MACEDONIAN DENTAL REVIEW

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THE USE OF A SILICONE INDEX AS GUIDANCE DURING TOOTH PREPARATION

УПОТРЕБА НА СИЛИКОНСКИ КЛУЧ КАКО ВОДАЧ ПРИ ПРЕПАРАЦИЈА НА ЗАБИТЕ

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Abstract

Objective: the aim of this study is to present a case report that will demonstrate the effect that the silicone index has on the clinician's ability to appropriately perform the preparation procedure and achieve the desired geometrical shape of the prepared tooth. **Case report:** a 43 year old patient came to us with a chief complaint to find a solution for the anterior upper teeth and the two missing premolars in the lateral right side of the upper jaw. These fixed prosthetic constructions were made of zirconia with CAD/CAM technology. Before tooth preparation, we made two silicone indexes, which we used as guidance for periodical checkups of the tooth preparation procedure, in order to maintain certain characteristics (such as precise amount of reduction of the tooth surfaces and their final shape). The preparation phase was followed with a standard protocol of taking impressions, laboratory procedures and at the end, cementation of the final restorations. **Results:** with the help of the silicone indexes we managed to perform a precise preparation of the teeth, which resulted in the desired smooth and mildly tapered tooth form with satisfactory primary retentive characteristics. Also, we provided enough space for the thickness of the porcelain, in order to exploit all the benefits that this material has to offer (while in the same time not jeopardizing the integrity of the hard dental tissues and the pulp). **Conclusion:** according to our previous experience, it is important that the clinician includes a guidance system for assistance during tooth preparation (in our case, a silicone index), which not only simplifies this procedure, but can also help avoid any unwanted consequences (which are likely to occur when a free hand approach for tooth preparation is used). **Key words:** prosthodontics; dental prosthesis, denture, partial, fixed; silicone index, CAD/CAM technology

Апстракт

Цел на трудот: Целта на овој труд е да се прикаже случај, преку кој би можело да се увиди ефектот на силиконскиот клуч врз текот на препарацијата и можноста за добивање на геометриски посакуван облик на забно трупче. **Приказ на случајот:** пациент на возраст од 43 години дојде на преглед, барајќи решение за горните предни заби и двата екстрахирани преткатници на десната бочна страна од максилата. Протетските реставрации ги изработивме од циркониja со помош на CAD/CAM технологијата. Пред почетокот на препарацијата, изработивме два силиконски клучеви, кои го користевме како показател при препарацијата и со кој правевме периодични контроли, со цел за да се запазат одредени карактеристики, како степенот на редукција на забните површини и нивниот конечен облик. После извршената препарација следуваше стандардниот протокол на земање отпечатоци, лабораториска фаза на работа и на крај цементирање на финалните изработки. **Резултати:** со употребата на силиконските клучеви, успеавме да извршиме коректна препарација на забите, која резултираше со добивање на забни трупчиња со саканата благо-конусна форма и задоволителна примарна ретенција. Исто така обезбедивме доволно простор за керамиката да биде со потребната димензија, за да може да се искористат сите предности на овој материјал (без притоа да го загрозиме интегритетот на тврдите забни ткива и пулпиното ткиво). **Заклучок:** Според нашето досегашно искуство, секогаш пожелно е да се употребува некој метод (во нашиот случај силиконски индекс), кој би послужил како навигатор при препарацијата и би ја поедноставил истата, воедно намалувајќи ги можностите за појава на несакани последици (кои можности се големи, особено кога препарацијата се врши со слободна рака). **Клучни зборови:** протетика; забна протеза, забна протеза, парцијална, фиксна; силиконски клуч, CAD/CAM технологија.

Introduction

Teeth do not possess the regenerative ability found in most other tissues in the human body. Therefore, once enamel or dentin is lost as a result of caries, trauma or wear, restorative materials and procedures must be used to reestablish the normal form and function of the affected teeth. When the defects in the tooth structure surpass any possibility of a conservative treatment, adequate measures should be taken for a fixed prosthodontics approach (dental crowns or bridges). Teeth require a preparation procedure in order to receive these prosthodontics restorations, and these preparations must be based on fundamental principles from which basic criteria can be developed to help predict the success of the prosthodontics treatment. These principles of tooth preparation can be divided into three categories:

1. Biologic principles, which affect the health of the oral tissues.
2. Mechanical principles, which affect the integrity and durability of the restoration.
3. Esthetic principles, which affect the appearance of the patient.

All principles should be taken in consideration because they have a great impact on the success of the tooth preparation and subsequent restoration. Often, improvement in one area will adversely affect another, and striving for perfection in one may unintentionally lead to failure in another aspect. For example, in the fabrication of a metal-ceramic or all ceramic crowns, sufficient thickness of porcelain is necessary for a lifelike appearance. However, if too much tooth structure is removed to accommodate a greater thickness of porcelain for esthetic reasons, the pulpal tissue may be damaged (biologic principles) and the tooth unduly weakened (mechanical principles). Predictable accomplishment of optimum tooth preparation often entails finding the best combination of compromises among prevalent biologic, mechanical and esthetic principles.

In contemporary dental practice, ceramic materials are usually used in the fabrication of fixed prosthodontics constructions (whether it is porcelain fused to metal-PFM or all ceramic materials). In order to satisfy the mechanical and esthetic needs of the prosthetic construction, a certain amount of tooth structure must be reduced. The PFM or metal-ceramic crowns require the metal to be with a minimum thickness of 0.5 mm[1], 0.4 mm[2] or 0.7 mm[3]; the porcelain with a minimum thickness of 1.2 mm- labial and 1.5 mm- occlusal/incisal[1], 1mm- labial and 1.5 mm-occlusal/incisal[3].

During tooth preparation procedures, it is of a great importance to take in consideration the minimum value needs of the restorations and the amount of tooth reduction. Clinicians often make mistakes in respect of over-preparation or under-preparation of the teeth, which can jeopardize the health of the oral tissues. When tooth preparation is excessive, there is a greater risk of damaging the pulp tissue (thus extending the time period for the fabrication of the final restoration) and decreasing the retentive characteristics of the prepared tooth (compromising the mechanical principles and the integrity of the final restoration). When tooth preparation is insufficient, it is difficult to achieve the appropriate size of the restoration; or if in this case of under-preparation, the restoration is fabricated in full size, it can have serious consequences on the adjacent tissues (hemodynamic disorders of the adjacent soft tissues, difficulty in maintaining hygiene in the interdental spaces, esthetic failure, etc.).

A large number of In vitro studies that evaluate preparations completed by dentists have reported these types of mistakes that occur during tooth preparation[4]. In most of these studies, clinicians demonstrated a tendency to underprepare teeth, especially when a freehand approach was used (this tendency occurred in spite of better access and visibility provided by an *In vitro* experimental setup, outside the patients mouth, on a working cast). Regardless of their years of experience, the clinicians can avoid these mistakes by including guided preparation helpers in their everyday teeth preparation. This includes the use of special silicone indexes or depth gauge burs for improving the accuracy of the preparation features.

The aim of this study is to present a case report that will demonstrate the effect that the silicone index has on the clinician's ability to appropriately perform the preparation procedure and achieve the desired geometrical shape of the prepared tooth.

Case report

A 43 year old male patient came to the Department of Prosthodontics in the University Dental Clinic Centre "St. Panteleimon"- Skopje, with a chief complaint about esthetic issues concerning the anterior upper teeth and an edentulous space with two missing premolar teeth. First, we commenced a thorough assessment of the patient's medical history, thus concluding that he is a healthy individual with no health disorders. Then, we continued with an examination of the oral health, making a comprehensive evaluation of the hard and soft oral tissues. In the lower dental arch we noticed presence of dental crowding, no signs of dental calculus or gingival inflammation and a small number of composite fillings. The upper dental arch was characterized by the presence of gaps (diastema) between 11 and 12, 11 and 21, 21 and 22, some old composite fillings and no clinical signs of tooth decay or gingival inflammation. After finishing the clinical examination, we focused our attention on finding a solution about the chief complaint by the patient seeking our help: to fulfill the edentulous space between 13 and 16, to fix the broken down composite restoration on 21, the discoloration on 22 and to correct the anterior diastema (which the patient considered to be an appearance problem) (Figure 1-a, b).

Before we engaged in any kind of treatment, radiographs (one panoramic and periapical xrays) were made in order to evaluate the condition of the alveolar bone, the periodontal tissue, presence of hidden carious lesions, residual tooth roots, etc. The radiographs displayed the following results: a correct root canal treatment was evident on 22, with no signs of periapical
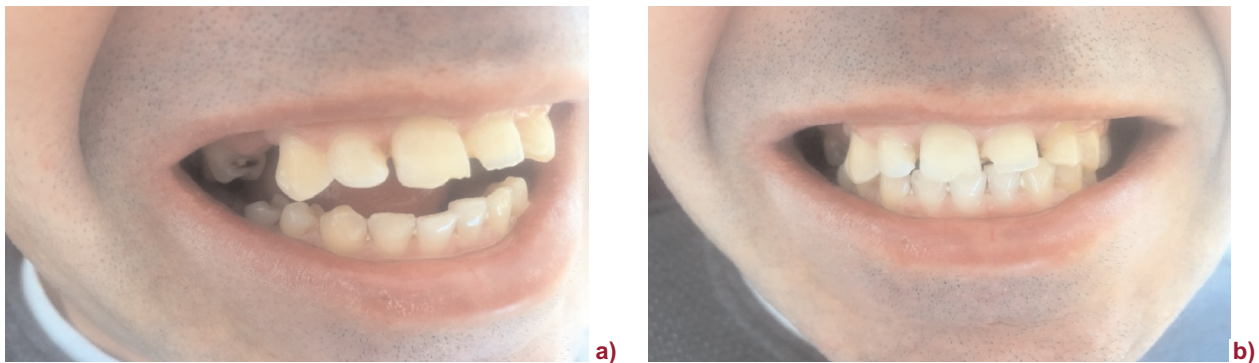
Figure 1. a), b) *Preview of the patient's main esthetic problem and the reason he requested our help: edentulous space between 13 and 16, broken down restoration on 21, discoloration on 22 and presence of anterior diastema.*

pathology (the patient confirmed that the treatment was done 7 or 8 years ago, and the tooth has been asymptomatic since then); the edentulous area was missing teeth 14 and 15 (these teeth were present as residual roots for a couple of years and extracted an year ago by an oral surgeon) and in a good condition concerning the alveolar bone and a relatively high position of the alveolar recesses of the maxillary sinus; a Class V carious lesion according to Black's principles was found on the mesial surface on tooth 16. The radiographic evaluation was followed by an examination of the patient's occlusion, palpation of the muscles of mastication, the position of the lips and the smile line. An impression of the upper and lower dental arch was taken with an irreversible hydrocolloid (alginate) in order to fabricate diagnostic casts. The casts were mounted on a semi adjustable articulator, with a previous use of a face bow and registration of the centric relation with an Addition-cure silicone (Obite, DMG). After analyzing the relations between the dental arches inside the patient's mouth and on the articulator, we noticed that the vertical dimension was preserved with no signs of interference during anterior and canine guidance (assessment of the propulsive and lateral movements of the mandible).

The first treatment plan that we suggested to the patient consisted of placing two implants in the edentulous area (for the missing first and second premolar), a single-unit crown for 22 and a composite restoration for 21. Due to financial reasons, the patient rejected the implants and also refused a composite filling for 21 due to bad previous experience with it (the old composite restorations on this tooth kept on breaking in the past). After the patient signed a consent in which he agreed that all types of treatment plans were explained to him, we came to a mutual reasonable solution for his problem, which included: fabrication of single-unit crowns

on teeth 11, 12, 21, 22 and a 4-unit dental bridge with teeth 13 and 16 as abutments. These fixed-prosthetic constructions were made out of zirconia with CAD/CAM technology.

The first phase of the treatment began with a silicone index, which we used as guidance during teeth preparation. As a material for the fabrication of the index we used heavy bodied silicone, which consisted of two components: base and catalyst. The material was mixed so that on one spoon of base material, 6-8 graduations of catalyst were added and then the mixture was prepared by crumpling it with our fingers. When the mixture gained a dough consistency, it was positioned and adapted so that it covered not only the teeth that were going to be prepared, but also one or two adjacent teeth that would provide support and stability of the index (the index covered the following tooth surfaces: labial, occlusal/incisal and palatal) (Figure 2a). We made one silicone index for 16 (which also included 17 for support of the index) and another larger index for 13, 12, 11, 21, 22, which we gradually reduced as the preparation of the teeth proceeded from 13 to 22. After removing the index, from an occlusal/incisal point of view, it was cut longitudinal in labial-oral direction, with the cut being made from the middle of each tooth (Figure 2b). This kind of index provides a clear visualization of the shape and size of reduction of the labial, occlusal/incisal and palatal tooth surface.

After silicone indexes were made, we began with tooth preparation. The preparation was performed with a previous administration of a 2% local anesthetic-Lidocaine with adrenalin, in the form of local plexus anesthesia. We performed the preparation of teeth with great care in order to produce and maintain a deep chamfer finish line with a 1 mm width (the chamfer finish line was produced with a round-tipped tapered dia-
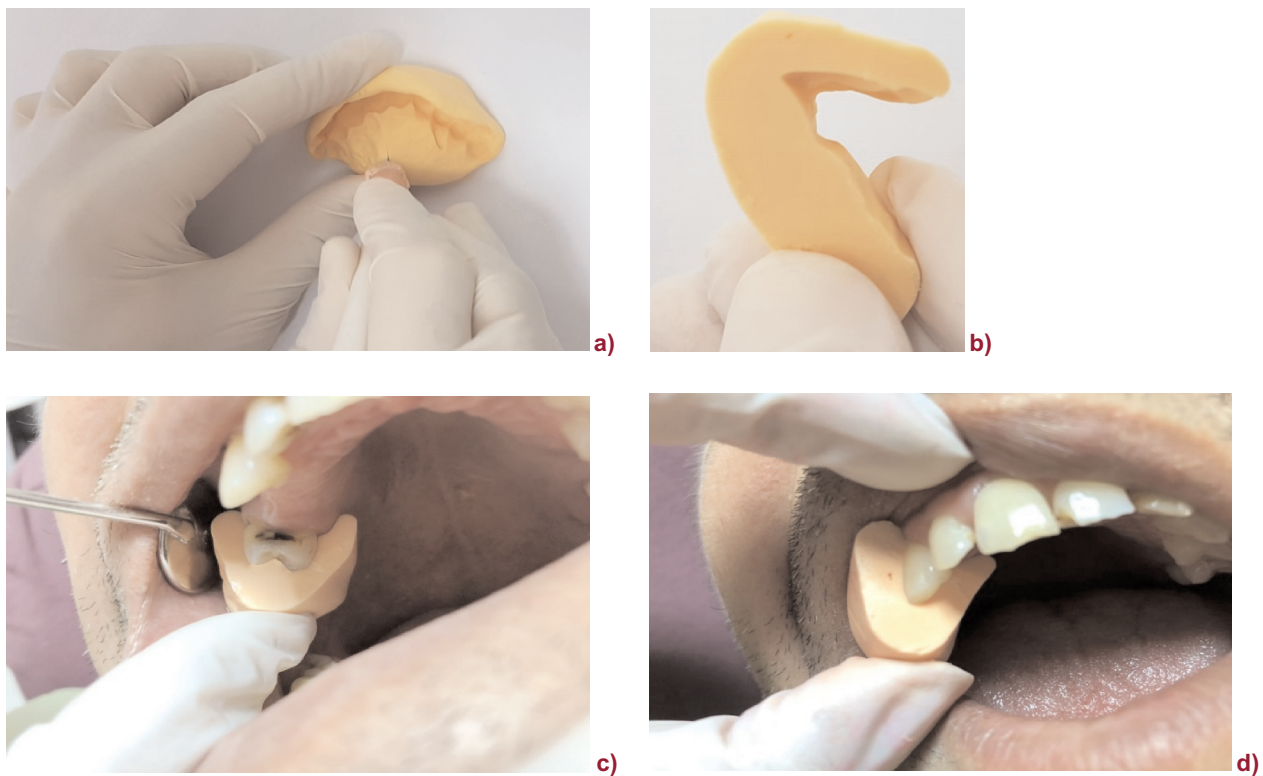
Figure 2. Fabrication of the silicone index, which was used as guidance during the preparation: a) Cutting the silicone index in a labial-oral direction; b) Visualization of the labial, palatal surface and incisal margin; c) The index adapted on the upper right first molar; d) The index adapted on the upper right canine.

mond bur5). At first, we reduced and shaped the occlusal surfaces and incisal margins with a round diamond bur, decreasing their size by 1.5-2 mm. This amount of tooth reduction doesn't only satisfy the esthetic needs, but also provides appropriate strength and enough free space for modeling the porcelain (this space is important to allow correct execution of mandibular movements). As the preparation was ongoing, we conducted periodical checkups in order to maintain the right form and size of the prepared tooth (Figure 3-a, b).

After preparing the occlusal surfaces and incisal margins, we continued with preparation of the labial surfaces by using a round-tipped tapered diamond bur. The labial surfaces were prepared in two levels: the cervical third was prepared to be parallel with the path of withdrawal, whereas the cervical and incisal thirds were mildly curved to imitate the natural tooth contour (of course this is controlled with the silicone index, making sure that the reduction on this surface is 1mm for adequate porcelain thickness). The oral surfaces were also prepared in two levels: the cervical third was reduced

with a round-tipped tapered bur in a plane parallel to the labial cervical third (parallel to the direction of withdrawal); from the cingulum to the incisal margin, the preparation consisted of producing a slight concavity with the help of a football-shaped diamond bur. The amount of tooth reduction of the lingual surface was 1 mm. The tooth preparation continued from the center of the cingulum wall into the proximal surfaces with the use of a round-tipped tapered bur, thus connecting the lingual chamfer with the labial chamfer. While preparing the proximal surfaces, the margin should follow the morphology of the free gingival crest, in order to prevent any harm to the periodontal tissues. After preparing and shaping the axial surfaces of the teeth, we proceeded in positioning the finish line subgingival in the anterior teeth and paragingival in the posterior teeth (in this case the first molar). For correctly positioning the finish line under the gingival margin and protection of the gingival tissue, we displaced the tissue by placing cords (Figure 4).

