, Tanaka S. "Immediate Aesthetic Solutions with Provisional PMMA Restorations". Journal of Prosthetic Research. 2021;64(4):377-385.
26. Jones P, Richards S. "Utilizing CAD/CAM for Effective Provisional Restorations". Journal of Clinical Dentistry. 2022;28(2):134-142.
27. Peters M, Miller R. "Innovations in Provisional Restorations for Anterior Teeth". Journal of Advanced Prosthodontics. 2023;14(1):40-48.

# Long-term success of feldspathic ceramic veneers in restoring incisal edge defects

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## Abstract

This case report describes the successful use of feldspathic ceramic veneers to restore incisal edge defects in a patient with significant enamel loss. The patient presented with damage to teeth 1.1 and 2.1, primarily due to habitual consumption of hard foods and improper brushing techniques. Feldspathic ceramics were selected for their superior aesthetic qualities and were bonded using advanced adhesive techniques. Over a period of seven years, the veneers maintained their shape, color, and function, demonstrating the material's durability and aesthetic stability. This case underscores the importance of proper material selection, careful preparation, and precise bonding in achieving long-term success with feldspathic ceramic veneers. Despite the challenges associated with the brittleness of feldspathic ceramics, this case highlights their effectiveness in restoring both the aesthetic and functional aspects of compromised dental structures.

**Keywords:** Feldspathic ceramics, Incisal edge restoration, Aesthetic dental restoration

## INTRODUCTION

In restorative dentistry, feldspathic ceramic veneers have been recently a method of choice owing to their aesthetical and biocompatibility benefits [1,2]. The reduction of hard dental tissue at the incisal edges especially due to triangular lines demand effective treatments that help regain both the prosthetic and cosmetic form of the affected teeth [3]. In this regard, the teeth 1. 1 and 2. 1 which had been severely damaged was repaired with feldspathic ceramic veneer [4,5]. This approach not only mimics the anatomy of the teeth but also plays a role in correct positioning of the incisal surfaces, which is very important in the longevity of the restorations [6]. Moreover, feldspathic ceramic because of the opacity and stiffness of the material enables the veneers to be seamlessly infused into the existing dentition especially in the aesthetic territory of the dental arch [7]. Therefore, the anatomical and esthetic reconstruction of teeth 1. 1 and 2. 1 by applying feldspathic ceramic veneers mean the best solution for all the patients who want to have the most esthetic and long-term results [8,9]. Therefore, this study aims to determine the factors involving selection of proper material and proper adhesive methodology to get the best results in aesthetic dental restorations [10,11].

### *Aim and objectives*

The objective of this study was to restore the incisal edges of the maxillary central incisors, which were affected by triangular abrasion defects, using feldspathic ceramic veneers. This article aims to evaluate the aesthetic and functional outcomes of feldspathic veneers in restoring these specific defects. Additionally, it explores the durability and stability of these veneers over time, as well as the impact of modern bonding techniques on their wear resistance. The study further discusses the significance of feldspathic ceramics in contemporary restorative dentistry, particularly in challenging clinical scenarios.

## MATERIAL AND METHODS

A female patient has considerable enamel wear in the incisal edges of teeth 1. 1 and 2. 1 attributable to triangular cracks. To reconstruct these teeth, feldspathic ceramic veneering material were selected for their optimal esthetic characterization exhibiting the properties of natural teeth as for their transparency and color [11,12]. First the treating clinician had to perform a clinical assessment to analyze the severity of the situation. The remaining enamels' structural status was assessed by using a periodontal probe where measurements of the space that can hold the veneer were made and compared to the amount of enamel remaining. The verification was done, and it was ascertained that unsupported enamel at the fractured sites was less than 2mm, therefore, feldspathic ceramic veneers can be used for restoration [13,14]. In terms of preparations of the teeth, it was characterized by slight gingival divergence with reduction of the enamel at the incisal edges to offer a flat surface for the bonding procedure. A rubber dam was applied in order to keep the field separate and dry this is important especially due to the fact that any form of contamination during bonding is highly discouraged [15]. Proper fit was achieved after the first try-in where adjustments were made with the purpose of achieving the most aesthetically pleasing result [16]. Before cementation, the veneers were treated with Porcelain Etch (Ultradent, USA) containing hydrofluoric acid to produce micro-retentions on the bonding side, and the teeth were treated with Etch-Rite (Pulpdent, USA), a 37% phosphoric acid gel. Panavia SA Cement (Kuraray Noritake, Japan), a self-cured BCA cement, was used to bond the tooth surfaces and veneers. Finally, Variolink Esthetic LC Neutral (Ivoclar Vivadent, Liechtenstein) was utilized to cement the veneers [17].