The completed chamfer finish line was 1 mm wide, smooth, continuous and free of any irregularities (presence of residual unsupported enamel)

Figure 3. a), b). As the preparation was ongoing, we conducted periodical checkups in order to maintain the right form and size of the prepared tooth. Control of the shape and size of the reduction of the canine and the upper first molar.

Figure 4. For correctly positioning the finish line under the gingival margin and in order to protect the gingival tissue, we displaced the tissue by placing cords.

At the end of the preparation, an additional checkup was made with the silicone index. After that, we continued with taking impressions with a standard metal tray in two steps: the preliminary impression was taken with a silicone material with a high bodied consistency; the second (correction) impression was taken with a silicone with a light bodied consistency. This phase ended by registering the centric relation with a face-bow, after which the work was handed off to the dental technician. The single-unit crowns and the 4-unit dental bridge were fabricated out of zirconia
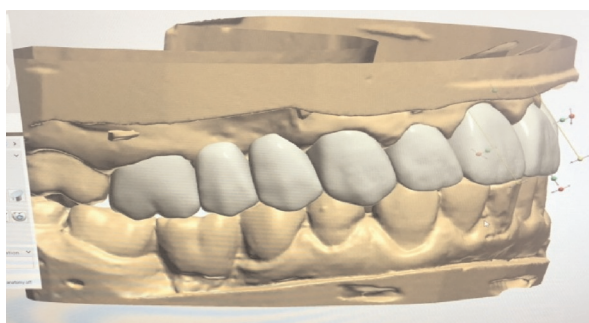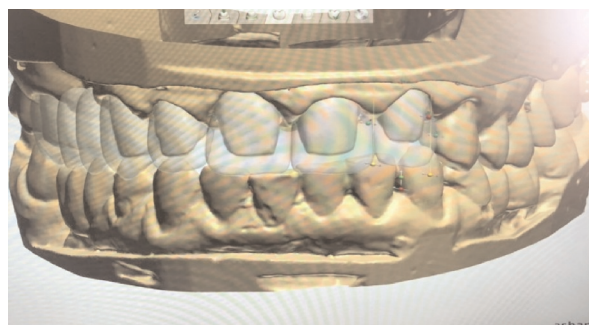
Figure 5. a), b), c), d) The single-unit crowns and the 4-unit dental bridge were fabricated out of zirconia with the use of CAD/CAM technology.

Figure 6. a), b) Preview of the prosthetic restorations after cementation.

with the use of CAD/CAM technology (Figure 5-a, b, c, d).

After their fabrication, we tried the restorations in the mouth of the patient, mainly because they were developed with the use of a semi adjustable articulator. The crowns and bridges were returned to the dental laboratory, where the dental technician performed the final glazing and finishing procedures. In the end, the finished restorations were cemented with the use of a glass ionomer cement (Figure 6-a, b).

Discussion

As mentioned before, the use of metal-ceramic or all ceramic materials has proven to be most effective in the fabrication of fixed prosthetic constructions in everyday dental practice. These materials have been submitted to many scientific and clinical examinations throughout the years, and still undergo changes in aspect of improving their quality and expanding their uses. The fact that these materials have well known characteristics and demands, simplifies their use in planning and producing fixed prosthetic constructions. As a result of this, the clinician knows exactly what must be undertaken in order to satisfy the mechanical considerations of these materials, namely how to perform the preparation of the teeth as to make use of these materials with all their benefits (strength, esthetic advantages, durability of the metal-ceramic or all ceramic materials)[6]. For the clinician to perform a preparation that is precise and correct, he/she must always utilize techniques for guided preparation (so called "navigators"), such as silicone indexes or depth burs.

According to Ahmed, Tracy & Petar March[7], the use of a silicone index as guidance during tooth preparation has proven to be of great help, especially because with it, we can observe several significant technical characteristics:

- Margin (dimension/height/consistency/smoothness)
- Taper (appropriate for restorations 4-10o)

- Amount of tooth reduction (control over the thickness of the porcelain and metal)
- Comparison of teeth shape before and after preparation (important for maintaining primary retention of the construction)

Aminian & Brunton[8] conducted a study in order to determine the effect that three different tooth preparation techniques had on the operator's ability to appropriately and consistently prepare teeth for metal-ceramic crowns. Thirty typodont maxillary central incisor teeth were mounted individually and randomly allocated to 3 equal groups (A, B and C). One operator was asked to prepare each tooth for a metal-ceramic crown. A freehand approach was used to prepare the teeth in group A, whereas groups B and C were prepared with the assistance of a silicone index and a suitable depth gauge bur, respectively. The results of this study displayed an under-preparation of the labial surfaces and over-preparation of the incisal/occlusal surfaces when a freehand approach was used. Over-reduction of the palatal surfaces occurred when the teeth were prepared with depth gauge burs.

The labial aspect of the preparation, particularly in the cervical region, requires careful consideration during tooth preparation to prevent under-preparation. This will affect the emergence profile of the restoration and cause technical difficulties when the restoration is produced, possibly with insufficient porcelain or metal or an over bulbous crown. Parkinson[9] in his study concluded that the creation of artificial crown contours greater than natural tooth convexities must be considered a parameter promoting endemic plaque niches. Under-reduction of finish lines may also predispose the restoration to technical failure arising from metal flexure and subsequent porcelain fracture or cement loss.

Hardik, Rupal & Hemal[10] executed an In vitro study in order to determine the significance of the use of silicone indexes and depth gauge burs in tooth preparation. Ninety maxillary left central incisor teeth were allocated to three equal groups (A, B and C) of thirty and mounted on a standard working model. A freehand approach

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was used to prepare the teeth in group A, whereas groups B and C were prepared with the assistance of a silicone index and suitable depth gauge burs, respectively. After the preparation, the index made prior to the preparation was injected with a light body silicone material and placed on the prepared tooth. This produced a silicone profile that displayed the amount of reduced tooth substance (the silicone profile occupied the space that was created by the tooth preparation). The index was sectioned axially along the midline of the prepared tooth with a scalpel and mounted on a microscope slide. Images of the sectioned index were captured with an optical microscope, transferred to a personal computer and calibrated image analysis software was used to measure the depth of preparation (in millimeters) at five points. The results of this study displayed under-preparation of the labial surfaces and incisal edges of the teeth whenever a freehand approach was used. In the cases when a depth gauge bur was used, an over reduction of the palatal surfaces was observed (this result was also present in the previously mentioned study by Aminian & Brunton[7]). On the other hand, in the group where a silicone index was used as guidance for the preparation, a precise and accurate reduction of the tooth surfaces of the maxillary central incisors was present.

Muller De Van stated that *the perpetual preservation of what remains is more important than the meticulous replacement of what is lost*[11]. It is particularly important to prevent unnecessary over-reduction of tooth substance during preparation. Chandler[12] reported that a 1.5 mm reduction left more than a quarter of teeth with less than 0.5 mm peripulpal dentin, thus leaving only a little room for operator error during tooth preparation. Excessive reduction led to pulpal exposure and subsequent loss of vitality, which can lead to early failure of the restored unit.

According to Bajevska[5], using a guidance system during preparation is of great essence in order to maintain an equal thickness of the metal and porcelain layers for an adequate distribution of the masticatory stress. In areas where porcelain is thinner, gaps or leakage may develop, that compromise the unity of the restoration. If the preparation does not provide enough space for the metal substructure, that could lead to cracking of the overlying porcelain layer, due to different elasticity deformations, which occur between the metal and the porcelain.

According to Mircev[2], the use of a silicone index or depth gauge bur provides a more precise preparation of the labial surfaces of the teeth, especially in the aspect of obtaining a labial surface that has two planes (the incisal third of the labial surface is under a certain angle to the other two thirds of the tooth). This provides an adequate tooth reduction and an appropriate thickness of the pro-

tective dentin layer which surrounds the pulpal tissue, thus avoiding a too bulky or oversized restoration and/or translucency of the metal substructure (Marxkors13 recommends a minimum thickness of 1 mm of the dentin that surrounds the pulp in adult patients, whereas in younger patients this thickness should be above 1.4 mm).

Conclusion

Certain undesirable phenomena that may appear in the final fixed prosthetic restoration can be caused by mistakes made in the early stages of tooth preparation (e.g. compromised esthetics, poor emergence profile, distortion of the metal substructure, insufficient primary retention and unnecessary exposure of the pulp tissue). In order to prevent any kind of mistakes from happening and to simplify the process of tooth preparation, it is important that the clinician includes a guidance system for assistance during tooth preparation (a silicone index if possible, which is more accurate according to the previously displayed results from various authors).

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PROSTHODONTIC REHABILITATION AFTER ORAL SURGICAL TREATMENT OF A PATIENT WITH EPULIS FISSURATUM - case report

ПРОТЕТИЧКА РЕХАБИЛИТАЦИЈА ПО ОРАЛНО ХИРУРШКИ ТРЕТМАН НА ПАЦИЕНТ СО EPULIS FISSURATUM – приказ на случај

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Abstract

Introduction. Epulis fissuratum is a fibrous hyperplasia of the oral connective tissue, which occurs by the continuous mechanical irritation with low intensity of removable dentures edges. **Material and method.** The presented case report is based on the evident changes in the mouth of the patient from the Department of Prosthodontics, wearing complete removable dentures over a period of 20 years. As a result of a long-lasting wearing of the dentures without appropriate control examinations, corrections, or replacing, we found inflammatory tissue hyperplasia around the vestibular edge of the lower removable denture during clinical examination. An intervention for removal of the changed tissue was performed at the Department for oral surgery. **Results.** After initial tissue consolidation, a prosthodontic rehabilitation with producing a new pair of dentures was done. **Aim.** The purpose of our study is to show the multidisciplinary approach for complete rehabilitation in a patient with Epulis fissuratum. **Key words:** complete removable dentures, Epulis fissuratum.

Апстракт

Вовед. Epulis fissuratum претставува фиброзна хиперплазија на сврзното ткиво во устата, која се јавува како резултат на континуирана механичка иритација со мал интензитет, а која најчесто потекнува од работ на подвижните протези. **Материјал и метод.** Прикажаниот случај се однесува на пациент од Клиниката за стоматолошка протетика кој е носител на тотални протези во период од 20 години. Како резултат на долготрајното носење на протезите без соодветни контролни прегледи и корекции, односно без замена на протезите со нови изработки, кај пациентот е забележана промена во вид на инфламаторна хиперплазија на ткивото околу вестибуларниот раб на долната тотална протеза. На клиниката за Орална хирургија извршена е орално-хируршка интервенција со која е отстането променетото хиперпластично ткиво. **Резултати.** По иницијалната консолидација на ткивото, се отпочна протетичка рехабилитација со изработка на пар нови тотални акрилатни протези. **Цел.** Целта на овој труд е да се прикаже мултидисциплинарниот пристап неопходен за потполна рехабилитација кај пациент со Epulis fissuratum. **Клучни зборови.** тотални протези, Epulis fissuratum.

Introduction

Edentulous patients are in need of a prosthetic device which can improve their important vital functions such as mastication, phonation, socialization etc. Complete removable dentures in this direction provide satisfactory improvements in the quality of life of these patients, but there are frequent changes that may occur when inadequate dentures are used, or when adequate dentures are subject to a prolonged period of wear[1].

Epulis fissuratum is a benign, tumor like type hyperplasia of fibrous connective tissue in the form of a reactive lesion which occurs as a result of chronic mechanical irritation most commonly caused by the edge of inadequate removable prosthetic constructions[2]. This condition is also referred to as inflammatory fibrous hyperplasia, denture epulis, denture-induced fibrous hyperplasia etc. Epulis fissuratum is presented as a lesion in the form of folds with a smooth surface, covered with normal or erythematous overlying mucosa. Sometimes, ulcerated surfaces can be seen as a result of chronic irritation when the oral mucosa is traumatized[3]. The size of lesions is variable and they can be seen as small lesions, localized hyperplasia with dimensions less than 1 cm, to

extensive changes involving most of the denture or the entire length of the tissue around its border[4].

The occurrence of epulis fissuratum is closely correlated with the active use of removable dentures that explains the high incidence of the presence of this change among elderly individuals. Epulis fissuratum most often occurs as a result of an ill-fitting denture, but a reason for this change are also considered activities like wearing the denture all day long, and through the night too, inadequate oral hygiene, smoking, age-related changes, and different systemic conditions and general diseases[5]. Patients with many medical conditions related to hypo salivation or some para-functional activity are exposed to higher risk of oral mucosal alteration[6].

The presentation of this condition according to gender is more common in women than in man, and in terms of the predilection place of appearance, we can speak about an equal presence in the maxillary and mandibular jaw, but the change is more commonly seen on the facial surface of the alveolar ridge. The greater female affectedness is thought to be due to the hormonal imbalance that occurs in women at certain periods of life (puberty, gravidity, menopause), which leads to atrophic epithelial changes in the tissues, which in turn lead to an increased response to trauma in female individuals. In relation to the age of people diagnosed with epulis fissuratum, the entity is usually met in middle-aged and older adults[7]. It is pointed out that chronic trauma with different intensity present in the oral cavity, mostly caused by the borders of the ill-fitting dentures, have the potential to cause oral carcinoma[8]. This kind of risk is also present when sharp edges of teeth, fillings, bridges or crowns are noticed in the patient's mouth[9].

Case Report

A 70-years old male patient, who was using the same pair of complete removable dentures in a period of over 20 years, visited the Department of Prosthodontics at the University Dental Clinic in Skopje, because of a filling of discomfort and obstacles in the everyday active use of the dentures. The main complaints were that he was not able to eat with his dentures as he used to do before. In the initial period of denture wearing, a few corrections were made, while in the later period during long years of wearing, additional control checks were not carried out at all.

During the clinical examination, we observed a change in the form of inflammatory hyperplasia of the tissue around the vestibular edge of the lower removable denture, followed by the incompatibility of the denture surfaces with the denture base tissue. On palpation, the change was painless, firm, fixed to the mucosa and sur-

Figure 1. *Tissue condition during the first clinical examination*

rounding structures, with a pink color, uneven and streaked surface (Figure 1). The edges of the denture laid in the grooves between the folds of hyperplastic tissue.

The biomaterial, from which the dentures were made, was impaired and porous, artificial teeth were abraded, the occlusal relations disrupted, with a reduced vertical dimension and altered physiognomic characteristics, visible deepening of the nasolabial and mentolabial furrow, absence of support of the lips, accompanied by depression of the lip commissures (Figure 2).
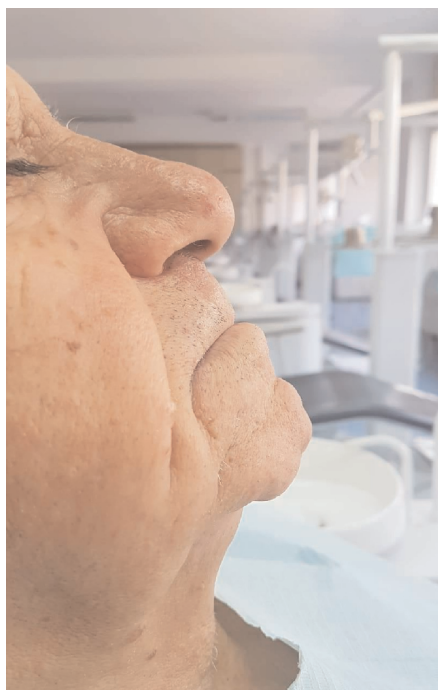
Figure 2. *Reduced vertical dimension with altered physiognomic characteristics*

The patient was referred to the Department of Oral Surgery, where oral surgery intervention was made. In order to eliminate the inflammation, the patient was

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advised not to use the dentures for a period of at least two weeks before the intervention. With the withdrawal of inflammation, partial regression of the lesion occurred, which in turn provided more favorable circumstances for carrying out the intervention. A conventional surgical excision of the changed tissue from the vestibule of the oral cavity was made (Figure 3).
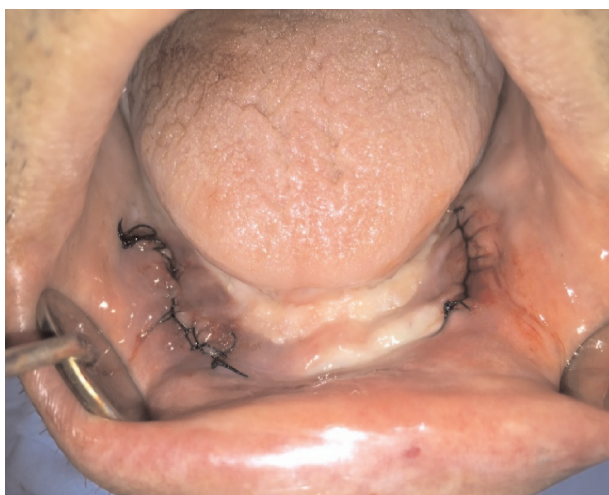
Figure 3. Tissue condition immediately after the surgery

During the surgery, the excised operating material obtained intra-operatively was immediately placed in two Eppendorf tubes. The material was sent for a histopathological analysis in the Institute of Pathology at the Medical Faculty – University" Ss. Cyril and Methodius" – Skopje. The analysis confirmed the existence of a chronic inflammatory hyperplasia of the tissue. On the microscopic level of the cutouts, an acanthotic and papillomatous elongation of a multilayer plate epithelium with parakeratosis were found, also subepithelial proliferated connective tissue with moderate and in sections strongly expressed chronic inflammatory infiltrate.

The postoperative protocol and a hygiene-dietary advice have been presented to the patient. After a period of one month, time necessary for initial tissue consolidation (Figure 4), the procedure for making a new pair of complete removable dentures began.

At first, anatomical alginate impressions were taken from both upper and lower jaw and then we made the secondary impression, which included determining the borders of the future dentures in accordance with the current condition in the oral cavity, and taking a functional impression. Following the next visit with the bite blocks (wax rims) on the upper and lower jaw, centric relationship was established and occlusal vertical dimension reconstruction was made (Figure 5).

Figure 4. Tissue after the initial consolidation
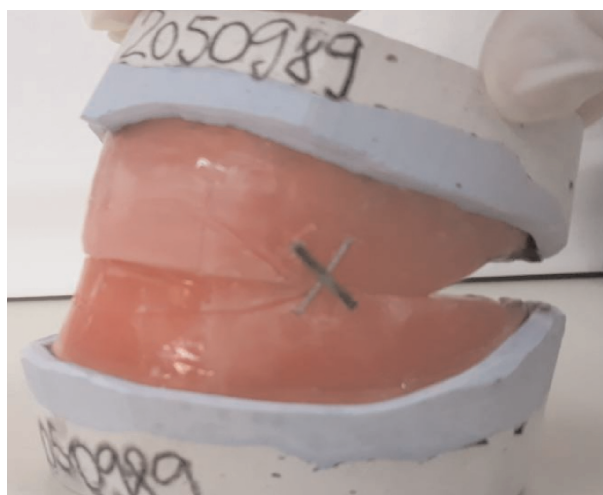
Figure 5. Bite blocks (wax rims)

Figure 6. New pair of dentures

Also, selection of form and color of the future teeth was made. During the third visit, artificial teeth were placed in the models, and with the consent of the patient, the models were sent in the dental laboratory for final preparation. Finally, on the fifth and last visit, we put the dentures in the patient's mouth and the patient did not hide the pleasure of manufacturing a new pair of dentures (Figure 6).

After presenting the possibilities and ways of maintaining the hygiene of the dentures and the oral cavity, the great importance of regular dental examinations was pointed to the patient. Firstly, more frequent examinations were suggested (once in a month), and later on, they will be performed in periods of 6 months, in order to determine the need for eventual correction or relining of the dentures during their use.

Discussion

The fibrous hyperplasia of the gingiva is clinically manifesting as a nodular mass that is firm and painless, with a smooth surface and normal coloration[10]. In the early stages of epulis fissuratum formation, when granulation tissue is present, the elimination of the source of irritation is sufficient to cause complete regression of the change, while in later stages of development when the granulation tissue is replaced by fibrous tissue, there is a need for a complex intervention[11].

There are many different techniques that can be used for removing the hyperplastic lesions: conventional surgery, made with a surgical scalpel, carbon dioxide laser, Erbium: YAG laser, Neodymium: YAG laser, and diode laser[12]. Nowadays, Liquid Nitrogen Cryosurgery is a technique that is used very often, because of the positive sides like painless procedure, excellent hemostasis, and aseptic environment. It provides good healing with minimal postoperative edema and pain[13].

The occurrence of epulis fissuratum has a long and interesting path. It is a well-known fact that after tooth extraction, there is a loss of bone width from 25%, and a loss in bone height of 4 mm in a period of 1 year[14]. Some patients use the same dentures over a long time, ignoring the fact that dentures should be changed on a regular basis because of the continuous process of resorption of the alveolar bone that can't be stopped. The resorption leads to a denture that doesn't fit well, causing the mechanical low-grade irritation that stimulates the growth of the tissue around the denture edges[15].

In line with the conclusion of the study done on a patient who wore conventional partial or complete removable dentures for at least 3 years, the most frequent complication of the denture carrier is the loss of retention, which can be followed by severe ulcerations[16].

Bone loss allows moving the edges of the dentures deeper into the tissues of the vestibule, allowing the occurrence of denture-induced hyperplasia of the tissue, known as epulis fissuratum. The existence of epulis fissuratum may be encountered during a routine dental examination. Early detection leads to adequate treatment of the reactive lesions, and it can also further reduce bone loss or other complications[17].

Conclusion

Epulis fissuratum is a condition often presented in elderly patients, with chronic low intensity irritation by inadequate dentures edges. The therapeutical approach depends on the lesions size, and conservative and surgical treatments are the options. New dentures should be fabricated as soon as possible, and the old one should be adjusted or relined.

It can be concluded that the regular control dental examinations play a big role in the prevention of occurrence of epulis fissuratum. It is simply necessary to establish a schedule for regular recalls and adhere to them as well, in order to have good clinical achievements and satisfied patients. Patients must maintain good oral hygiene and hygiene of the denture prosthesis.

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DENTAL TREATMENT OF PATIENTS WITH MASTICATORY DISEASES

СТОМАТОЛОШКИ ТРЕТМАН НА ПАЦИЕНТИ СО МАСТИКАТОРНИ ЗАБОЛУВАЊА

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Abstract

INTRODUCTION. Dental treatment of patients with masticatory diseases is a challenge for the dental prosthetist. Masticatory diseases have different etiological causes, among which a special emphasis is given to bruxism. **Purpose:** Presentation of dental treatment of patients with masticatory diseases in diagnosed night bruxism. **Material and Method:** As material, we examined 40 patients divided in two groups. The first group of 20 patients had diagnosed night bruxism with accompanying masticatory diseases. The second group of 20 patients did not have bruxism and present masticatory diseases. Clinical, paraclinical and digital methods were used for the diagnosis of bruxism. Appropriate prosthetic rehabilitation of patients was applied. An anterior deprogrammer was developed to alleviate symptomatology. This was followed by the development of splints. Physiotherapy, pharmacotherapy, laser therapy and psychotherapy were applied. **Results and discussion:** In patients with bruxism due to the nature of their condition and hyperactivity of the masticatory system, there is a pronounced pain originating from the masticatory muscles that can sometimes irradiate in other areas of the head and neck. Masticatory diseases develop, requiring specific treatment. Patients treated with prosthetic restorations, with an anterior deprogrammer and splints, have positive results from the aspect of reducing or eliminating the symptom of pain. **Conclusion:** With an early diagnosis, a timely treatment is started that relieves the patient of the symptomatology given from the masticatory diseases and improves the quality of life. **Key words:** masticatory diseases, bruxism, anterior deprogrammer, splint.

Апстракт

Вовед: Стоматолошкиот третман на пациенти со мастикаторни заболувања претставува предизвик за стоматологот протетичар. Мастикаторните заболувања имаат различни етиолошки причинители меѓу кои посебно акцент е даден на бруксизмот. **Цел:** Приказ на стоматолошки третман на пациенти со мастикаторни заболувања кај дијагностициран ноќен бруксизам. **Материјал и метод:** Како материјал беа испитувани 40 пациенти кои беа поделени во две групи. Првата група од 20 пациенти имаа дијагностициран ноќен бруксизам со пропратни мастикаторни заболувања. Втората група од 20 пациенти немаа бруксизам и присутни мастикаторни заболувања. За дијагноза на бруксизмот беа применети клинички, параклинички и дигитални методи. Беше применета соодветна протетичка рехабилитација на пациентите. Се изработуваше антериорен депрограмер за олеснување на симптоматологијата. По тоа следеше изработка на сплинтови. Се примени физиотерапија, фармакотерапија, ласертерапија и психотерапија. **Резултати и дискусија:** Кај пациенти со бруксизам заради природата на нивната состојба и хипереактивност на мастикаторниот систем доаѓа до појава на изразена болка со потекло од мастикаторните мускули која некогаш може да ирадира и во други предели на главата и вратот. Се развиваат мастикаторни заболувања, кои изискуваат специфичен третман. Пациентите кои се третираат со протетички реставрации, со антериорен депрограмер и со сплинтови имаат позитивни резултати од аспект на редуцирање или елиминирање на симптомот на болка. **Заклучок:** Со рана дијагноза, се започнува со навремена терапија која го ослободува пациентот од симптоматологијата која ја даваат мастикаторните заболувања и се подобрува квалитетот на живот. **Клучни зборови:** мастикаторни заболувања, бруксизам, антериорен депрограмер, сплинт.

Introduction

Masticatory diseases represent a challenge for the treatment by the dental prosthetist. The most common etiological causes of masticatory diseases are the parafunctions. The term parafunction was first introduced by Drum, which suggests the difference between occlusal stress occurring during mastication or swallowing and occlusal stress beyond the limits of normal functions[1]. An occlusal parafunction that differs from normal functions such as chewing, swallowing, breathing and speech, requiring specific dental treatment is bruxism[2].

The occurrence of bruxism can be seen in 6-20% of the population, at any age, starting from the eruption of

the deciduous teeth[2]. Bruxism is common in our population, which is manifested by clenching and grinding of the teeth and is characterized by varying intensity and periodic repetition. This condition tends to decrease with age, while generally a large representation in the general population is observed[3].

The major lesions caused by the present bruxism can be seen as: changes in the teeth, periodontium, masticatory diseases, changes in the temporomandibular joint (TMJ), behavioral and psychological effects[4].

There are several different indices for determining tooth damage in patients. Among them, the index by Smith and Knight should be highlighted. This index determines the degree of teeth abrasion caused by damage from the destructive forces of bruxism. It is graded with appropriate scales made by the authors[5].

Masticatory diseases are accompanied by muscle symptoms that include fatigue, muscular dysfunction, constant pain, muscular pressure sensation, palpable sensitivity to m. masseter, m. temporalis, m. pterygoideus medialis[2].

Kapusevska et al. suggest that in patients with bruxism treated with prosthetic devices, masticatory muscles quickly respond to the use of conservative methods of the type of repositioning and stabilisation splints[6].

Purporse

The purpose of this paper is to present dental treatment for masticatory diseases in patients with diagnosed night bruxism. After complete rehabilitation of the dental system, the therapist's aspiration is to eliminate the present symptomatology originating from masticatory diseases in patients with night bruxism, as well as to preserve the achieved prosthetic success by applying contemporary methods and devices for this purpose.

Material and methods

For the purposes of this paper, a study over 40 patients who were divided into two groups was conducted.

The first group of 20 patients was diagnosed with night bruxism. In them, masticatory diseases with accompanying symptoms such as muscle fatigue, pain, pressure, restricted mouth opening were observed. This group consists of two subgroups of 10 patients depending on the type of treatment (10 treated with fixed structures and 10 with skeletal dentures).

The second group of 20 patients does not have the etiological factor bruxism and accompanying masticatory diseases, they have a normal function of the dental system and represent the control group.

The research was performed at the Public Health Institute University Dental Clinical Center "St. Panteleimon", at the Clinic for Dental Prosthetics.

Before the start of the treatment, each patient was given a form of consent for work and interventions. Also, patients answered a questionnaire on the way they feel the pain and changes caused by bruxism. From the analysis of the given answers, significant data were obtained related to the subjective symptoms that patients with bruxism feel.

The methodology of the research is composed of several successive procedures:

1. Performing extraoral clinical examination - on the lower third of the face, muscles and TMJ by methods of inspection, palpation, percussion and auscultation. The lower third of the face is measured with a digital shambler;

2. Performing an intraoral clinical examination - making an analysis of the present teeth, oral mucosa and the tongue;

3. Establishing diagnosis of bruxism with a paraclinical method using a bruxchecker;

4. Analysis of the degree of abrasion of the remaining natural teeth - with an index of damage to the hard tooth substance by Smith and Knight. This index in everyday clinical practice is used to determine the degree of abrasion of the destructed teeth from the forces of bruxism. It can be practiced with a simple scale for grading the degree of damage to hard tooth tissue:

   0 - no loss of enamel;
   1 - loss of enamel;
   2 - minimally exposed dentine;
   3 - significantly exposed dentin;
   4 - pulp exposure;

5. Development of an individual plan for esthetic-functional prosthetic rehabilitation in patients with diagnosed night bruxism;

6. Application of dental therapy in masticatory diseases for relieving the symptomatology;

7. Making an anterior deprogrammer for relief of painful symptomatology;

8. Making a splint from the material durasoft@ pd from the company Scheu Dental Technology, Germany;

9. Application of low frequency therapy - using the Scorpion Dental Optima diagnostic and therapeutic complex (Optica Laser Sofia);

10. Application of alternative therapy - physiotherapy, pharmacotherapy and psychotherapy.

***Figura.1. a), b), c)** Clinical presentation of manufacturing and adaptation of anterior deprogrammer*

Clinical presentation of a patient with masticatory disease and bruxism

Case study number 2
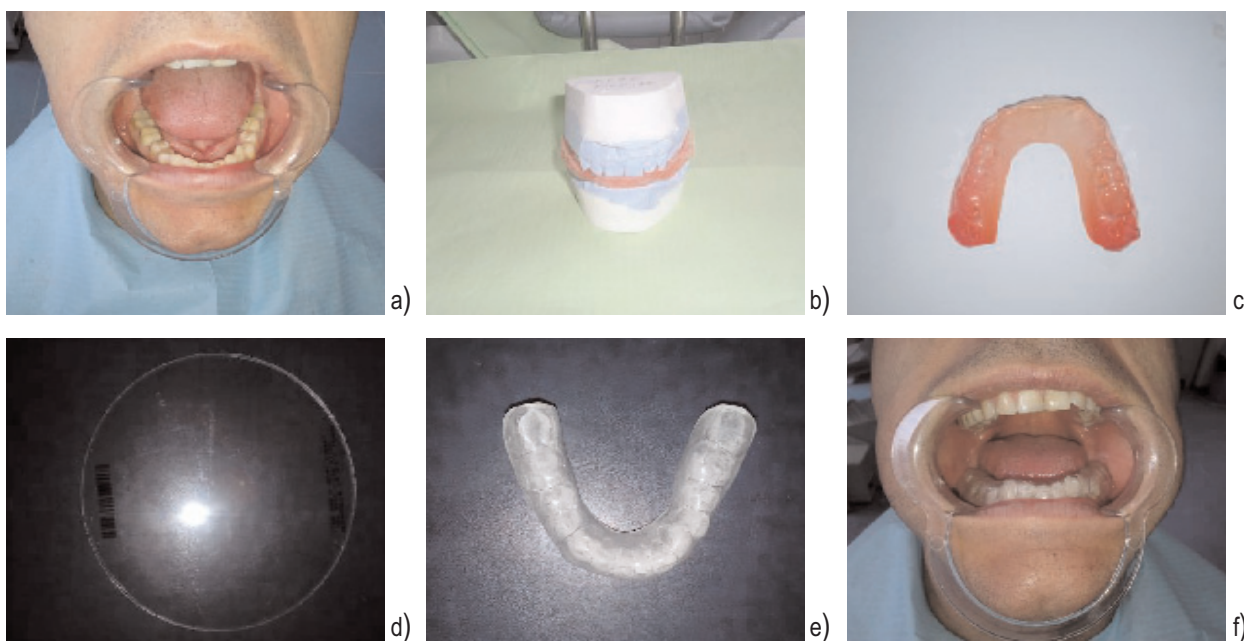
***Figura. 2. a), b), c)** Diagnosis of night bruxism with bruxchecker*
***Figura. 2. d), e), f)** Presentation of a splint (durasoft@pd),*

Results and discussion

Table 1 presents the mean value for the index by Smith and Knight. At the first examination of the first subgroup within the treated group, the Smith and Knight index was 3 (expressed dentine affection). After the therapy with the production of metal ceramic crowns, in the first subgroup of patients with night bruxism, the index was not determined on the following controls, since it is only applied when there is damage to the hard tooth substance.

Table 1. Index by Smith and Knight in patients with masticatory disease and night bruxism

Index by Smith and Knight	First visit at the prosthetist	Control after 1 month	Control after 3 months	Control after 6 months	Control after 12 months	Control after 18 months	χ^2	p
Patients with fixed constructions	3	/	/	/	/	/	15	0.45
Patients with skeletal dentures	2	2	2	2	2	2	15	0.45

Table 2. Presence of symptoms from masticatory diseases before and after treatment in patients with night bruxism

Present symptoms anamnestically and clinically proven	Before therapy		After therapy	
	n	%	n	%
	20	100	2	11.1
Total	20	100	2	11.1

The second subgroup of patients treated with skeletal dentures indicated that the Smith and Knight index was 2 (damage to the hard tooth substance with dentine affection). The statistical analysis shows the inconsistency of this index, because it remains unchanged for the overall period of control of these patients.

From the point of extraoral examinations of patients, it is important to analyze each change, since the lower third of the face may be lowered as a result of teeth abrasion, whereby sulcus nasolabialis et mentolabialis can be significant, and thus the patients look prematurely aged. This can be measured with a digital shambler.

The diagnosis of masticatory diseases begins with their palpation. The palpation of the masticatory muscles is carried out at their respective locations. Authors emphasize that those masticatory muscles which are sensitive and warm on touching and soft in consistency show signs of present pain. Clinical observation detects that localized and solid nodules, sensitive on touch are detected in patients experiencing muscle pain. The activation of pain leads to information that is carried out to the brain and interpreted as an unpleasant sensation[2]. In this study, patients indicated tiredness, pressure of the masticatory muscles, occurrence of pain that sometimes irradiates in other regions such as head and neck.

Because of the muscle load, there is a difficulty in opening the mouth during mastication.

The bruxchecker is used as a paraclinical method for the diagnosis of bruxism. The special foil adapted to heat under pressure is a factory made product of polyvinyl with a thickness of 0.1 mm and is painted on one side with a color of plant origin. Once the bruxchecker is developed, the patient wears it during sleep. After a certain period of using it and subsequent analysis, the deleted points are read at the places where occlusal contacts were realized. There is an interpretation in the literature that its practical application is simple, by reading surfaces without color at places where there was friction due to movements caused by bruxism[7].

In our research, with the aid of a bruxchecker, we came to realize the diagnosis of occlusal patterns of teeth grinding, visualizing the direction of the bruxism patterns in patients wearing it overnight. Detection of active surfaces for clenching and grinding with the teeth and control of bruxism even after prosthetic rehabilitation is also performed if there is an indication.

For acute reduction of symptoms of orofacial origin, deriving from occlusal parafunctions and temporomandibular dysfunction, besides other therapy, Kapusevska uses an anterior (butterfly) deprogrammer. In this study, it has proven to be an effective method in the treatment of patients to reduce symptomatology originating from masticatory diseases.