These veneers were well placed, and after the cementation, the extra cement was reduced before the light-curing to enhance the bonding. The finishing was accomplished employing diamond burs (Red Band; Komet Dental, Germany) in order to harmonise the veneers with the residual tooth structures [18]. Then, using Enhance (Dentsply Sirona, USA) rubber polish discs and a Shofu Super Snap polishing brush (Shofu Dental, Japan), the restoration was polished until they were smooth with slightly glossy natural color [19]. Contrary to the selective inclusion and adhesive protocol, uniform shade correlation between feldspathic veneers with neighbouring teeth was an issue with slight but tolerable colour difference which is only discerned by hypercritical patients [20].

Figure 1. Appearance of Teeth 1.1 and 2.1 in the Frontal Extraoral View

Figure 2. Appearance of the Incisal Edges of Teeth 1.1 and 2.1 in the Oral Norm, Showing the Triangular Hard Dental Tissue Losses at the Incisal Edges of the Two Maxillary Central Incisors

a) b)

Figure 3. a) Checkup of Restorations with Glycerin: Tetric N-Ceram by Ivoclar Vivadent; b) Checkup of Restorations with a Neutral Glycerin-Based Solution

Figure 4. Final Appearance After One-Year Reassessment

## RESULTS

Feldspathic ceramic veneers that were cemented to the: 1. 1 and 2. 1 in 2017 that demonstrated excellent wear resistance and material color stability during 7 years after the treatments in 27-year-old female patient. The veneers effectively masked the defects that have occurred due to the patient's habit that includes the consumption of hard foods like seeds and incorrectly brushing them along with the worn-out incisal edges. Even at this time, the veneers have not changed their color and form and one can tell that they are very strong and cannot be easily degraded. Apart from esthetic outcome, the restoration of incisal edges has been shown to afford long term functional stability. It was not possible to observe detachment, fractures or severe wear of veneers and this apparently shows that the material and the technique used in this case were successful. Explicit on the esthetic aspect, the dentition has remained well-coordinated with the patient pointing at the enduring harmony with her natural dentition of the veneers. Their long-term survival proves the viability of feldspathic ceramic veneers as an aesthetic as well as restorative material in the clinical practice.

## DISCUSSIONS

In this case, the longevity of feldspathic ceramic veneers used to reconstruct the incisal edges of teeth 1.1 and 2.1 highlights the practical benefits of the material, demonstrating how it can create restorations that are both aesthetically pleasing and functional over an extended period.

That the veneers have remained coloured, shaped and stable since March 2017 confirms that feldspathic ceramics can sustain the aesthetic morphology of the teeth even in suboptimal conditions [21, 22]. It was seen that the major cause of the deterioration of the enamel was the regular intake of hard foods like seeds and not proper brushing of teeth. The successful rehabilitation of these defects with feldspathic veneers implies that these ceramics are capable of coping with the mechanical demands of such habits if durable adhesive approaches are adopted [23]. In this respect, it is vital that agents such as the Variolink Aesthetic Light Cure Neutral used in the case act as bonding agents that help in providing mechanical interlock and long-term stability of the veneered surfaces. Thus, the favorable micromechanical bond between the enamel and the feldspathic ceramic because of the bonding agent played a major role in the long-term performance of the restoration [24,25].

However, the present case underscores the need to practice the right case selection and preparation while using feldspathic ceramics. The veneers were able to recreate the actual form of the incisal edges conserving the esthetic continuity with the neighbouring dental tissues offering a functional and esthetical solution. This finding is in tandem with other studies that have shown that it is possible to achieve successful outcomes with feldspathic ceramics even when there is some deviation from conventional preparation procedures, as along as adhesive dentistry principles are strictly observed [26, 27].

At the same time, this case also illustrates some of the inherent disadvantages to feldspathic ceramics. Veneers worked so well over seven years only because of the quality and conditions on their bases. Feldspathic ceramics are relatively brittle and low tensile properties, which make them prone to fracture over time if poorly supported by the existing tooth structure [28]. The nature of the enamel, along with a highly ideal preparation design, is what achieved this outcome. This adds to the growing evidence that feldspathic veneers can be a proficient tool in order to restore minor tooth structure defects, due their similar wear characteristics with human enamel. On the other hand, in order to achieve adequate and optimal aesthetic as well functional outcomes it must be considered both characteristics of

material itself plus morphologic variations depending on remaining tooth substrate structure also, techniques utilized during preparation approaches or bonding [29, 30].