Durasoft@ pd is a high quality material that is factory-shaped by two types of material. PETG - polyethylene terephthalate glycol modified with solid consistency and TPU - soft thermoplastic polyurethane. If used correctly according to the manufacturer's instructions, the material is resistant to abrasion even by applying strong forces[8]. Cold polymerizing acrylate can be added to splints fixed in an individual articulation depending on the patient's indications (such as canine lifting for designing stabilization splints).

According to Kapusevska et al., there is an improvement in the functioning of the masticatory muscles in patients who are rehabilitated with prosthetic and occlusal therapeutic restorations[9]. In this paper, patients who complained about pain that can be both muscular and of other origin, have been reported to have a decrease or complete elimination of painful symptomatology.

In their book, Michael JT and Giuseppe P describe the success of patients with night bruxism and partial edentulousness, who wear specially made occlusal splints during sleep[10].

The studies conducted for the needs of this paper should provide a scientific contribution from the aspect of preventive and therapeutic functions of anterior deprogrammers and application of splints. If there is pain associated with inflammatory origin and with a strong manifestation, antibiotics and corticosteroids can be prescribed[4]. Sometimes patients may be advised to use tranquillizers from the group of benzodiazepines, which act to loosen the masticatory muscles, soothe the central nervous system, and thus reduce the symptomatology of bruxism.

In addition to diet recommendations, the use of B vitamin supplements, magnesium and relaxation measures should be considered. General recommendations cannot always be applied equally to all people.

Patients are pleased to accept additional therapy as physiotherapy because it relieves the symptoms of pain. Sometimes a complete opening of the mouth is disabled. Because of this, patients also perform exercises that comparatively with literature data have great importance in reducing the degree of pain[4].

It is very important for these patients to be provided with appropriate therapy that would alleviate symptomatology with the origin of masticatory diseases. When there is an indication, a local anesthetic is injected into the painful muscle, i.e. in trigger points. Moreover, education of patients is an important aspect of how they can help themselves. Nonsteroidal anti-inflammatory drugs, usually Ibuprofen of 800mg are administered two to three times daily. Then, pharmacological therapy is continued, supplements and vitamins (B vitamin, magnesium) are added, and the patient is prosthetically rehabilitated (with fixed or mobile structures). After that, an anterior deprogrammer is manufactured and worn for a period of 6 months. The anterior deprogrammer is usually made of acrylic material. In this article we used the Triplex material from Ivoclar Vivadent, Liechtenstein. The anterior deprogrammer can be made with many methods, depending on the indication on the dental prosthetist. If following this period it is noticeable that there is still persisting pain and teeth grinding, splints from the material durasoft@ pd are made. We selected this material because it is simple to operate, with a soft component that allows the amortization of mastication forces that develop overnight. There is a possibility for its modification by applying a cold polymerizing colorless acrylate over the rigid component, to produce a stabilisation splint, which is expected to decrease to completely eliminate the symptomatology.

The masticatory muscles with their hyperactivity and tension create painful sensations that sometimes irradiate both towards the head and neck. Therefore, patients with masticatory diseases whose etiological cause was bruxism underwent laser treatment using the Laser Multifunctional Scorpion Dental Optima (Sofia Laser), which proved to be a useful tool in patients with moderate and severe bruxism and with proven subjective and objective symptomatology. Treatments are performed when there is a strict indication and can last approximately 6-7 sessions, and if necessary, longer, in time intervals strictly prescribed for the treatment of such dysfunctions. The positive effect of this type of therapy was determined, both in this paper and in some of the authors in their papers11.

The overall therapeutic protocol improves both the subjective and objective symptomatology during the dental treatment of patients with masticatory diseases (table 2). Patients also experience relief in opening the mouth if they previously had difficulty with it.

Conclusion

The obtained results of this study confirm the effectiveness of dental treatment for patients with masticatory diseases in diagnosed night bruxism. A special emphasis is put on the production of an anterior deprogrammer designed from the acrylic Triplex, of Ivoclar Vivadent, Liechtenstein and a split of duraspoft @ pd from Scheu Dental Techology, Germany.

The deprogrammer and the splint are a contemporary method and there are various possibilities for their design and manufacturing and they should be implemented in everyday dental practice. On arrival at the dentist, patients with masticatory diseases originating from diagnosed night bruxism are relieved of painful symptomatology at the first visit. Then, the therapy that follows improves the oral health by preventing damage to all structures of the stomatognatic system, thereby protecting the overall health of the patient. This would improve the patient's quality of life and increase the dental team's satisfaction.

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ACCURATE MEASUREMENT OF CANAL LENGTH DURING ROOT CANAL TREATMENT: IN VITRO STUDY

МЕТОДИ ЗА ОПРЕДЕЛУВАЊЕ НА ДОЛЖИНАТА НА КАНАЛОТ ПРИ ЕНДОДОНТСКИ ТРЕТМАН: IN VITRO СТУДИЈА

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Abstract

The aim of this in vitro study was to compare the precision in determining the working length through three methods: radiological, electronic and tactile-sensitivity. **Material and method:** The working length was determined in 30 extracted teeth with single straight completely formed root canals. An X-ray image was made on each tooth and it was used as orientation in determining the working length. The teeth were randomized in three groups by the method used for determining the working length: I group – determination with an apex locator, II group - x-ray method and III group - sensitivity-tactile working length determination. In order to directly determine whether there is a matching of the required reference point with the physiological apical constriction, the apical third was opened to the full exposure of the root canal. We analyzed the apical part of the samples under 3X magnification. **Results:** Among the three groups examined, the electronic apex locator shows the exact position of the apical reference point in determining the working length. There was no statistically significant difference between the results obtained with the electronic and the radiological method, but the difference between the electronic and the x-ray and tactile-sensitivity method is statistically significant. **Conclusion:** Determining the working length of the root canal with an apex locator is simpler and faster than using the radiographic method, while reducing the need for unnecessary exposure to radiation. **Key words:** apical foramen, apical constriction, electronic apex locator, endodontic therapy, radiographic odontometric method, tactile-sensitivity method

Апстракт

Целта на ова in vitro испитување беше да се спореди прецизноста во одредување на работната должина преку три методи: рендгенолошка, електронска и тактилно-сензорна. **Материјал и метод:** Работната должина беше одредувана кај 30 прави еднокорени екстрахирани заби со целосно формиран корен. На секој заб беше направена рендгенграфска снимка, која служеше како ориентација при одредување на работната должина. Примероците беа поделени во три групи според методот за определување на работната должина: 1 група - со помош на апекс - локатор, 2 група - рендгенолошка метода и 3 група - сензитивно-тактилно определување на работната должина. Со цел директно да го утврдиме дали постои совпаѓање на бараната референтна точка со физиолошкото апикално стеснување, апикалната третина ја отворавме до целосно експонирање на коренскиот канал. Апикалниот дел од примероците го анализиравме под зголемување од 3 пати. **Резултати:** Помеѓу испитуваните три групи, електронскиот апекс локатор ја покажува најточната позиција на апикалната референтна точка при одредувањето на работната должина. Помеѓу резултатите добиени со електронската и рендгенолошката метода не постоеше статистички значајна разлика, но разликата меѓу електронската и рендгенолошката и тактилно-сензорната метода е статистички значајна. **Заклучок:** Одредувањето на работна должина на коренскиот канал со апекс локатор е поедноставно и побрзо отколку користење на радиографската метода, а притоа е намалена и потребата од непотребно изложување на радијација. **Клучни зборови:** апикален отвор, апикално стеснување, електронски апекс локатор, ендодонтска терапија, рендгенолошка одонтометриска метода, тактилно - сензорна метода

Introduction

The main goal of endodontic therapy is to thoroughly remove the contents of the whole root canal system. This is achieved by shaping the root canal simultaneously with intra-canal irrigation and medication. However, the first step towards endodontic therapy success is determining the exact length of the canal. Having this in mind, the purpose of the test is to compare the possibilities and precision of the various methods for determining the working length.

The aims of this in vitro study were to compare the accuracy in determining the working length of three methods: radiological, electronic and tactile-sensitivity method, and to assess whether there is a matching of the exact apical point of the radiological finding with physiological apical constriction.

Material and methods

30 straight single-rooted extracted teeth with a fully formed root were used. From the examination, the teeth were excluded if they were carious, restored or fractured and if there was root resorption.

Before starting the examination, teeth were placed in 3% sodium hypochlorite to remove all residues from the periodontal ligament. To avoid any interpersonal differences, all teeth were processed by one examiner.

Each tooth underwent x-ray imaging, which was used as an orientation in determining the working length. For determining the length, a millimeter grid was used that we set up through the x-ray image. The assumed working length was established by subtracting 1 mm from the measured length of the x-ray image (Figure 1).
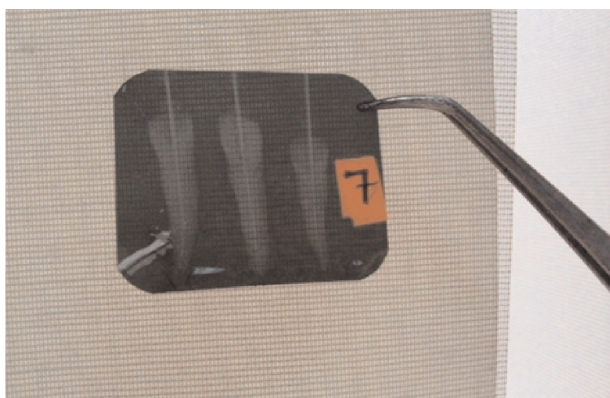
Figure1. Determining the canal length from the x-ray image with a millimeter grid

The teeth were prepared by forming the accessory cavity and at the same time the remnants of the pulp were removed. The apex of each tooth was placed in the fresh mixed alginate. All the measurements were performed for a period not longer than 30 minutes to maintain the alginate moist, which is especially important when using apex locator.

The randomly selected teeth were divided into three groups according to the method used to determine the working length. The working lengths in the first group were determined with an apex locator (iPex NSK, Tokyo, Japan). In order to imitate the natural conditions in the oral cavity, the roots of the teeth were placed in a freshly mixed alginate, and the electrode which should be placed on the patient's lip was placed in the alginate as well (Figure 2). The resistance of the freshly mixed alginate is similar to the resistance of the vital tissues in the oral cavity, and therefore we obtained relevant measurement results.

Figure 2. Teeth from the first group placed in the alginate for determining the working length with an apex locator

The Ingle method was used for the teeth of the second group.. The procedure was as follows: the length of the canal was measured on the first x-ray image (initial measurement); 1mm was subtracted from the initial measurement and then the second x-ray image was done together with the instrument (tentative working length). After the calculation we obtained the real working length with an additional 1mm shortening as a safety factor. Schematically, this method is shown in Figure 3.
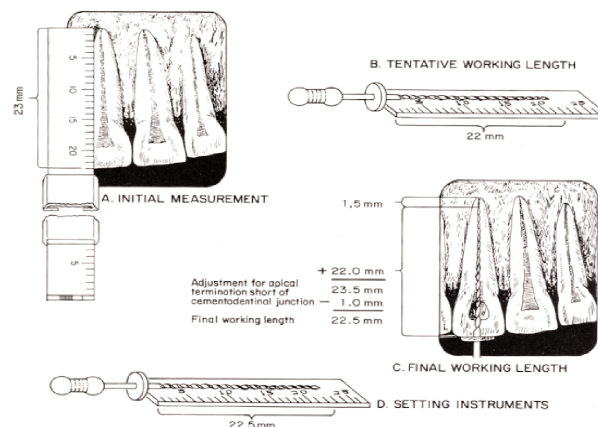
Figure 3. Schematic presentation of the Ingle method

Working length of teeth from the third group was determined by the tactile-sensitivity method. To avoid any subjectivity, the roots of the teeth were also put in alginate.

After determining the working length, in all groups of teeth, the canal instrument was placed in the position previously measured and fixed in the specified position with glass ionomer cement. A second (or third image for the second group) X-ray was done, according to which we determined the accuracy of the measurement in each

of the three methods examined. The reference point in our study was located 1 mm shorter of the apical foramen as the point of apical constriction or as the WL gold standard.

In order to analyze the ratio of the top of the canal instrument with the physiological apical constriction, the apical third was opened by gradually removing the dentin on one side, layer by layer with a diamond burr. When only a thin layer of translucent dentin remained, it was removed with a scalpel (Figure 4). We analyzed the apical part of the samples under 3X magnification. The acceptability of the results obtained was again categorized as in the first part of the test.

Figure 4. *Teeth with open-prepared apical part of the canal. The tips of the canal instruments can be noticed.*

Data from both groups were analyzed with the SAS System and the t-test. Statistically significant we will be considered the values that are p<0.05.

Results

The obtained data from the precision of the three methods: electronic, X-ray and tactile-sensitivity are shown in the following tables. In Table 1, the accuracy expressed in mm is shown, and in Table 2 they are grouped according to clinical success or acceptability.

The correct determination was achieved by the electronic method. Precise determination of the length to the desired zero level in this method was achieved in 4 cases, and for an additional 5 deviation it was up to ± 0.5 mm (acceptable precision) which means that the success in the in vitro test in single-rooted teeth working length using the apex locator is 90% (Table 2).

In this part of the test, the acceptable errors were in the direction of a too high working length, but maximally 0.5mm. In the X-ray method, accurate results with a tolerance of ± 0.5mm were obtained in 80% of the exam-

ined samples, equal to the number of too high and too low specified lengths. The accuracy of the tactile-sensitivity method in single-rooted teeth was small and amounted to 40% with this group, although there was one case of too high working length, in the other samples the instrument was shorter. In this group the results were very uneven.

From the results on frequency distribution of the distance between the tip of the instrument and the desired reference point n (%) obtained by the electronic and the radiological method there was no statistically significant difference (p=0.5390). Among the results of odontometry obtained with the electric and tactile-sensitivity (p=0.0154), as well as between the X-ray and the tactile-sensitivity method (p=0.0343), there were statistically significant differences.

The results that provide in what measure the radiographic image is, is a real indicator of the structures in the apical part, i.e. how close is the tip of the instrument, whose radiographic images to the apical constriction (physiological foramen) are shown in Tables 3, 4, 5 and 6. We measured these results after opening the root canal in the apical part. In all examined samples, the apical aperture and apical constriction were clearly visible.

Table 1. Number of teeth according to the distance between the tip of the instrument and the desired reference point n (%) obtained by three examined methods

Distance in mm	Electronic method	X-ray method	Tactile-sensitivity method
> 1.1			1
1- 0.6	1		
0.5-0.1	4	2	2
0	4	4	2
-0.1 - 0.5	1	2	
0.6 - 1		1	2
- 1.1 - 2		1	1
-2.1 - 3			2
total	10	10	10

In Table 3, 4 and 5, the difference between the radiographic findings and the direct visualization of the apical part is shown individually for each group where a different method of odontometry was applied. In 90% of the samples with electronically determined working

Table 2. Level of precision of the three examined odontometric methods

Results	Electronic method	X-ray method	Tactile-sensitivity method
precise	4	4	2
acceptable	5	4	2
error	1	1	2
significant error	0	1	4
total	10	10	10

lengths, and in 60% of the radiographic determined ones, the difference between the tip of the endodontic instrument and the apical constriction was within the range of ± 0.5 mm. Only 40% of the samples from the tactile-sensitivity group had such a match.

Among the results of the frequency distribution of the distance from the tip of the instrument to the physiological foramen obtained by the electronic and the x-ray method, there was no statistically significant difference (p=0.0694). In respect of the results obtained with the electronic and tactile-sensitivity method, the differences were statistically significant (p=0.0154). The difference between the X-ray and tactile-sensitivity method (p=0.1914) according to the analysis did not show any statistically significant differences.

It can be noted that in all examined samples there was a certain higher position on the tip of the instrument in the apical constriction than it seems on the X-ray.

Discussion

In-vitro performed examinations are usually considered problematic because of the lack of apical periodontium. To simulate the clinical conditions, several experimental models are proposed, which suggest different media where extracted teeth should be placed, for example, alginate, agar, saline or gelatin. However, if it is necessary to examine the work of electrical apex locators,

Table 3. Electronic measurement according to x-ray image and direct visualization

Up to	> 1.1	1 0.6	0.5 0.1	0	-0.1 - 0.5	-0.6 -1	- 1.1 -2	- 2.1 -3
x-ray image			2	4	2	1	1	
direct visualization		2	3	3		2		

Table 4. X-ray measurement according to x-ray image and direct visualization

Up to	> 1.1	1 0.6	0.5 0.1	0	-0.1 - 0.5	-0.6 -1	- 1.1 -2	- 2.1 -3
x-ray image			2	4	2	1	1	
direct visualization		2	3	3		2		

Table 5. Tactile-sensitivity measurement according to x-ray image and direct visualization

Up to	> 1.1	1 0.6	0.5 0.1	0	-0.1 - 0.5	-0.6 -1	- 1.1 -2	- 2.1 -3
x-ray image	1		2	2		2	1	2
direct visualization	1		1	2	1	1	3	1

which operate on the principle of electricity, the conduction of the medium is more important than its biological properties.

It is best if the material used for this purpose provides the same electrical resistance as the periodontal ligament to obtain accurate measurement data[1]. The alginate has colloidal consistency, which is a good simulator of the periodontium, it is accessible and easy to prepare. Among those, the alginate, used in our examination, best imitates the electrical impedance of the human periodontium[2]. We made the measurements in the shortest possible time, to ensure that the alginate is sufficiently humid.

In the first part of this study, we evaluated the accuracy of the methods according to the X-ray image in line with the same principle as in the usual clinical trial. Although the radiological odontometric method is still considered to be the "gold standard" according to which all other methods are evaluated and is the most used method for determining the working length in the world, the obtained results have shown that the most accurate determination of the working length was achieved by the electronic method, where the exact determination was achieved in 90% of the samples tested, if the tolerated deviation was up to ± 0.5mm. Our results were in line with those of Puri[3], Nelson-Filho[4], Paludo[5] and Shanmugaraj[6] using the same methodology.

In the paper, the radiographic method according to Ingle was used, which yields the most accurate results[7, 8]. Exact results were measured in 80% of the examined samples, which did not differ statistically from the electronic, which coincides with the results of Kqiku et al.[9]. The tactile-sensitivity method has again proved to be the most unreliable method for determining the working length, with the difference between the two methods being statistically significant.