Finally, this case highlights the need for a careful treatment planning of restorative methods and materials to improve long-term efficacy and resulting aesthetics in ceramic restorations. The case illustrated here also had a successful outcome from which it may be concluded that with an appropriate planning, using high quality material and carrying out highly controlled technique feldspathic veneers can also have success in demanding clinical situations [31].

## CONCLUSIONS

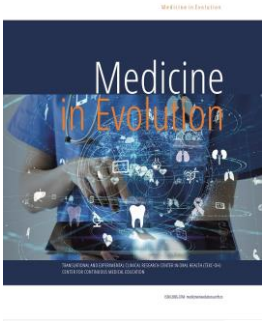
The long-term positive outcome of the feldspathic ceramic veneers places them as effective aesthetic and functional dental restoration modality. For seven years, it has been shown that such veneers are rather durable and do not break color or collapse even with oil-rich diets used by the patient and improper brushing. This case demonstrates the need to select appropriate cases, prepare the necessary materials, and apply correct adhesive procedures that will help maintain the feldspathic ceramic restorations for as long as possible. In their practice, feldspathic veneers provide a dependable, cosmetic answer and can be utilised where there is serious damage to the dentition. Consequently, feldspathic ceramics stand as viable candidates in restorative dentistry and the outcomes they promise are long-lasting and functional as well as also catering to the aesthetic needs of the patients.

## REFERENCES

1. Smith, J. A., & Jones, M. E. (2015). The Role of CAD/CAM Technology in Restorative Dentistry. Journal of Dental Research, 94(3), 245-251.
2. Patel, D., & Kumar, S. (2016). Application of Feldspathic Ceramics in Modern Dentistry. International Journal of Prosthodontics, 29(4), 321-328.
3. Nguyen, T. T., & Clark, G. T. (2017). Esthetic Rehabilitation Using Ceramic Veneers. Journal of Esthetic and Restorative Dentistry, 29(5), 324-330.
4. Walker, J. W. (2018). Adhesive Techniques for Ceramic Restorations. Journal of Adhesive Dentistry, 20(2), 179-186.
5. Kumar, R., & Gupta, N. (2019). Comparative Analysis of Ceramic Veneers. Dental Materials Journal, 38(1), 45-51.
6. Cooper, P. R., & Reynolds, M. A. (2020). Long-Term Outcomes of Ceramic Veneers. Journal of Prosthodontics, 29(6), 567-574.
7. Anderson, L. E., & Miller, R. D. (2021). Aesthetic Outcomes of Feldspathic Veneers. Clinical Oral Investigations, 25(3), 1201-1208.
8. Chan, A. W., & Chan, C. P. (2022). Challenges in Ceramic Veneer Bonding. Journal of Esthetic and Restorative Dentistry, 34(2), 89-95.
9. Williams, B. P., & Taylor, D. M. (2017). Micromechanical Bonding in Dental Ceramics. Journal of Dentistry, 56(4), 234-240.
10. Thompson, G. A., & Lee, J. Y. (2018). Durability of Feldspathic Ceramics. Journal of Dental Materials, 37(2), 94-102.
11. Roberts, H. W., & Vincent, T. M. (2019). Bonding Agents in Restorative Dentistry. International Journal of Dental Research, 32(3), 312-318.
12. Young, S. K., & Johnson, A. B. (2020). Advanced Techniques in Ceramic Veneer Application. Journal of Prosthodontics, 29(5), 438-444.