The second aspect in our in vitro examination was to determine whether our assumed reference point corresponds to the apical constriction. We determined this by measuring the distance for which the tip of the instrument in the canal deviated from the apical constriction after its position was determined by one of the methods examined. Our results showed that among these three groups, the electronic apex locator shows the exact position of the apical reference point in determining the working length in endodontics.

According to the results of Vieyra[10], if the tip of the instrument is set to exactly 1mm from the radiographic apex, only 32% of the canals will be positioned on the apical constriction itself, while the remainder will be between the two apexes (anatomic and physiological). Another study of Hoer et al.[11] shows that apical constriction can be accurately determined in 43% of teeth.

This is explained by the correct configuration of the extracted teeth. As mentioned earlier, the apical constriction is the ideal point where the working length should be. However, it is also known that the exact position of the apical foramen can be reliably determined by the points between the physiological foramen and the constriction, but they cannot be metrically determined.

According to the results obtained, it can be concluded that in both methods (electronic and radiographic) the instrument is set slightly higher than it is monitored on the X-ray, but this is not as stressed as in the Alothmani test[8], which showed that in 28.5% of the cases the instrument exceeded the length of the canal despite the acceptable appearance of the recording. Similar conclusions to ours were obtained by Shanmugaraj[6] and Ravanshad et al.[12].

According to these results it can be concluded that the X-ray film should be considered as relative, since it only shows the relative position of the instrument in relation to the root and the radiographic peak of the root. Often, the location of the endodontic instrument tip that appears to be too low is in the correct position relative to the reference point[13,14], and if it appears to be higher, it means it is really higher and further than the desired reference point.

However, it should always be borne in mind that X-ray diagrams show us what cannot be seen with electronic apex locators, and also the advantages and possibilities of apex locators are much better than X-rays. This means that confrontation is the best way to determine the working length. The combination of both methods achieves the greatest success in work and the best service for the patient.

Conclusion

There was no statistically significant difference between the electronic and the x-ray method, and the two methods yielded good results. A statistically significant difference was confirmed between the electronic and the X-ray versus the tactile-sensitivity method, i.e. the tactile sensitivity method precision is much smaller. The use of an electronic apex locator in odontometry is practical and reliable, mostly due to the reduction of unnecessary exposure to X-rays.

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EVALUATION OF THE TIME REQUIRED FOR RETREATMENT WITH THREE ENDODONTIC SYSTEMS

ЕВАЛУАЦИЈА НА ВРЕМЕТО ПОТРЕБНО ЗА РЕТРЕТМАН СО ТРИ ЕНДОДОНТСКИ СИСТЕМИ

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Abstract

When endodontic treatment fails, retreatment consists of the complete removal of the root canal filling material for thorough cleaning and reobturation. Various techniques are available for the filling removal procedure with varying degrees of efficacy and a varying length of time to perform. **The aim** of this study was to compare the time required to carry out endodontic retreatment with three different endodontic systems (one manual-Hedstroem and two machine rotary nickel-titanium systems Pro Taper Retreatment and Pro Taper Gold). **Material and Methods:** Hundred and twenty extracted human teeth kept in in vitro conditions were endodontically treated and retreatment was performed using three different endodontic systems. Samples were divided into 3 groups; A-retreatment with Hedstroem hand files, B-retreatment with Pro Taper Retreatment files and C-retreatment with Pro Taper Gold files. The time required to remove the filling materials was measured with a stopwatch. The data were analyzed using the ANOVA one-way test (α = 0.05). **Results:** The time required to remove the filling material was significantly shorter in group B, followed by group C, the slowest being group A (P<0.05). **Conclusions:** Pro Taper Retreatment System was the fastest method for removing root canal filling material. **Key words:** retreatment, debris, manual instrumentation, NiTi instruments

Апстракт

Кога едодонтскиот третман ќе се покаже неуспешен, повторното лекување се состои од целосно отстранување на материјалот за полнење на коренскиот канал и реобурација. Постојат различни техники за ендодонтски ретретман, кои покажуваат различна ефикасност, како и различно време за нивна реализација. Времето потребно за ендодонтски ретретман е важен двигател за конечниот успех на оваа постапка. **Целта** на оваа студија беше да се спореди времето потребно за изведување на ендодонтскиот ретретман со три различни ендодонтски системи (еден рачен Hedstroem и два ротирачки никел-титаниумски системи Pro Taper Retreatment и Pro Taper Gold). **Материјал и методи:** Сто и дваесет екстрахирани човечки заби беа во in vitro услови ендодонтски третирани, додека ретретманот беше направен со користење на три различни ендодонтски системи. Примероците беа поделени во 3 групи; А- ретретман со Hedstroem рачни инструменти, В - ретретман со Pro Taper Retreatment машински инструменти и С- ретретман со Pro Taper Gold машински инструменти . Времето потребно за отстранување на материјалите за полнење беше мерено со стоперка. Податоците беа анализирани со помош на ANOVA one-way test (α = 0,05). **Резултати:** Времето потребно за отстранување на материјалот за полнење беше значително пократко за групата В, по што следи групата С, додека најспоро за групата А (Р <0.05). **Заклучок:** Pro Taper Retreatment системот се покажа како најбрз метод за отстранување на материјалот за полнење од коренскиот канал. **Клучни зборови:** ретретман, дебрис, рачна инструментација, NiTi инструменти

Introduction

Conventional endodontic retreatment is a therapy of choice for endodontic treated teeth in case the post-treatment disease requires an intervention[1,2,3]. The main goal of the retreatment is to access the apical foramen by completely removing the previous filling material and to perform additional cleaning and shaping of the root canal system[4,5]. Numerous techniques have been described for removing the filling of the root canal, including the use of hand or machine rotary files, heat, ultrasound or chemical solvents in different combinations[6,7,8,9]. Some rotating NiTi systems are specially designed for the retreatment of the root canal system. Studies for clinical use and efficiency of rotary retreatment instruments have concluded that they are more appropriate in terms of the efficiency and speed of removing the filling material at endodontic retreatment versus hand instruments[10].

In addition to the efficiency of the instruments and procedures used in retreatment, the total operating time is another factor conditioning the clinical efficiency of gutta-percha removal techniques. Total operating time is the time taken to reach the working length and ideally, to achieve complete removal of the obturation material[11].

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The Pro Taper Gold system (Dentsply Maillefer, Ballaigues, Switzerland) was placed on the market in late 2016, as a revolutionary product in terms of its flexibility. According to the manufacturer the resistance to cyclic fractures of the instrument is increased up to 30%, due to the special metallurgical processing of the NiTi alloy. The files have a golden glow on the surface.

Since the number of studies examining the efficiency of this new product is relatively small, we hope that this study will provide new data about time required for retreatment with Pro Taper Gold files in correlation with hand Hedstroem files (commonly used for retreatment) and ProTaper Universal Retreatment files (specially designed for this procedure).

The purpose of this study was to compare the time required to remove filling material using three endodontic systems. The Null hypothesis is that there is no significant difference in time required for endodontic retreatment between these three different endodontic systems.

Material and methods

The study investigated three endodontic systems of which one endodontic system was used for manual instrumentation of the root canal, and the other two endodontic systems were used for mechanical instrumentation. The sample included 120 extracted teeth. The teeth were extracted for other reasons, not for the purpose of our research, with the approval of the Ethics Committee of the Ss. Cyril and Methodius University in Skopje, Faculty of Dentistry-Skopje (Ethics number; 2018.82-1577/3). The samples included in the study were selected according to certain criteria: teeth with a present crown at the level of the pulp chamber, not previously endodontically treated teeth with fully formed apex and teeth with previously determined root canal patency to anatomic apical foramen. Our research was performed in in vitro conditions in order to evaluate the real efficiency of the three different endodontic systems by excluding the subjective patient factors. All samples were examined by only one operator in order to eliminate subjective factors that would result from subjectivity if there were multiple operators. Prior to the endodontic retreatment with the three examined endodontic systems, the specimens (extracted teeth) were previously prepared for the procedure.

Preparation of the specimens (root canal preparation and filling)

Soft tissue, calculus and foreign bodies of the samples were removed with tap water and a metal brush and/or ultrasound. For disinfection and removal of the organic debris, the teeth were completely immersed in 2% sodium hypochlorite (Cerkamed, Stalowa Wola,

Poland) within 24 hours. They were washed with tap water and stored in a physiological solution (Dental Medical, Subotica, Serbia) until used. Standardization of the samples was made by decoronating them with a long conical burr (TF-11, ISO 173/014, MANI, Tochigi, Japan) and a water spray using an air hand piece (ET605C, KaVo, Biberach, Germany) with 280000 rpm speed. A long conical diamond burr (TF-11, ISO 173/014, MANI, Tochigi, Japan) was used only for opening the entrance to the canal, without expanding it. Hand K-file #15 (MANI, Tochigi, Japan) and 17% EDTA (DiaPrep Pro17%, DiaDent, Seoul, Korea) were used and irrigation was made with 3% H_2O_2 (Alkaloid, Skopje, North Macedonia) and distilled water (Alkaloid, Skopje, North Macedonia). For each sample the root canal patency was established. The K-file #15 (MANI, Tochigi, Japan) was inserted until the tip of the instrument was visible at the apical foramen. The samples were divided in 3 groups according to retreatment systems. The groups were marked with A-hand Hedstroem files-H (MANI, Tochigi, Japan), B-machine Pro Taper Universal Retreatment files-PTR (Dentsply Maillefer, Ballaigues, Switzerland) and C-machine Pro Taper Gold files-PTG (Dentsply Maillefer, Ballaigues, Switzerland). The samples in each group were marked with numbers from 1 to 40 and 3 groups of 40 samples each were formed. Further, each of the samples was instrumented with the Step Back technique and the working length (WL) was recorded 1-mm short of the length of the patency file. The last file used was #30 K-file. After changing the instruments, samples were irrigated with 2 ml 3% H_2O_2. Final irrigation was with 5 ml 3% H_2O_2. Samples were obturated with root canal filling Endofil (Produits Dentaries, Vevey, Switzerland) and gutta-percha cone (MANI, Tochigi, Japan) and sealed with temporary coronal filling (Provis, Favodent, Karlsruhe, Germany). Samples were stored in distilled water (Alkaloid, Skopje, North Macedonia) during the entire study on room temperature (20-25ºC).

Root canal retreatment

Three weeks after, endodontic retreatment was performed (Crown down technique) with the corresponding investigated system (H; PTR; PRG) according to the manufactures instructions. The Hedstrom files are made up of a continuous sequence of cones. They are very sharp with a cutting tip. They were used in a push-pull fashion. Pro Taper Universal Retreatment files were used with speed of 500-700 rpm for gutta-percha removal and 300 rpm for paste fillers removal and torque set at 3 N-cm. Pro Taper Gold files were used with speed of 300 rpm and torque 5 N-cm for S1&Sx; 1.5 N-cm for S2&F1; 3 N-cm for F2, F3, F4, F5.

The retreatment with the appropriate endodontic system (H; PTR; PTG) was performed. During the canal instrumentation only distilled water was used for irrigation, because the aim of the research was to determine the efficiency of endodontic systems that derives from their characteristics, without the use of chemical agents. Irrigation protocol was: After every 3 insertions of each file, 2 ml distilled water was used with 27- gauge open-ended needle that was inserted into the canal as deeply as possible into the apical third of the root canal. Final irrigation was performed with 5 ml distilled water.

Complete removal of the obturation material was defined by the following criteria: when there was no evident filling material on the instrument.

Time required for gutta-percha removal

A stopwatch was used and the total time required to remove the gutta-percha cone and Endofil ™ was considered to be the time lapsed from the moment the files were first inserted into the root canal until the files reached the WL. Using a stopwatch, the time duration from entering the root canal with file or engine driven instrument to the completion of the reinstrumentation was measured in seconds[12,13,14,15].

Statistical analysis

The time required to remove the filling materials was expressed in seconds. The values obtained are shown through their mean values and standard deviation. The minimum and maximum measured values are also displayed. A one-way analysis of the variance (ANOVA) for comparison between the three examined endodontic systems was performed as well as a post hoc test for comparison among the groups. The significance level was set in all cases at α = 0.05 (there is statistical significance for P <0.05). Statistica 10 (StatSoft, 2010) was used for data analysis.

Results

Mean ± SD, maximum and minimum values of the time required to remove filling material from root canals using the three different retreatment systems are shown in Table 1. The mean of the working time (seconds) for the retreatment was the highest for SiA and the lowest for SiB.

ANOVA one-way analysis showed a high significant difference between the three groups P = 0.000048 (Table 2).

Table 2 shows that the F-value is greater than the F-critical value for the alpha level selected (0.05). Therefore, we reject the null hypothesis because at least one of the three samples has significantly different means.

To check which samples had different means we performed the post hoc test. There was a significant differ-

Table 1. Mean ± SD, maximum and minimum values of the time required to remove filling material from root canals

System	Mean (sec)	SD (sec)	Median (sec)	Min (sec)	Max (sec)
Si A	711.175000	332.564386	627.500000	274.000000	1745.000000
Si B	449.200000	186.672509	437.000000	115.000000	929.000000
Si C	519.700000	240.870132	472.000000	128.000000	943.000000

Table 2. A one-way analysis of the variance (ANOVA) for comparison between the three examined endodontic systems
ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1470184.35	2	735092.175	10.83865084	0.00004803503	3.073762904
Within Groups	7935100.575	117	67821.37244			
Total	9405284.925	119				

ence between the SiA vs. the SiB (0.000042) and the SiA vs. the SiC (0.004204) (P < 0.05). This means that SiA obtained the highest time (711s) with statistically significant differences in relation to SiB and SiC. Between SiB (449s) and SiC(520s) there are not any statistically significant differences.

Discussion

Removal of root canal filling material is a procedure of major importance in endodontic retreatment because, through the use of instruments and irrigating solutions, it constitutes an effective measure against the debris and microorganisms associated with apical periodontitis[16,17].

Three different root canal retreatment systems were compared: one manual-Hedstroem and two machine rotary nickel-titanium systems Pro Taper Retreatment and Pro Taper Gold files to determine which was the fastest.

According to the results obtained, Pro Taper Retreatment files (SiB) removed filling material in a shorter time than Pro Taper Gold files (SiC) and Hedstroem hand files (SiA). Hedstroem hand files obtained the highest time in seconds, meaning SiA performed the retreatment the slowest.

Although endodontic retreatment is common in dental practice, some techniques and materials make the removal of the filling material difficult, leading to a search for faster, safer and more effective resources, which undoubtedly, result in success[18,19,20]. The most common filling material to be removed is gutta-percha[21,22]. For this purpose, either hand or rotary instruments, with or without solvents, can be used[23,21,19,20].

Concerning to rotary instruments, Pro Taper Retreatment System has instruments with active point enabling the filling material removal without using solvents, eliminating the formation of a gutta-percha film on root canal walls, which could prevent the action of intra-canal medication on the root canal disinfection process during endodontic retreatment[21]. Our study showed the same results, Pro Taper Retreatment System performed the fastest in the retreatment procedure.

On the other hand, the Pro Taper Gold system, in spite of its improved elasticity, does not have any instruments with active point which, according to our results, lead to slower time for the retreatment than Pro Taper Retreatment files.

The results of the present study revealed that the rotary systems were faster than the manual system, findings that concur with previous studies[12,24,25]. These findings may be explained by the design of the rotary files (motion, flute design, different taper and active tip). In addition, the softening or plasticization of the gutta-core is caused by the higher rotational speeds, which leads to easier removal of the obturation material[26,27].

Takahashi et al.[28] compared manual files + Gates-Glidden drills with ProTaper Retreatment System, with or without the use of solvents, and had the same conclusions like us, that the rotary system without solvents was the fastest technique. Bramante et al.[29], studying two rotary systems and comparing them with a manual technique, indicated that Protaper Retreatment System had the best performance, corroborating the findings of Vale et al.[30] that similar to our results.

Our study showed that the Pro Taper Gold System was slower than the ProTaper Retreatment System, dissipating its improved elasticity. The reason is the active tip of the ProTaper Retreatment files. Still, the design of these instruments is more effective in cleaning the root canals than hand instrument, because of the instrument rotation, which causes the plasticization of gutta-percha. This makes the removal of the filling material easier, because of the tendency of the gutta-percha to be pulled towards coronal direction[31]. The general analysis of the results regarding the retreatment time differed from most of the previous studies including our reporting that rotary instruments were faster in removing the filling material. Finally, it is noteworthy to mention that none of the procedures promoted the complete removal of the filling material, fact that has been identified by other studies[30,32].

Conclusion

The results of this in vitro study showed that the Pro Taper Retreatment System was the most rapid method for removing filling material in the retreatment of root canals, and the manual was the slowest one.

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DENTAL CARIES IN CORRELATION WITH LIFE STYLE AND HABITS

КАРИЕСОТ ВО КОРЕЛАЦИЈА СО ЖИВОТНИОТ СТИЛ И НАВИКИ

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Abstract

INTRODUCTION. Dental caries is a multifactorial disease. Sugar consumption, oral hygiene, quantity and composition of saliva, the presence of fluoride and other factors play a major role in its emergence. Everyone is at risk of dental caries, but children and adolescents above all. The majority of dental caries occurs in adults because the disease is cumulative. **AIM.** To determine the correlation of dental caries with lifestyle and habits. **MATERIAL AND METHOD.** We have examined 134 respondents aged over 6 years at the Dental Clinic "Jane Sandanski" Skopje. To realize the goal with the help of a questionnaire and dental examination, we noted the parameters DMF and OIH-index. **RESULTS.** The value of the DMF increases with age, ranging from 1.47 in the group from 6 to 12 years to 15.92 in the group over 51 years. In each age group, various risk factors have shown to be dominant. **CONCLUSION.** Health education and motivation of the entire population is needed. **KEY WORDS:** dental caries, risk factors, prevention.