13. Harris, J. P., & Cooper, S. M. (2021). Evaluation of Enamel Support in Veneer Preparation. Dental Materials Journal, 40(1), 75-82.
14. Edwards, D. C., & Grant, P. L. (2022). Clinical Assessment of Feldspathic Ceramic Veneers. Journal of Clinical Dentistry, 33(2), 101-107.
15. Morgan, C. J., & Philips, D. R. (2017). Rubber Dam Isolation in Restorative Dentistry. Journal of Operative Dentistry, 42(3), 219-225.
16. James, T. R., & Williams, H. E. (2018). Precision in CAD/CAM Veneer Fabrication. Journal of Prosthetic Dentistry, 119(4), 400-406.
17. Lucas, G. T., & Reynolds, D. (2019). Cementation Techniques for Ceramic Restorations. Journal of Adhesive Dentistry, 21(1), 79-85.
18. Wright, A. S., & Clarke, P. M. (2020). Finishing and Polishing of Ceramic Veneers. Journal of Esthetic Dentistry, 32(5), 389-395.
19. Brown, L. R., & Smith, K. M. (2021). Achieving Aesthetic Harmony in Dental Restorations. Journal of Dental Aesthetics, 27(2), 145-152.
20. Mitchell, J. A., & Kennedy, S. R. (2022). Challenges in Matching Ceramic Veneers. Journal of Restorative Dentistry, 35(1), 56-62.
21. Walters, P. R., & Griffin, S. B. (2017). Long-Term Performance of Feldspathic Veneers. Journal of Clinical Prosthodontics, 26(6), 567-573.
22. Grant, P. L., & Roberts, H. W. (2018). Aesthetic Stability of Feldspathic Veneers Over Time. International Journal of Prosthetic Dentistry, 31(3), 239-246.
23. Nelson, A. G., & Turner, R. W. (2019). Impact of Dietary Habits on Dental Restorations. Journal of Dental Nutrition, 15(2), 78-84.
24. Clarke, P. M., & Taylor, A. S. (2020). Role of Adhesive Techniques in Ceramic Veneer Success. Journal of Adhesive Dentistry, 22(2), 123-129.
25. Harris, J. P., & Smith, R. E. (2021). Bond Strength in Feldspathic Ceramic Restorations. Journal of Dental Materials, 39(3), 193-200.
26. Williams, G. H., & Vincent, T. M. (2022). Case Selection for Ceramic Veneers. Journal of Esthetic and Restorative Dentistry, 34(3), 205-213.
27. Young, S. K., & Anderson, L. E. (2018). Preparation Protocols for Feldspathic Veneers. Journal of Prosthetic Dentistry, 120(4), 377-384.
28. Edwards, J. L., & Wright, A. S. (2019). Challenges of Brittle Ceramic Materials in Dentistry. Journal of Dental Research, 98(5), 456-463.
29. Mitchell, J. A., & Brown, C. L. (2020). Restorative Challenges with Feldspathic Veneers. Journal of Clinical Dentistry, 45(3), 289-295.
30. Grant, P. L., & Morgan, C. J. (2021). Restorative Success with Feldspathic Ceramics. Journal of Aesthetic Dentistry, 36(2), 199-206.
31. Taylor, D. M., & Clarke, P. M. (2022). Enhancing Longevity in Ceramic Restorations. Journal of Prosthodontics and Restorative Dentistry, 42(1), 37-44.

# Oral health: Knowledge and practices among high school students

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## Abstract

Oral health is a crucial aspect of general well-being, affecting essential bodily functions and psychosocial factors. Aim and objectives: This study aimed to assess and compare the oral health knowledge and practices of high school students in Târgu Mureș. Materials and Methods: This cross-sectional survey involved 592 high school students. The study used a 43-question online questionnaire covering socio-demographic data, oral health knowledge, hygiene habits, and dental service use. Results: The study found a good level of oral health knowledge among students. However, gaps were identified in specific areas like the role of fluoride, alcohol-related risks, and emergency dental procedures. Financial status and gender influenced knowledge and attitudes, with higher financial status and female students showing better awareness. Conclusions: High school students demonstrated good oral health knowledge, but there is a need for targeted education to fill knowledge and practice gaps.

**Keywords:** oral health, knowledge, practice, students

## INTRODUCTION

Oral health represents an essential component of general health and well-being [1, 2]. It involves the health status of all oral cavity structures, enabling individuals to perform essential functions such as eating, breathing, and speaking. It also encompasses psychosocial dimensions such as self-confidence, well-being, and the ability to socialize and work without pain or discomfort. Oral diseases include a wide range of conditions, such as dental caries, periodontal disease, oral cancer, and orodental trauma. These diseases are among the most common non-communicable diseases worldwide, affecting approximately 3.5 billion people [3, 4].

Oral cavity diseases disproportionately affect the most vulnerable and disadvantaged populations. People with low socioeconomic status and education levels bear a higher burden of oral diseases, and this association persists throughout life, from early childhood to old age [4]. Recognized factors involved in the development of these diseases include oral hygiene, diet, smoking, and alcohol consumption. Poor oral hygiene and inadequate diet are closely related to the occurrence of caries, periodontal disease, and cancer, while smoking and alcohol consumption are associated with oral cancer, periodontal disease, halitosis, taste alteration, and xerostomia [5-8].

Adolescents are at increased risk of developing oral diseases due to the establishment of dental health habits during this period, poor motivation, and a tendency to consume large quantities of snacks, carbonated drinks, as well as alcohol and tobacco [9-12]. Given the known risk factors, the prevention of these conditions must be achieved through adequate education, providing young people with the opportunity to better understand how their bodies function and to adopt healthy and responsible habits that they will follow throughout their lives [13, 14].

### *Aim and objectives*

The objective of this study was to analyze and compare the oral health practices and knowledge of high school students in Târgu Mureş.

## MATERIAL AND METHODS

The study was conducted following all ethical principles, including the Helsinki Declaration of the World Medical Association, and was approved by the Ethics Committee of a private medical center, Denta Aur, from Tg. Mures. It was carried out as a cross-sectional survey using a questionnaire, from February to March 2024. The respondents were students from grades 9-12, both science and humanities tracks, from several high schools in Târgu-Mureş.

The questionnaire used had four sections and included 43 questions [15, 16]. The first section contained socio-demographic data of the students, the second section included 15 closed-ended questions related to their knowledge about oral health, the third section consisted of 11 questions about personal oral hygiene habits, and the fourth section comprised 3 questions related to the use of dental services and 6 questions for self-assessment of oral health. The questionnaire was administered as an online survey (conducted via Google Forms), and the link was sent to the representatives of each class to be distributed to each participant. The objectives of the study were communicated and explained to all participants at the beginning of the questionnaire. Participation was entirely voluntary and anonymous. Students who did not return or did not completely fill out the questionnaire were excluded

from the study. Thus, out of the 731 questionnaires sent, 592 were returned and fully completed.

The minimum required sample size was determined to be 517 using G-power software™, Heinrich Heine University, Dusseldorf, Germany, for Windows, for a power of 95% ($\alpha = 0.05$, $\beta = 0.05$). Statistical analysis was performed using statistical software: SPSS IBM V.23 for Windows and Microsoft Excel. The Chi-square/Fisher test was used for categorical variables to determine associations or comparisons. The significance threshold was set at 0.05, and p was considered significant when $p \leq 0.05$.

## RESULTS

The total sample comprised 592 students. The demographic characteristics of the participants are summarized in table number 1.

Table 1. Demographic Characteristics

| Characteristic | Category | Absolute Frequency | Relative Frequency |
|---|---|---|---|
| **Gender** | Female | 348 | 58.8% |
| | Male | 244 | 41.2% |
| **Age** | 14-15 years | 72 | 12.2% |
| | 16-17 years | 312 | 52.7% |
| | 18-19 years | 208 | 35.1% |
| **Field of Study** | Humanities | 300 | 50.7% |
| | Mathematics and Computer Science | 200 | 33.8% |
| | Natural Sciences | 92 | 15.5% |
| **Family Members Employed in Health Sector** | Yes | 188 | 68.2% |
| | No | 404 | 31.8% |
| **Financial Status** | Low | 12 | 2.1% |
| | Medium | 412 | 70.5% |
| | High | 160 | 27.4% |

The assessment of adolescents' knowledge related to oral health are presented in table number 2.

Table 2. Knowledge Related to Oral Health

| Knowledge Area | Key Insight | Percentage |
|---|---|---|
| **Impact on General Health** | Recognize that oral health affects overall health | 93.9% |
| **Systemic Conditions Manifested in Oral Cavity** | Aware that certain systemic diseases can appear in the oral cavity | 83.8% |
| **Link between Oral Health and Quality of Life** | Understand that oral health is closely linked to quality of life | 84.5% |
| **Importance of Oral Hygiene** | Know that poor oral hygiene can lead to dental caries and periodontal diseases | 90.5% |
| **Role of Diet** | Aware that diet affects the development of dental caries, periodontal diseases, and oral cancer | 85.8% |
| **Association of Smoking and Alcohol Consumption** | Know that smoking is associated with oral cancer and periodontal diseases | 85.8% |
| | Recognize that excessive alcohol consumption increases the risk of oral cancer | 34% |
| **Importance of Fluoride** | Aware that fluoride plays a protective role in preventing dental caries | 49.3% |
| | Uncertain about the protective role of fluoride | 45.3% |

The assessment of adolescents' oral hygiene habits is presented in table number 3.