Апстракт

ВОВЕД. Кариесот е мултикаузално заболување. Во неговото настанување голема улога имаат конзумацијата на шеќери, оралната хигиена, количината и составот на плунката, присуството на флуор и други фактори. Секој е изложен на ризик од забен кариес, но децата и адолесцентите се најмногу изложени на ризик. Во поголем дел кариесот е присутен кај возрасните, затоа што ова заболување е кумулативно. **ЦЕЛ.** Да се утврди корелацијата на забниот кариес со животниот стил и навики. **МАТЕРИЈАЛ И МЕТОД.** Беа опфатени 134 испитаници на возраст над 6 години кои се обратиле на Дежурна стоматолошка служба „Јане Сандански" Скопје. Целта ја реализиравме со помош на анкетен лист и стоматолошки преглед, ги нотиравме параметрите КЕП и ОХИ-индекс. **РЕЗУЛТАТИ.** Вредноста на КЕП индексот расте со возраста, почнувајки од 1,47 во групата 6-12 години до 15,92 во групата над 51 година. Кај секоја возрасна група различни ризик фактори се покажаа како доминантни. **ЗАКЛУЧОК..** Потребна е едукација и мотивација на целокупното население. **КЛУЧНИ ЗБОРОВИ:** дентален кариес, ризик фактори, превенција.

Introduction

Dental caries is still a major oral health problem in industrialized countries, affecting 60-90% of school-children and the vast majority of adults[1]. The prevalence of caries has increased steadily with the advance of civilization. The causes and mechanism for the formation of dental caries are well known. Several factors influence the formation of dental caries, including: diet, microorganisms, saliva, age, gender and genetic predisposition.

Under the influence of acids produced by cariogenic microorganisms in the dental plaque, when metabolizing sugars from food and beverages, demineralization of the enamel occurs. Demineralization counteracts the saliva with its buffering capacity; it is also a mineral reservoir that allows remineralization. These processes of demineralization and remineralization occur many times a day. When demineralization prevails, caries develops. The early manifestation of caries is in the form of a small stain of demineralized enamel, most often hidden in the fissures and pits of the teeth, or their approximate surfaces[2].

When demineralization occurs frequently, and overcomes remineralization over months, it leads to cavity formation. The destruction of the enamel spreads to the softer and more sensitive part of the tooth - dentine. The weakened enamel without support is subjected to breaking, and gradually a cavity[3] is formed. Untreated dental caries causes pain, dental abscess, severe local and systemic infections, and tooth loss[4]. It reduces quality of life, limits activities at school, work and home, causing millions of lost hours away from school and work every

year, worldwide[5]. At the end of the last century, developed European countries and North America, having perceived the problem, started implementing preventive and prophylactic measures.

A decline in caries prevalence has been observed in many developed countries as a result of public preventive health measures, combined with lifestyle changes and improved care for their own health. Developed countries have put dental caries under control, which is not the case with developing countries where caries is still a major economic problem[6].

Aim

The purpose of this study was to determine the correlation between dental caries and lifestyle and habits. In the realization of our work the following conditions were observed among the respondents:

- Habits and oral hygiene situation
- Application of prophylaxis with fluoride at home
- Eating habits
- Habits to visit a dentist
- Dental health situation.

Material and methods

The set goal was realized with the help of a questionnaire (children filled it with the help of parents) and dental examination of the teeth. 134 respondents from both sexes were included, aged 6 years onwards, who came to the Emergency Dental Service at the Clinic "Jane Sandanski" in Skopje, in the period from December 2018 until February 2019. For a more detailed interpretation of the results, respondents were divided into 5 groups depending on the age group: group 6-12 (43 respondents), group 13-20 (15 respondents), group 21-30 (31 respondents), group 31-50 (32 respondents) and a group over 51 (13 respondents). In total, we had 134 respondents.

The reviews were made in accordance with WHO recommendations.

As parameters of the test we noted:
- Klein - Palmer index (DMF – index),
- OHI (Oral Hygiene Index) - according to the Green-Vermillion method

Results

The results of the survey and clinical research are shown in the following tables:

Table 1. DMF-Index Scores

Permanent teeth	6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
Carious teeth	41	65%	104	58%	203	49%	134	31%	39	19%	**521**	**41%**
Teeth with filling	22	35%	53	30%	167	41%	190	44%	62	30%	**494**	**38$**
Extracted teeth	0	0%	21	12%	41	10%	105	25%	106	51%	**273**	**21%**
Total	**63**		**178**		**411**		**429**		**207**		**1288**	
DMF-index	1.47		11.87		13.26		13.41		15.92		9.61	

Table 2. OHI-Index values

Permanent teeth	6-12 years	13-20 years	21-30 years	31-50 years	Over 51 years	Total
	35	15	31	32	9	120
Total teeth surfaces	198	90	186	192	54	720
Points	350	141	296	267	76	1130
OHI-index	**1.8**	**1.6**	**1.6**	**1.4**	**1.4**	**1.6**

Table 3. Oral hygiene maintenance

RESPONDENTS		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
		43	%	15	%	31	%	32	%	13	%	**134**	%

How often do you brush your teeth?

A	After every meal	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
B	Only in the morning	6	14%	1	7%	8	26%	8	25%	3	23%	26	19%
C	Only in the evening	11	26%	0	0%	1	3%	3	9%	1	8%	16	12%
D	In the morning and evening	12	28%	10	67%	15	48%	13	41%	7	54%	57	43%
E	Don't brush them every day	14	33%	4	27%	7	23%	8	25%	2	15%	35	26%

How long do you brush your teeth?

A	1 Minute	25	58%	8	53%	11	35%	13	41%	4	31%	61	46%
B	2-3 Minutes	15	35%	7	47%	16	52%	17	53%	9	69%	64	48%
C	Longer than 3 Minutes	3	7%	0	0%	4	13%	2	6%	0	0%	9	7%

Which additional tools for oral hygiene do you use?

A	1 Minute	1	2%	1	7%	7	23%	8	25%	1	8%	18	13%
B	2-3 Minutes	0	0%	1	7%	0	0%	1	3%	2	15%	4	3%
C	Longer than 3 Minutes	0	0%	6	40%	5	16%	4	13%	1	8%	16	12%
D	Dental floss	42	98%	7	47%	20	65%	22	69%	9	69%	100	75%

Table 4. Fluor Prophylaxis values

RESPONDENTS		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
		43	%	15	%	31	%	32	%	13	%	134	%

Which fluoride supplements do you use?

A	Fluoride tooth paste	43	100%	15	100%	31	100%	32	100%	13	100%	134	100%
B	Fluoride rich tablets	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
C	Mouthwash with fluoride	0	0%	6	40%	5	16%	4	13%	1	8%	16	12%
D	Fluoride varnish and gels	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
E	Don't use fluoride supplements	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%

Table 5. Dietary habits values13

	RESPONDENTS	6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
		43	%	15	%	31	%	32	%	13	%	134	%
A	2-3	18	42%	4	27%	14	45%	19	59%	9	69%	64	48%
B	3-5	25	58%	11	73%	15	48%	12	38%	4	31%	67	50%
C	6 or more	0	0%	0	0%	2	6%	1	3%	0	0%	3	2%

How often do you consume the following food products?
Fruit and fizzy drinks

		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
A	Once a day	6	14%	5	33%	4	13%	4	13%	1	8%	20	15%
B	Many times a day	10	23%	3	20%	5	16%	5	16%	0	0%	23	17%
C	Once a week	3	7%	0	0%	3	10%	1	3%	1	8%	8	6%
D	Many times a week	7	16%	6	40%	7	23%	9	28%	1	8%	30	22%
E	Rarely or never	17	40%	1	7%	12	39%	13	41%	10	77%	53	40%

Cakes , chocolates

		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
A	Once a day	12	28%	3	20%	9	29%	6	19%	2	15%	32	24%
B	Many times a day	20	47%	5	33%	4	13%	2	6%	0	0%	31	23%
C	Once a week	1	2%	2	13%	2	6%	5	16%	1	8%	11	8%
D	Many times a week	8	19%	5	33%	6	19%	15	47%	6	46%	40	30%
E	Rarely or never	2	5%	0	0%	10	32%	4	13%	4	31%	20	15%

Candies, lollipops

		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
A	Once a day	0	0%	0	0%	0	0%	0	0%	1	8%	1	1%
B	Many times a day	6	14%	0	0%	2	6%	1	3%	3	23%	12	9%
C	Once a week	1	2%	2	13%	1	3%	0	0%	0	0%	4	3%
D	Many times a week	8	19%	3	20%	3	10%	0	0%	1	8%	15	11%
E	Rarely or never	28	65%	10	67%	25	81%	31	97%	8	62%	102	76%

Chips, snacks

		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
A	Once a day	5	12%	0	0%	3	10%	4	13%	1	8%	13	10%
B	Many times a day	6	14%	2	13%	0	0%	1	3%	0	0%	9	7%
C	Once a week	3	7%	2	13%	2	6%	5	16%	0	0%	12	9%
D	Many times a week	16	37%	6	40%	10	32%	5	16%	1	8%	38	28%
E	Rarely or never	13	30%	5	33%	16	52%	17	53%	11	85%	62	46%

Table 6. Dentist visiting habit values

RESPONDENTS		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	

How often do you go to dentist?

		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
A	Every 3 months	8	19%	0	0%	4	13%	4	13%	0	0%	16	12%
B	Every 6 months	1	2%	2	13%	2	6%	4	13%	1	8%	10	7%
C	Once a year	1	2%	0	0%	3	10%	2	6%	2	15%	8	6%
D	When needed	25	58%	6	40%	4	13%	6	19%	6	46%	47	35%
E	Only in case of a pain	8	19%	7	47%	18	58%	16	50%	4	31%	53	40%

If the answer of the previous question is D, what do you think the reason might be?

		6-12 years		13-20 years		21-30 years		31-50 years		Over 51 years		Total	
A	Fear	5	12%	5	33%	9	29%	8	25%	0	0%	27	20%
B	Financial condition	3	7%	2	13%	0	0%	1	3%	1	8%	7	5%
C	Lacking of dental knowledge	0	0%	0	0%	0	0%	1	3%	2	15%	3	2%
D	Not enough time	0	0%	0	0%	9	29%	6	19%	1	8%	16	12%

DMF - INDEX

Table 1 shows the DMF-index score. In the first group we got the DMF 1.47, of these carious teeth 65%, teeth with fillings 35%, and extracted teeth 0%. In the second group (13-20 years) we received a DMF 11.87, of this caries 58%, teeth with fillings 30% and extracted teeth 12%. In group 21-30 years we noted the DMF was 13.26, from this carious teeth 49%, teeth with fillings 41% and extracted teeth 10%. In group 31-50 years we noted the value of DMF 13.41, of this 31% are carious teeth, teeth with fillings 44% and extracted teeth 25%.

In the last group over 51 years we noted the DMF was 15.92. Carious teeth were 19%, teeth with fillings 30% and extracted teeth 51%.

From the overall analysis of all respondents we received the DMF was 9.61. Carious teeth were observed in 41%, teeth with fillings in 38% and extracted teeth in 21% of the cases.

OHI-INDEX

Table 2 shows the values of the OHI Index. We found the highest value in the group 6-12 years, namely OHI 1.8, then in the groups 13-20 and 21-30 years, we established the value of OHI index 1.6, and in the last two groups, that is, the group 31-50 years and over 51 years, the OHI index was 1.4. The total value of the index for all respondents was OHI 1.6.

ORAL HYGIENE HABITS

Table 3 shows the results of the survey list for the maintenance of oral hygiene.

When patients were asked how often they brushed their teeth, none of the respondents from any group gave a response that they were brushing them after each meal. In group 6-12 years 33% (the largest percentage) reported that they do not brush their teeth every day, 28% in the morning and in the evening, only 26% in the evening and only 14% in the morning. In the other groups, the largest percentage reported that they brushed their teeth in the morning and in the evening, as follows: in group 13-20 years in the morning and in the evening 67%, do not brush every day 27% and 7% in the morning only; in group 21-30 years in the morning and in the evening 48%, in the morning only 26%, do not brush every day 23% and only 3% brush in the evening; in the group 31-50 years in the morning and in the evening brush their teeth 41%, do not brush every day 25%, the same percentage answered only in the morning, and only in the evening 9%; in the group over 51 years in the morning and in the evening brush 54%, in the morning only 23%, not every day 15% and only in the evening 8%.

The total score is as follows: in the morning and in the evening 43%, not every day 26%, only in the morning 19% and only in the evening 12%.

When asked how long they brushed their teeth, most of the first two groups replied 1 minute, as follows: in the group 6-12 years: 1 minute 58%, 2-3 minutes 35%, longer than 3 minutes 7%; in the group of 13-20 years, 1 minute 53% and 2-3 minutes 47%.

In the other groups, the biggest percentage responded 2-3 minutes, as follows: in the group of 21-30 years: 2-3 minutes 52%, 1 minute 35%, longer than 3 minutes 13%; in the group 31-50 years: 2-3 minutes 53%, 1 minute 41%, longer than 3 minutes 6%; in the group over 51 years: 2-3 minutes 69%, 1 minute 31%.

The total results are: 2-3 minutes 48%, 1 minute 46%, longer than 3 minutes 7%.

On the question which additional tools for oral hygiene they use, the highest percentage in all groups responded that they do not use additional tools. The overall results are as follows: additional tools do not use 75%, dental floss use 13%, mouth rinse 12% and interdental brushes 3%.

FLUOR PROPHYLAXIS

From the Fluor prophylaxis table 4, it is evident that 100% of the respondents answered that they use a tooth paste with fluoride. Of the remaining fluoride supplements, only fluoride mouth rinse was listed by 12% of the subjects. No one uses fluoride tablets and fluoride varnish and gels.

DIETARY HABITS

Table 5 presents the results for dietary habits. When asked how many meals they have during the day, the largest percentage of respondents in the first three groups reported that they had 3-5 meals per day. In the other two groups, most respondents reported having 2-3 meals a day. The overall result shows: 50% had 3-5 meals a day, 48% had 2-3 meals a day, and only 2% had 6 or more meals a day.

In terms of sweet food products, fruit and fizzy juices are most commonly consumed by respondents in the group of 13-20 years, as follows: 40% consume them many times a week, 33% once a day, 20% more times a day, and 7% respond rarely or never.

The total score of all groups shows: 40% rarely or never, 22% more times a week, 17% more times a day, 15% once a day and 6% once a week.

Cakes and chocolates are most commonly consumed by the respondents from the first two groups. The largest percentage of them, 47% of the group 6-12 years and 33% of the group 13-20 years, answered several times a day.

The overall result is as follows: 30% more times a week, 24% once a day, 23% more times a day, 15% rarely or never and 8% once a week. The candies and lollipops are more frequently consumed by the respondents in the first and last group compared to the other groups.

However, in all groups, the largest percentage reported that they are consuming rarely or never.

The total score shows: 76% rarely or never, 11% more times a week, 9% many times a day, 3% once a week and 1% once a day.

Chips and snacks are more likely consumed by the respondents from the first two groups than others. Most of them answered several times a week.

The total score shows: 46% rarely or never, 28% many times a week, 10% once a day, 9% once a week and 7% many times a day.

DENTIST VISITING HABIT

Table 6 shows the results from the Dentist visiting habits. The first two groups of respondents visit the dentist more regularly, in both groups, most of them responded that they go if needed (these are in the stage of treating decayed teeth).

In the 6-12 year group, 58% go if needed, 19% every 3 months, and the same percentage answered only in case of pain, 2% every 6 months and the same percentage answered once a year. In the group over 51, 46% answered if needed, 31% in the case of pain, 15% once a year and 8% at 6 months. In the other groups, most of them responded that they go to the dentist only in case of pain. In the group of 13-20 years, 47% go only in case of pain, 40% when needed, and 13% at 6 months. In the group of 21-30 years, 58% go only in case of pain, 13% when needed and the same percentage answered at 3 months, 10% once a year and 6% at 6 months. In the 31-50 age group, 50% they go only in case of pain, 19% when needed, 13% every 3 months and the same percentage at 6 months, 6% once a year. The total score shows: 40% only in case of pain, 35% when needed, 12% every 3 months, 7% every 6 months and 6% once a year.

When we asked patients, who go to the dentist only in case of pain (40%), what is the reason for this, half of them (20%) answered that the cause is fear, 12% stated the reason not having enough time, 5% answered financial situation and 2% answered lack of dental knowledge.

Discussion

In this study, we obtained a statistically significant difference in the values of the DMF Index between the group 6-12 years (DMF 1.47) and the remaining groups:

group 13-20 years (DMF 11.87), group 21-30 years (DMF 13.26), group 31-50 years (DMF 13.41) and a group over 51 years (DMF 15.92). We can notice that with the age the value of the DMF index increases. The D (decay) component of the DMF index is dominant in the respondents up to 30 years, the F (filling) component is dominant in the respondents from 31-50 years, while in the group over 51, the E (extraction) component is in the lead. These results are similar to a study involving 26 countries around the world, which studied the differences in the caries level between 12-year-olds and 35-44 year-old people. Much higher levels of caries occurred in adults than in children in all 26 countries. Whereas the DMFT in 18 of the 26 countries had levels below 1.5 at 12 years of age, 14 of those with such low scores for children had DMFT levels above 10 at 35-44 years[7].

By the respondents from 6-12 years of age we received the DMF 1.47 with no extracted permanent teeth, which is really encouraging data. However, we received disappointing results from the questionnaire and from the examination of oral hygiene (OHI 1.8).

FDI (World Dental Association) recommends brushing the teeth 2 times a day[8]. In our study, as many as 72% of children in this group do not brush frequently enough, with a high proportion of those who replied that they do not brush every day which is 33%.

FDI recommends that the duration of brushing should be 2-3 minutes[8].

Most of the respondents in this group or 58% reported that they brush their teeth for 1 minute.

Most of them (98%) do not use additional oral hygiene tools, and no one has stated that they use any fluoride supplements at home, except toothpaste.

From the results about the dietary habits we can see that they often consume cakes and chocolates, and 47% of them consume them many times a day.

The data obtained for the oral hygiene and dietary habits are correlated with the high value of the OHI - index.

Regarding to how often they go to the dentist, 58% responded if needed (in the process of treating the decayed teeth), which can be taken as a positive result.