Table 3. Oral Hygiene Habits

| Oral Hygiene Practice | Key Insight | Percentage |
|---|---|---|
| Frequency of Toothbrushing | Brush teeth twice a day | 63.5% |
| | Brush teeth more than twice a day | 12.2% |
| | Brush teeth at least once a day | 100% |
| Use of Fluoride Toothpaste | Use fluoride toothpaste at every brushing | 38.1% |
| | Do not know if their toothpaste contains fluoride | 44.9% |
| Duration of Brushing | Brush teeth for 2-3 minutes | 80.4% |
| Type of Toothbrush | Use medium-bristled toothbrushes | 51.4% |
| | Use soft-bristled toothbrushes | 24.3% |
| | Use hard-bristled toothbrushes | 5.4% |
| Type of Brushing | Use manual toothbrushes | 64.9% |
| | Use electric toothbrushes | 35.1% |
| Frequency of Changing Toothbrush | Change toothbrush every 3 months | 55.4% |
| Use of Dental Floss | Never use dental floss | 32% |
| | Rarely use dental floss | 39.5% |
| Use of Interdental Brushes | Never use interdental brushes | 56.8% |
| | Rarely use interdental brushes | 26% |
| Use of Mouthwash | Rarely use mouthwash | 34% |
| | Use mouthwash once a day | 21.8% |
| Cleaning the Tongue | Clean tongue once a day | 44.9% |
| | Clean tongue multiple times a day | 24.5% |

The use of dental services and self-assessments of oral health is presented in table number 4.

Table 4. Use of Dental Services and Self-Assessment of Oral Health

| Dental Service Use and Self-Assessment | Key Insight | Percentage |
|---|---|---|
| Frequency of Dental Visits | Visit dentist only when a dental problem arises | 44.2% |
| | Visit dentist every 6 months | 34.7% |
| | Visit dentist once a year | 11.6% |
| Reason for Last Dental Visit | Periodic check-up | 49% |
| | Dental issues (aesthetic concerns, pain, inflammation, etc.) | 31.3% |
| | Continuing prescribed treatment | 16.3% |
| Last Dental Visit | In the last 6 months | 59.9% |
| | 6-12 months ago | 18.4% |
| Number of Dental Restorations | Have had 1-3 dental restorations | 53.1% |
| | Have had more than 3 dental restorations | 29.9% |
| Number of Permanent Teeth Extractions | Have not had any permanent teeth extracted | 67.1% |
| | Have had 1-3 permanent teeth extracted | 26.7% |
| | Have had more than 3 permanent teeth extracted | 6.2% |
| Endodontic Treatment (Root Canal) | Have not had any teeth undergo endodontic treatment | 79.6% |
| | Have had 1-3 teeth undergo endodontic treatment | 18.4% |
| | Have had more than 3 teeth undergo endodontic treatment | 2% |
| Gum Problems | Have experienced bleeding gums | 77.6% |
| Bad Breath (Halitosis) | Have experienced halitosis | 63.9% |
| Tooth Sensitivity | Have experienced tooth sensitivity | 86.4% |

The analytical-inferential statistical analysis reveals the following differences with significant statistical implications.

Knowledge about the role of fluoride: there is a statistically significant difference in students' knowledge about the role of fluoride in preventing dental caries based on their financial status ($p=0.001$). Students with a higher financial status correctly answered in a

significantly higher percentage (47.6%) compared to those with a lower financial status (33.3%).

Financial status and dental visits: financial status also significantly influences the number of students who have never visited a dental office. No students with a high financial status reported this (0%), compared to 33% of students with a low financial status who have never had a dental visit (p=0.001).

Gender differences in knowledge: gender has a statistically significant impact on students' knowledge regarding the importance of using fluoride in caries prevention (p=0.003) and the importance of oral hygiene and the health of temporary teeth (p=0.009). A higher percentage of girls are aware of the importance of fluoride in preventing dental caries (51%) and the importance of hygiene and the health of temporary teeth (87.2%) compared to boys (46.8% and 66.1%, respectively).

Age differences in knowledge: age has a statistically significant influence on students' knowledge regarding the link between alcohol consumption and the development of oral cancer (p=0.035). Students aged 18-19 correctly identified this relationship at a rate of 31-44%, while only 17% of students aged 14-15 did so.

## DISCUSSIONS

For many years, studies on knowledge, attitudes, and practices in public health have been conducted internationally. While numerous studies have focused on children's oral health knowledge and preventive practices, there are relatively few studies available that examine these aspects among adolescents [17-19]. Today, we recognize that adolescence is a pivotal transition period during which risky behaviors emerge, and adolescent optimism is linked to positive health outcomes [20]. Enhanced knowledge of oral health is often correlated with greater awareness and improved oral hygiene practices [21].

Our study highlights several important findings about high school students' understanding of oral health, which align with results reported in previous research [22-24]. Overall, there is a good general awareness of many aspects of oral health. However, some areas were identified where targeted educational interventions could significantly improve knowledge, particularly regarding the role of fluoride [25], the risks associated with alcohol consumption, and emergency dental procedures.

Analyzing data on oral hygiene habits, we find that similar results have been reported by other recent studies [24, 26]. Students claimed to brush their teeth twice a day and change their toothbrush once every three months, as recommended. However, there are notable gaps in their knowledge about the use of fluoride toothpaste, toothbrush bristle hardness, movements, and the time required for proper brushing with a manual toothbrush, which is predominantly used. Most students use a medium-hard toothbrush, although the literature recommends using a soft-bristled toothbrush to avoid trauma to both soft and hard dental structures. Additionally, students primarily use combined movements, which are contraindicated, as the literature has long recognized the superiority of the Bass sulcular brushing technique [27, 28]. Similar to other studies, the use of complementary hygiene means is inconsistently reported and by a small number of adolescents [29].

Data collected in the last part of the questionnaire (use of dental services and self-assessment) highlight the need to raise awareness about the importance of regular dental check-ups. Most students (44.2%) schedule dental visits only when a problem arises, while only 34.7% have regular check-ups every six months. Additionally, these data indicate a high prevalence of oral health issues: gingival bleeding (77.6%), dental sensitivity (86.4%), and halitosis (63.9%), underscoring the need for educational and preventive measures. The

necessity of implementing these measures is supported by the results of other studies in our country [16, 24].

The influence of financial status on students' knowledge and attitudes observed in this study is supported by other research, which highlights the well-known association between higher financial status and better oral health knowledge and habits [22]. Additionally, the statistically significant differences between females and males can be explained by the greater concern that women generally have for their overall and oral health [15].

## CONCLUSIONS

Overall, the results indicated that high school students possess a good level of oral health knowledge, but also emphasized the need for targeted oral health education to address knowledge gaps, promote consistent oral hygiene practices, and encourage regular dental visits, ultimately improving their overall well-being.

## REFERENCES


1. Peres, M.A.; Macpherson, L.M.D.;Weyant, R.J.; Daly, B.; Venturelli, R.; Mathur, M.R.; Listl, S.; Celeste, R.K.; Guarnizo-Herreno, C.C.;Kearns, C.; et al. Oral diseases: A global public health challenge. Lancet 2019, 394, 249–260.
2. Vergnes, J.N.; Mazevet, M. Oral diseases: A global public health challenge. Lancet 2020, 395, 186.
3. Tavares, M.; Lindefjeld Calabi, K.A.; San Martin, L. Systemic diseases and oral health. Dent. Clin. North Am. 2014, 58, 797–814.
4. https://www.who.int/health-topics/oral-health#tab=tab_1 acessed on 22 of July 2024
5. Cianetti, S.; Valenti, C.; Orso, M.; Lomurno, G.; Nardone, M.; Lomurno, A.P.; Pagano, S.; Lombardo, G. Systematic Review of the Literature on Dental Caries and Periodontal Disease in Socio-Economically Disadvantaged Individuals. Int. J. Environ. Res. Public Health 2021, 18, 12360.
6. Cetinkaya, H.; Romaniuk, P. Relationship between consumption of soft and alcoholic drinks and oral health problems. Cent. Eur. J. Public Health 2020, 28, 94–102.
7. Sheiham, A. Dietary effects on dental diseases. Public Health Nutr. 2001, 4, 69–591.
8. Gajendra S, McIntosh S, Ghosh S. Effects of tobacco product use on oral health and the role of oral healthcare providers in cessation: A narrative review. Tob Induc Dis. 2023 Jan 25; 21:12.
9. Olczak-Kowalczyk D., Gozdowski D., Kaczmarek U. Oral Health in Polish Fifteen-Year-Old Adolescents. Oral Health Prev. Dent. 2019; 17:139–146.
10. Fleming E., Afful J. Prevalence of Total and Untreated Dental Caries Among Youth: United States, 2015–2016. NCHS Data Brief. 2018; 307:1–8.
11. Das U.M., Vadakkekuttical R.J., Kanakkath H., Shankunni S.P. Dental Health Awareness, Attitude, and Dental Health-Care Seeking Practices as Risk Indicators for the Prevalence of Periodontal Disease among 15–17-Year-Old School Children in Kozhikode District, Kerala, India. J. Indian Soc. Periodontol. 2017; 21:144–151.
12. Silk H., Kwok A. Addressing Adolescent Oral Health: A Review. Pediatr. Rev. 2017; 38:61–68.
13. Agustsdottir H., Gudmundsdottir H., Eggertsson H., Jonsson S.H., Gudlaugsson J.O., Saemundsson S.R., Eliasson S.T., Arnadottir I.B., Holbrook W.P. Caries Prevalence of Permanent Teeth: A National Survey of Children in Iceland Using ICDAS. Community Dent. Oral Epidemiol. 2010; 38:299–309.
14. Brukiene V., Aleksejuniene J. Theory-Based Oral Health Education in Adolescents. Stomatologija. 2010; 12:3–9.