Compared with the habits of these respondents, we received a low value on the DMF index. This group of children is included in the Strategy for prevention of oral diseases in children from 0-14 years, introduced in our country in 2008. This strategy, besides educational programs in kindergartens and schools, include obligatory regular dental examinations, sealants for permanent teeth and local fluoride supplements[8]. In the future, if bad habits are not eradicated, we can expect a significant increase in the value of the DMF index, since we do not protect the proximal surfaces of the teeth with sealants.

The results that we have obtained in the group of 13-20 years were DMF 11.87 and OHI 1.6. Although a rather large percentage (67%) answered that they brush their teeth in the morning and in the evening, this does not support the high values of the OHI and the DMF index, which can be partly due to the short duration of the brushing, i.e. 53% answered 1 minute. The dental floss as additional tool for oral hygiene that removes the plaque from the proximal surfaces of the teeth is used by only 7%. Observational studies have shown that individuals using dental floss have lower levels of caries and gingival inflammation[9].

Recently, additional tools for oral hygiene such as mouth rinses that contain fluoride have been implemented and 40% of the patients reported that they use them.

This group stands out from the rest with frequent consumption of juices. In one study, the association of the frequency of consuming sweetened drinks with carious growth was investigated in adults over a period of 4 years. It has been proven that adults drinking sweetened drinks 1-2 times and 3 or more times a day, had respectively 31% and 33% greater net DMFT increments than those not drinking any sweetened drinks[10]. A typical example of the strong cariogenic potential of the sweetened drinks is the occurrence of baby bottle caries by children fed with a baby bottle[8].

Concerning to how often they go to a dentist, as many as 47% answered only in case of pain, most of them explained that the main reason for that is fear. This data is in favor of the high value of the DMF-Index.

The results of the survey list for groups 21-30 years and 31-50 years show a great similarity. A great similarity is also perceived in the values of the DMF and OHI index in these groups (group 21-30 years – DMF 13.26 and OHI 1,6, group 31-50 years – DMF 13,41 and OHI 1,4). About half of the respondents maintain oral hygiene regularly, the percentage of those who use additional tools for oral hygiene is small. Dental floss, as widely recommended tool for removing dental plaque from the proximal tooth surfaces[11], is used by 23% of the group 21-30 years and 25% of the group 31-50 years.

Regarding the diet, we noted that cariogenic foods are used less often in these two groups compared to the previous two groups.

Regarding the habit of visiting a dentist, in these two groups, in comparison with the rest, we received the highest percentages with the answer that they go only in case of pain, and the fear and lack of time are almost equally mentioned as the reason for this. This goes in favor of the high value of the DMF - Index. We noted that with the rapid pace of living, work and family obligations, people have less time to visit a dentist, which significantly affects their oral health. Many of them do not attach great importance to dental health; young people are easily opting for extraction.

On the other hand, dental anxiety proved to be an important indicator of poor dental and periodontal status[12]. The prevention of pain and discomfort combined with the correct psychological attitude of the dental team to the patient is the basis for success in overcoming fear[13].

From the survey list in the group over 51 we noticed that the respondents are conducting regular oral hygiene, very few of them use additional tools for oral hygiene. The respondents in this group appear as the most common consumers of candy compared to the rest. Salivary flow is often diminished in this population and by taking candies; they try to relieve the feeling of dry mouth. Chronic periodontitis often present in this population leads to stripping of the teeth roots, and increased mobility. The teeth mobility, as well as their reduced number is the reason for consuming soft foods. This is the reason for frequent occurrence of cervical caries and root caries of the tooth[14].

With this study we once again proved that caries is a multifactorial disease that commonly affects people of all ages, throughout their lifetimes, which through interacting with food, dental plaque and microorganisms over a long period of time leads to an irreversible destruction of the hard tooth substance[15].

Conclusion

Health education and motivation of the entire population is needed (pregnant women, young children, pre-school children, school children, adults, parents, educators, and teachers).
Only in this way we can expect an improvement in oral health.

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DENTAL EDUCATION IN THE PROMOTION OF ORAL HEALTH AMONG TWELVE-YEAR-OLDS

СТОМАТОЛОШКАТА ЕДУКАЦИЈА ВО ПРОМОЦИЈА НА ОРАЛНОТО ЗДРАВЈЕ КАЈ ДВАНАЕСЕТГОДИШНИ ДЕЦА

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Abstract

Dental education is a special discipline whose planning, programming and performing covers all professional health persons and services as well as educational and pedagogical persons, orienting all their activities towards the individual and the community in order to motivate and transform them in the role of active participants in keeping and improving their own personal health. The aim of our study is to enhance the positive forms of health behavior and promote oral health as an undivided segment of health as a whole to children at the age of twelve; to develop motivation for protecting oral health with timely recognition of risk factors for development of oral diseases and correction of bad habits and attitudes of children at the age of twelve. For realizing the given aim we followed 80 respondents from both genders, at the age of twelve, with different hygiene-dietetic regimes, all pupils in the primary school "Nikola Vapcarov" – Skopje. Respondents had good general and oral health, with exclusion of dental caries. The study was realized in three phases, whereof, the first phase was realized during the conducted dental education of all respondents, the second phase one month after the dental education, and the third one three months after the conducted dental education. The condition of dental health in all respondents in our study is shown through DMF index values whose average was 7.05. There was a significant differences between oral hygiene index values in all pupils between the first and the second phase, between the second and the third phase of the research, as well as in values of the OHI index during the implementation of education and three months after that. **Key words:** Promotion of oral health, dental education, twelve-year old children, dental status.

Апстракт

Стоматолошката едукација претставува посебна дисциплина во чие планирање, програмирање, и изведување учествуваат сите здравствени стручни лица и служби, наставни и педагошки лица, насочувајќи ги сите активности кон поединецот и заедницата да ги мотивираат и да ги трансформираат во улогата на активни ученици во зачувувањето и унапредувањето на сопственото здравје. Цел на нашата студија е да постигнеме унапредување на позитивните форми на здравствено однесување и промоција на оралното здравје како неделив сегмент на здравјето во целина кај деца на дванаесетгодишна возраст; развој на мотивација за заштитата на оралното здравје со благовремено препознавање на факторите на ризик за развој на оралните заболувања и корекција на лошите навики и ставови кај деца на дванаесетгодишна возраст. За реализација на поставената цел беа проследени 80 испитаници од обата пол, на возраст од 12 години, со различен хигиено-диететски режим, ученици во основното училиште "Никола Вапцаров" - Скопје. Испитаниците се со зачувано општо и орално здравје, со исклучок на денталниот кариес. Студијата се реализираше во три фази, при што, првата фаза беше реализирана пред спроведената стоматолошка едукација на сите испитаници, втората фаза еден месец по стоматолошката едукација, и третата фаза беше реализирана три месеци по спроведената стоматолошка едукација, при што беа детерминирани вредностите на рН на плунката, ОХИ индексот, индексот на гингивална инфламација и индексот на гингиворагија и беше регистриран КЕП индексот. Состојбата на денталното здравје кај сите испитаници во нашата студија е прикажана преку вредностите на КЕП индексот чија средна вредност изнесува 7,05. Сигнификантна е разликата меѓу вредностите на ОХИ индексот кај сите ученици меѓу првата и втората фаза, меѓу втората и третата фаза на истражувањето, како и на вредностите на ОХИ индексот пред одржувањето на едукацијата и три месеци после тоа. **Клучни зборови:** Промоција на оралното здравје, стоматолошка едукација, дванаесетгодишни деца, дентален статус.

Introduction

It is a fact that health has been a case of interest and interpretation of experts in different scientific disciplines for many years, giving its universal value, it is still, as a whole and in very respectful level can be discussed only from a medical and biological point of view. Nourishing health has always been a significant duty of each individual and society. In the past, health was seen only from the diseases aspect, and questions regarding maintaining health were reviewed only in the sphere of health protection. Promotion of health represents a concept in which health is created through political and social processes to reach social, mental and physical well-being of all people.

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Teeth diseases and other tissues in the oral medium, such as: dental caries, parandotopathy, orthodontia anomalies, malign and hereditary diseases belong to the group of chronic diseases, representing a great health problem with expressed social aspects. Widespread dental caries, parandotopathy and orthodontia anomalies give the characteristics of pandemic diseases. Of those, dental caries represents a special health problem, because it is shown very early, but spreads very quickly, covering more and more new people, new teeth, causing heavy complications, which leads to complete or incomplete loss of teeth with all present consequences from that loss.[1]

The World Health Organization (WHO) defines health education as an active process of learning and empowerment of individuals and the public in applying the acquired knowledge for health.[2,3] Dental health education represents special a discipline in which planning, programming, organizing and performing are covered by all professional health persons and services, educational and pedagogical persons, orienting all the activities towards the individual and the community in order to motivate and transform them in the role of active participants in keeping and improving their oral health .

In Scandinavian countries, the postulates of the World Health Organization (WHO) are reached and achieve the values of the average caries index of 1.5 in children of twelve years of age.[4,5] Also, in Denmark the value of this index is 0.8, in Norway 1.6, while in twelve-year old children in Portugal it is 1.5.[6]

Prevention programs which also involve the educational staff in teaching the importance and improvement of oral health in Poland, during a period of five years, resulted in decreasing the average caries index from 4.2 to 3.8. Wierzbicka M. et al.[7]

National research made in Italy by Campus G. et al.[4] during the period between 2004 and 2005, in twelve-year-old children showed values of average caries index of 1.09, with statistical siginifcant differences among children of different genders, and that in girls it was 1.20 while in boys 0.99.

Well organized prevention programs realized through regular and correct brushing of teeth with a toothpaste for everyday maintenance of oral hygiene which contain fluorides, implementing oral education, and conducting organized watering fissures and yolks of lateral teeth, in Slovenia,[3] contributed to decreased values of average caries index from 5.1 in 1987 to 1.8 in 1998 in twelve-year-old children and from 10.2 to 4.3 in fifteen-year old children.

The last data are from 2009 by the Clinic for child's and preventive dentistry and the Faculty of Dentistry in Belgrade, with the intention to be used in designing a dental preventive program in the Republic of Serbia.[8,9] The results showed that in twelve-year old children, the average caries index was 2.8 while in fifteen-year old children it was 5.6.

The study of Knezevic R. et al.[10] indicates the successfulness of the preventive program conducted within three years, reaching an improvement of oral health in children. The preventive program started 2005, when the structure of the parandotosis index in respondents for healthy teeth was 75%, teeth with caries 18% and sealed teeth 7%, the average OHI index was 1.60%. Three years later, = in the same pupils the structure of the KEP index for healthy teeth was 81%, teeth with caries 10%, sealed teeth 8%, and the average OHI index was 0,95%.

Sheiham A.[11] indicates significantly lower indices of gingival inflammation and gingival virus, as well as an OHI index, in all respondents who brushed with fluoride toothpaste under supervision in relation to respondents who brushed under supervision, but with non-fluoride toothpaste; compared to respondents who brushed without supervision with fluoride toothpaste.

The aim of our study is to improve positive forms of health behavior and to promote oral health as an undivided segment of health as a whole in children at the age of twelve; to develop their motivation for protecting oral health with timely recognition of risk factors for development of oral diseases and correction of bad habits and attitudes in twelve-year-old children.

To realize the given aims, the study followed and determined: the values of the KEP index in all respondents; the structure of the KEP index; the values of KIO – general caries frequency; the values of the OHI index, before implementing dental education in the first phase; one month (II phase) and three months after the realized education (III phase) and its comparison and to the implemented questionnaire.

Material and methods

For realizing the given aim we followed 80 respondents from both genders, at the age of twelve, with different hygiene-dietetic regimes, all pupils from the primary school "Nikola Vapcarov" – Skopje. Respondents had a good general and oral health, with exclusion of dental caries. The study was realized in three phases, whereof, the first phase was realized during the conducted dental education of all respondents, the second phase one month after the dental education, and the third phase three months after the conducted dental education, when we determined the values of the DMF index (*Klein-Palmer-system*), the Structure of the DMF index, the values of KIO – General caries frequency, the values of the OHI index (*method of Greene – Vermillion*), implemented questionnaire.

For statistical processing of the obtained data we applied software EXCEL 2007, SPSS version 12 and STATISTIKA version 7.

Results

Dental education in our study was conducted in the first phase of the research, after dental examination of each child, with the help of a power point presentation and an individual demonstration. Dental education was realized in order to provide the students with the necessary information for maintaining oral hygiene, applying fluoride and establishing a proper dietary regime, as well as motivating them to take an active part in preventing the onset of diseases in the oral medium. The state of dental health is shown through the values of the DMF index, in all respondents, of both genders (Table 1.). The average value of the DMF index is $\bar{x} = 7.05$, with minimum values of 0.00 and a maximum of 14.0. Regarding the gender, the values of the DMF Index amounted to 6.9 in male and 7.2 in female respondents.

Table 1. Mean values of the DMF index in all respondents

Number of respondents	$\bar{\chi} \pm \sigma$ (total)	$\bar{\chi} \pm \sigma$ M / F	min	max
8o	7.05	6.9 / 7.2	0.00	14.o

In the twelve year old students, of the total DMF (7.05), the biggest percentage, 75.8%, were cariogenic, unwashed teeth, and much more in males (81.9%) than in females (69%). Extracted teeth were represented by 3.9%, i.e. 3.19% in males and 4.6% in females, while compared to restored teeth; they were represented with 20.2%, 14.8% in males and 25.5% in females (Table 2./Graph 1.).

The prevalence of dental caries in permanent teeth among our respondents expressed through the CIP index or the general caries frequency is 98.75%, as shown in Chart 2.

The median values of the Oral Hygiene Index (OHI) among all our respondents in all phases of the research are shown in Table 3. It can be noted that in the first phase of the research it is the highest at 1.72 ± 0.58, with registered minimum values of 0.66 and maximum of 3.00. After the conducted dental education, in the second phase of the survey, the mean value of the OHI index decreased to 1.36 ± 0.46, with minimum values of 0.33 and maximum of 2.33 and a similar value in the period of three months after the conducted dental education at 0.94 ± 0.62, with a minimum value of 0.0 and a maximum value of 2.0 (Table 3.)

Table 2. Structure of the DMF Index

Structure of DMF	M	F	TOTAL
D - decay	81.9 %	69.8 %	75.8 %
E - extraction	3.19 %	4.6 %	3.9 %
F - filling	14.8 %	25.5%	20.2 %
Total	100%	100%	100%
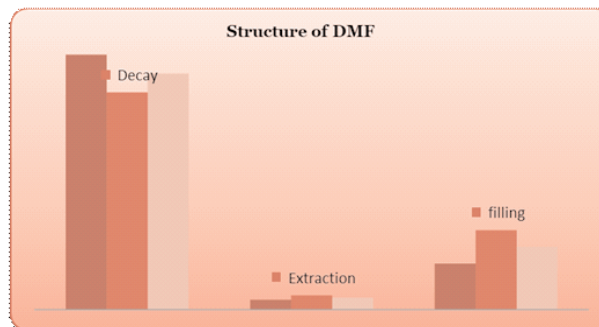
Chart 1. *Structure of the DMF*
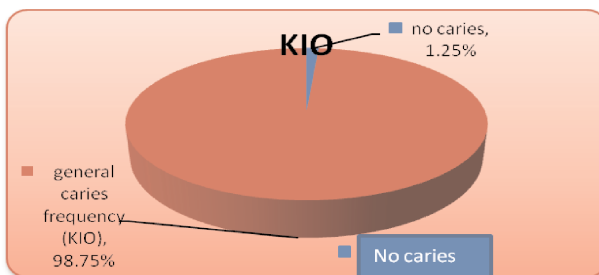
Chart 2. *Values of the KIO index*

Table 3. Average values of the OHI index in all phases of the research

OHI values	No. of respondets	$\bar{\chi} \pm \sigma$	Min	Max
OHI 1	80	1.72 ± 0.58	0.66	3.0
OHI 2	80	1.36 ± 0.46	0.33	2.33
OHI 3	80	0.94 ± 0.62	0.0	2.0

The relationships between the average values of the Oral Hygiene Index among all respondents in the three phases of the study, shown through the Student's "t" test for dependent samples, indicate a significant difference between the values of the OHI index among all students between the first and second stages, between the second

Table 4. Correlation between the OHI values in the three phases of the ANOVA test

	ANOVA test about OHI							
Variable	SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	P
OHI 123	24.40396	2	12.20198	74.39049	237	0.313884	38.87418	0.000000

Table 5. Correlation between the values of the OHI index for all respondents in the three phases of the research

OHI	$\overline{\chi} \pm \sigma$	Σ	"t"	P
OHI 1 - OHI 2	0.36	0.34	9.37	<0.01
OHI 1 - OHI 3	0.78	0.59	11.7	<0.01
OHI 2 - OHI 3	0.41	0.56	6.61	<0.01

and third stages of the research, as well as the values of the OHI index before the education and three months after, there is a significant difference (p <0.01) (Table 4. and 5.). These results speak for the improvement of oral hygiene among our respondents after the dental education. With the ANOVA test for OXI, the index shows a statistical significance of improved oral hygiene in children who followed the educational hour (f = 38.87, p≤0.01).

From the total number of questionnaires or 8 in number, we could statistically process only 5, which we compared statistically in respct of the gender of students. The highest percentage of children in our study, for the first time, visited a dentist at the age of six, 57%, then 28% visited the dentist for the first time at the age of five, while for the first time 15% of the examinees visited the dentist at the age of seven years (Table 6.).

In the three examined groups, the respondents visit their dentist more than once annually - 58.8%, 50% of the

Table 6. Distribution of respondents by age from the first visit to the dentist

First visit	No. of respondets	M	F	Total
5 year old	80	21.9	35.8	28 %
6 year old	80	60.9	51.2	57 %
7 year old	80	17	12.8	15 %

male and 67.5% of the girls. Once a year responded25%, twice a year a total of 12.5% and never visited a dentist, a total of 3.8% of the respondents (Table 7.). The statistical analysis of values with the Mann-Whitney test (Z = 0.5 p>0.05), as well as with the test of Kolmogorov-Smirnov (0.44) does not show the existence of a statistic significance.