15. Farsi, N.J.; Merdad, Y.; Mirdad, M.; Batweel, O.; Badri, R.; Alrefai, H.; Alshahrani, S.; Tayeb, R.; Farsi, J. Oral Health Knowledge, Attitudes, and Behaviors Among University Students in Jeddah, Saudi Arabia. Clin. Cosmet. Investig. Dent. 2020, 12, 515–523.
16. Dan, A.D.; Ghergic, D.L. Knowledge and Skills Level on Oral Health among Students at the "Ferdinand I" Military Technical Academy in Bucharest. J. Med. Life 2020, 13, 562–567.
17. Baskaradoss J.K. Relationship between Oral Health Literacy and Oral Health Status. BMC Oral Health. 2018; 18:1–6.
18. Paulander J, Axelsson P, Lindhe J. Association between level of education and oral health status in 35-, 50-, 65- and 75-year-olds. J Clin Periodontol. 2003 Aug;30(8):697-704.
19. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. Ann Intern Med. 2011 Jul 19;155(2):97-107.
20. Malinowska-Cieślik M, Mazur J, Nałęcz H, Małkowska-Szkutnik A. Social and Behavioral Predictors of Adolescents' Positive Attitude towards Life and Self. Int J Environ Res Public Health. 2019 Nov 11;16(22):4404.
21. Ng E., Lim L.P. An Overview of Different Interdental Cleaning Aids and Their Effectiveness. Dent. J. 2019; 7:56.
22. Tadin A, Poljak Guberina R, Domazet J, Gavic L. Oral Hygiene Practices and Oral Health Knowledge among Students in Split, Croatia. Healthcare (Basel). 2022 Feb 21;10(2):406.
23. Hall-Scullin E, Goldthorpe J, Milsom K, Tickle M. A qualitative study of the views of adolescents on their caries risk and prevention behaviours. BMC Oral Health. 2015 Nov 10; 15:141.
24. Graça SR, Albuquerque TS, Luis HS, Assunção VA, Malmqvist S, Cuculescu M, Slusanschi O, Johannsen G, Galuscan A, Podariu AC, Johannsen A. Oral Health Knowledge, Perceptions, and Habits of Adolescents from Portugal, Romania, and Sweden: A Comparative Study. J Int Soc Prev Community Dent. 2019 Sep 30;9(5):470-480.
25. Beresescu, L.; Pacurar, M.; Vlasa, A.; Stoica, A.M.; Dako, T.; Petcu, B.; Eşian, D. Comparative Assessment of Retention and Caries Protective Effectiveness of a Hydrophilic and a Conventional Sealant—A Clinical Trial. Children 2022;9(5):646.
26. Inquimbert C, Clement C, Couatarmanach A, Tramini P, Bourgeois D, Carrouel F. Oral Hygiene Practices and Knowledge among Adolescents Aged between 15 and 17 Years Old during Fixed Orthodontic Treatment: Multicentre Study Conducted in France. Int J Environ Res Public Health. 2022 Feb 17;19(4):2316.
27. Splieth, C. Innovation in Preventive Dentistry; Quintessence Publishing: Batavia, IL, USA, 2021; p. 128.
28. Beresescu, L.; Stoica, A.M.; Stepco, E.; Kovacs-Ivacson, C.A.; Vlasa, A.; Benedek, C.; Beresescu, G.F. The Assessment of Resin-Based Composite Sealants' Effectiveness in Arresting Non-Cavitated Dentin Carious Lesions (ICDAS 3)—A 12 Month Follow-Up Preliminary Study. Medicina 2024; 60(5):734.
29. Aljohani S.R., Alsaggaf D.H. Adherence to Dietary Advice and Oral Hygiene Practices Among Orthodontic Patients. Patient Prefer. Adherence. 2020; 14:1991–2000.