Table 7. Distribution of respondents from the three groups according to the frequency of visiting a dentist

Visits to the dentist	Gender		**Total**
	M / %	F / %	
Once a year	30	20	25
Twice a year	12.5	12.5	12.5
More times	50	67.5	58.8
Never	7.5	0	3.8
Total	40 / 100	40 / 100	80 / 100

In the three groups of examinees, pupils performed teeth brushing twice a day (62.5%, with the same percentages in both sexes), followed by after each meal (28.8%, 22.5% of the boys and 35% of the girls), while brushing teeth once a day was practiced by 8.8%, 15% of boys and 2.5% of girls (Table 8.).

The statistical analysis of the values of the teeth brushing frequency with the Mann-Whitney test showed 90% significance (Z = -1.8 p≤0.10), and the Kolmogorov-Smirnov test (0.55) did not show the existence of a static significance.

The largest percentage of respondents in our study are changing their toothbrush every three months (81.3%, 87.5% males and 75% females), 7.5% every six months (10% of boys and 5% of girls), while 10 % of respondents change the toothbrush once a year (2.5% boys and 17.5% girls). It is interesting to point out that 1.3% of all respon-

Table 8. Distribution of respondents by sex of the three groups according to the frequency of teeth brushing by gender

Tooth brushing	Gender		Total
	M / %	F / %	
Once a day	15	2.5	8.8
Twice a day	62.5	62.5	62.5
After each meal	22.5	35	28.8
Total	40 / 100	40 / 100	80 / 100

Table 9. Distribution of respondents by gender according to changing toothbrushes

Changing the brush	Gender		Total
	M / %	F / %	
Every 3 months	87.5	75	81.3
Every 6 months	10	5	7.5
Once a year	2.5	17.5	10
Never	0	2.5	1.3
Total	40 / 100	40 / 100	80 / 100

Table 10. Distribution of examinees from the three groups according to the use of dental hygiene means

Dental devices	Gender		Total
	M / %	F / %	
Dental floss	10	17.5	13.8
Refreshing liquid	30	42.5	36.3
Interdental brush	0	5	2.5
None of the listed	60	35	47.5
Total	40 / 100	40 / 100	80 / 100

dents reported that they do not change the toothbrush at all (Table 9).

Educating how to brush your teeth (Tab.8) and tips regarding more frequent changes of the toothbrushes (Tab.9) have proved statistically nonexistent with Kolmogorov-Smirnov (0.78), but with Mann-Whitney showed a significance of 90% (Z = -1.6, p≤0.10).

In the largest proportion of the three examined groups, the respondents do not use any of the additional means of maintaining teeth hygiene (47.5%, 60% boys and 35% girls), followed by a rinse water 36.3%, of which 30% boys and 42.5% girls. Dental floss is used by 13.8% of the respondents, 10% by boys and 17.5% by girls. Interdental brush is used by 2.5% of the examinees (Table 10).The percentage difference registered between the modalities of the use of additional means of teeth hygiene among the examinees of both sexes, with the Mann - Whitney test, the significance of the education was statistically significant for 95% (Z = - 2.01, p≤0.05).

Discussion

Health education, as part of the promotion of oral health, contributes to a better understanding of the importance of oral health and helps develop specific skills, enabling the application of behavior from risk to health-improving. Its application is of particular importance to schoolchildren because of the early development of behavior that has a long-term impact on oral health and is difficult to change later in life.

The state of dental health among all respondents in our study is shown through the values of the CEP index with an average value of 7.05, with minimum values of 0.00 and a maximum of 14.0. Of the total CEP (7.05), the largest percentage, 75.8%, were caries, unwashed teeth, and much more in males (81.9%) than females (69%). Extracted teeth were represented by 3.9%, 3.19% in males and 4.6% in females, while compared to restored teeth, they were represented with 20.2%, 14.8% for males and 25.5% for females - children.

Davidovic, V. et al.[1] examined the state of dental health in twelve children from Foca, Cainice and Kalinovich, and found that only 4% of children had healthy teeth, the lowest value of KEP was 1, and was observed in 2.2% of children, while the highest value of the CEP index was 21 and was registered in 0.2% of children. In 16.4% of children, the most frequent value of the CEP index was 4. The overall prevalence of dental caries was 50.3%, while in girls the values of the CEP index were higher than for boys (p <0.05).

Rajic Z. et al.[12] in their epidemiological study provide data on the values of the CEP index in twelve year olds over a longer period of time (1968, 1973, 1980, 1990/1 and 1999), starting in 1968, when the PEP index was 7.0 and in 1991 it fell to a value of 2.6. However, in 1999, the value of the CEP Index rose to 3.5 as a result of the war in Croatia and the reorganization of the health care system in this period, considered as an authority in this study.

Results on the oral status of 12-year-old children in Cambodia, obtained in the research by Teng O. et al.[13]

showed a mean value of the CEP index of 2.33, of which unsanitary teeth had 2.31%, extracted teeth 0.01% and sealed teeth 0.01%. The children from the school with good cooperation had less significance at the mean of the CEP 1.62 as opposed to the school with moderate to low cooperation CPI 2.67.

According to the study of Gladwell G. et al.[14] which was implemented in two different cities in Kenya, there was a significantly high caries prevalence of 37.5% in Nairobi West District children, with regard to caries prevalence of children in the city of Mathira West District (24.0%). The values of the CEP index in the first city were 0.76 ± 1.2 while in the Mathira West District values of 0.36 ± 0.7 were recorded.

The respondents in our study were recommended to brush their teeth at least twice during the day, in the morning and in the evening. At the same time, they were educated on the proper way of maintaining oral hygiene. The median values of the Oral Hygiene Index (OHI) among all our respondents were followed in the three phases of the trial. It was noted that in the first phase of the research it was the highest at 1.72 ± 0.58, with registered minimum values of 0.66 and a maximum of 3.00. After the conducted dental education, in the second phase of the survey, the mean value of the OHI index decreased and it was 1.36 ± 0.46, with minimum values of 0.33 and maximum of 2.33 and a similar value in the period of three months after the conducted dental education 0.94 ± 0.62, with a minimum value of 0.0 and a maximum of 2.0.

Natasa I. J. et al.[15] investigated the degree of oral hygiene, through the values of the OHI index and caries prevalence in children with special needs in a group of healthy children in Croatia. The values of the OHI-S index ranged from 3.8-4.53 in children with special needs and 2.73-2.84 in the group of healthy children. In general, the results in this study speak of a significantly low level of oral hygiene and a very high prevalence of dental caries in both groups of children, which, in turn, imposes the need for reorganization and improvement of preventive dental care, especially for children with special needs in Croatia.

In his study Yee R. et al.[16] examined the degree of oral hygiene among 12-13 and 15 year olds in urban, rural towns and rural villages in Nepal. Among 12-13 year old school-age children living in urban towns, the mean value of the OHI index was 0.98 compared to the children from rural towns where it was 1.34 and the values of the OHI index of 1.44 in children from rural areas - villages. Statistical processing of values indicates the significance of differences in the OHI index values in the three examined groups of children.

For children at the age of 15, in urban towns the OHI index was 1.00 compared to children in rural towns where

it was 1.37 and 1.43 for children from rural areas - villages. Analysis of the results in this research in respect of children's oral hygiene showed that the children of urban schools had the lowest results compared to children from rural towns and rural villages. When comparing the median values of the OHI Index and the CEP Index, an inverse relationship was observed between the degree of oral hygiene and the presence of dental caries.

The relationships between the average values of the Oral Hygiene Index of all respondents in the three phases of our research, shown through the Student's "t" test for dependent samples, indicate a significant difference between the values of the OHI index among all students between the first and the second stage, between the second and the third stage of the research, as well as the values of the OHI index before the education and three months after, there is a significant difference. These results speak for the improvement of oral hygiene among our respondents after the dental education.

According to the study by Rivera M. C. A.[17], dental caries and gingivitis are the most prevalent diseases in Chile. The purpose of their examination was to evaluate oral health in children aged 4 and 5 in Peralillo, Chile before the start of the oral health program, between November, 2010 and February 2011. Clinical trials consisted of recording the presence of dental caries through the values of the CEP index and determining oral hygiene through the values of the OHI index (simplified method) and the presence or absence of gingivitis. Dental caries was found in 49.2% of children, with a mean of the CEP index of 2.4. Gingivitis was found in 9.2% of children, with mean OHI index in all children of 1.4. The analysis of the results obtained in this study, in conclusion, imposes the need for promotion and education for oral health, as well as increasing the resources for reducing the prevalence of oral diseases in the future. These results are in line with the results obtained in our Valuation Index of Oral Hygiene Index. The mean values of the Oral Hygiene Index (OHI) among all the respondents in our research were 1.72 ± 0.58, in the first phase before the realization of dental education, 1.36 ± 0.46 in the second phase of the research, 0.94 ± 0.62, in the period of three months of the conducted dental education.

The highest percentage of children in our study visited a dentist for the first time at the age of six, i.e. 57% (males 60.9% and females 51.2%), 28% visited the dentist for the first time at the age of five (21.9% and 35.8% female), and 15% of respondents visited the dentist for the first time at seven years, (male 17% and female 12.8%). In the three examined groups, the respondents visit their dentist more than once annually - 58.8%, 50% male and 67.5% female. About 25% visit the dentist once a year (30% male and 20% female), twice a year, a total of

12.5% (12, 5% representation in both sexes) and never visited a dentist by total of 3.8% (7.5% boys and 0% girls) of the respondents.

The statistical analysis of the values with the Mann-Whitney test, as well as with the Kolmogorov-Smirnov test does not show the existence of a static significance. Our results are consistent with the results of the study by Obradović M. et al.[18] who examined 12-year-old children from urban and rural areas of Banja Luka, regarding the first visit to the dentist and the frequency of visits. The results of the survey questions showed that in the urban environment, 27% of the children under 4 years of age visited the dentist for the first time, 47% of children aged 4-6 years, 23.5% at enrollment in school, and 1.9% never visited a dentist. Of children from rural areas, 11.4% visited a dentist with less than 4 years for the first time, 34.8% at the age of 4 - 6, 48.4% at enrollment in school and never 5.4%.

Regarding the frequency of visits to the dentist results in the study of Obradović M. et al.[18], show that 11.9% of urban children visit the dentist every three months, every 6 months 5.8%, once a year 3.5%, when needed without any schedule 65.3%, when they have toothache 11.9% and never 1.6 %. Children from rural areas also frequently or 51.1% visit the dentist when needed, 10.3% of children visit the dentist every 3 months, 2.2% every 6 months, 4.3% once a year, 25.5% when they have a toothache and 6.5% never.

Tooth brushing should be carried out regularly and correctly. The old rule is that oral hygiene should be carried out after each meal; however, if patients do not have the opportunity, it is recommended this to be carried out twice during the day, in the morning and in the evening. Patients with compromised oral health need to brush their teeth more often.

In the majority of cases, in the three examined groups, the examinees brushed their teeth twice a day (62.5%, with the same percentages in both sexes), followed by 28.8% after each meal, 22.5% of boys and 35% of girls, while 8.8.% brush their teeth once a day, 15% of boys and 2.5% of girls. The percentage difference registered between the modes of the frequency of teeth brushing between the three groups is statistically non-significant.

The highest percentage of the respondents in our study which is 81.3%, change the toothbrush every three months (87.5% male and 75% females), 7.5% every six months (10% of boys and 5% of girls), while 10% of respondents change the toothbrush once a year (2.5% boys and 17.5% girls). It is interesting to point out that 1.3% of all respondents reported that they do not change the toothbrush at all.

The results in our study are inconsistent with the research of Bekirogllu N. et al.[19], conducted in Turkey,

whose results indicate that the majority of the respondents, 38.8% change the toothbrush twice a year, 11.5% of the children change the brush once a year and 25.9% of the respondents change the toothbrush three times a year.

According to a study by Mwakatobe AJ et al.[20], conducted in 12-year-olds from Tanzania, 91.2% of children brushed teeth regularly, 71.9% used toothpaste, and most children consume sugars and beverages more at home (64.5%) than in school (35.5%). 76.1% of children have never visited a dentist. The CEP index among the subjects in this study was 0.76, and it was significantly more in female (0.84) than in male children (0.64).

The largest percentage or 47.5% in the three examined groups, do not use any additional means for maintaining hygiene of the teeth (60% boys and 35% girls), followed by a rinse water by 36.3%, of which 30% boys and 42.5 % girls. Dental floss is used by 13.8% of the respondents, 10% of boys and 17.5% of girls. Interdental brush is used by 2.5% of the examinees. The percentage difference registered between the modalities of the use of additional means of teeth hygiene among the examinees of both sexes, with the Mann - Whitney test indicates a statistical significance.

Conclusion

The results of this study demonstrated the importance of the promotion of oral health in twelve year olds with the help of dental education and the individual demonstration for maintaining oral hygiene. Oral health has a primary importance in the preservation of general health, functioning and life of people overall. This condition can be improved and sustained in a very economical way, with the advantage of giving treatment prevention, motivating individuals to act in the direction of preserving and promoting their own and the oral health of their children.

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THE EFFECTS OF THE "LACALUT" TOOTHPASTE ON CARIOGENIC MICROORGANISMS

ЕФЕКТИТЕ НА ПАСТАТА ЗА ЗАБИ „ЛАКАЛУТ" ВРЗ КАРИОГЕНИТЕ МИКРООРГАНИЗМИ

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Abstract

The aim of this study was to establish the counts of *Streptococcus mutans* and *Lactobacillus speci*es in saliva before and after teeth brushing with a Lacalut dentifrice containing a combination of sodium fluoride and amine fluoride as its main components. In order to accomplish the objective, we used the Lacalut teens 8+® dentifrice, product of Arcam GmbH, Homburg, Germany. The examined group consisted of 30 healthy schoolchildren aged 10 to 11 of both sexes from an elementary school in the Centar municipality of Skopje, Republic of North Macedonia. The examinees had a good general and oral health and approximately the same DMF index. In order to obtain better precision and accuracy, the same group was used as a control group, too. The saliva samples were taken before and 20 minutes after tooth brushing, early in the morning, after at least 12 hours without oral hygiene. The counts of *Streptococcus mutans* and *Lactobacillus species* were determined using commercially available CRT bacteria® strips produced by Ivoclar-Vivadent, Liechtenstein. A significant reduction in salivary MS and LB levels was observed in all examinees. **Key words:** *antimicrobial agents, dental decay, Streptococcus mutans, Lactobacillus species.*

Апстракт

Целта на овој труд е да се утврди квантитативната застапеност на *Streptococcus mutans* и *Lactobacillus species* во плунката пред и по употребата односно четкањето на забите со паста за заби „Лакалут". Главен составен дел на оваа паста е комбинацијата на натриумфлуорид и аминофлуорид. За реализирање на поставената цел користевме паста за заби Lacalut teens 8+, производ на Arcam GmbH, Homburg, Germany. Испитуваната група беше составена од 30 испитаници на возраст од 10-11 години, од двата пола, ученици на едно основно училиште во општина Центар во Скопје, Република Македонија. Заради поголема прецизност и точност во испитувањето, оваа група беше и контролна. Испитаниците беа со добро општо и орално здравје, со слишен хигиенски режим и начин на исхрана и со приближно еднаков КЕП-индекс. Примероците на плунката беа земани пред, и 20 минути по четкањето на забите, во утринските часови, без претходно спроведена орална хигиена најмалку 12 часа. Квантитативна застапеност на *Streptococcus mutans* и *Lactobacillus species* беше одредена со комерцијално набавени стрипови CRT bacteria, Ivoclar-Vivadent, Schaan – Liechtenstein. Кај сите испитаници имаше сигнификантно намалување на бројот на кариогените микроорганизми. **Клучни зборови:** *антимикробни соединенија, дентален кариес, Streptococcus mutans, Lactobacillus species.*

Introduction

Caries is a disease that has accompanied humans since the beginning of mankind. The first assumptions regarding the etiology of dental caries date back to the new era. There have been many theories and definitions regarding its etiology, starting from the 19th century (1889) with the so-called Miller's chemical-parasitic theory, which has been scientifically proven and for the first time mentioned microorganisms as the causative agents of dental caries. Numerous investigations, from this theory, through the theories of Gottlieb, Boedecker, Martin-Schatz, Egyied and many others, up to today's most sophisticated investigations, indicate that the presence of certain bacteria in the oral cavity is perhaps the most important element in the process called dental caries or dental destruction. The second half of the 20th century has highlighted caries as a complex and multicausal disease that is caused through the interaction of 3 basic factors: the dental surface, microorganisms and the environment. Keyes and Jordan have schematically presented these three factors by three overlapping circles, one of which is the host (the surface of the tooth), the second is the trigger (the properties of the microorganisms), and the third is the environment, i.e. substrate for the microorganisms. Later on, a fourth dimension – time –

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was added to this scheme. Towards the end of the last century, the classical theory prevailed according to which caries is a local, pathological destruction of hard tooth tissues caused by external causes with a progressive flow and irreversible nature, which spreads from the enamel or cement into the dentine, and later on into the pulp with the possibility of further complications in the periodontal tissues, endangering sometimes the distant tissues and even the life of the patient. The classical theory was followed by the caries-balance theory (based on the supremacy of the pathogens or of the protective factors). According to this theory, there are three main pathogenic factors: microorganisms, irregular nutrition, xerostomia, and several protective factors: saliva, fissure sealing, use of antimicrobials, fluorides and proper nutrition. The pathogenic factors, on the one hand, and the protective ones, on the other, are in a constant balance that varies and changes dynamically during the day. Depending on the change in the equilibrium, dental caries will or won't occur[1]. Despite the efforts by scientific circles to give a full definition of the onset of dental caries, there is no dental caries without microorganisms[2]. The common point of all modern understandings regarding the etiology of dental caries is that it is an infectious disease that results in the destruction of the tooth structure, and is caused by microorganisms, primarily from mutans streptococci[3,4]. Accordingly, dental caries corresponds to the description of an infectious disease with the following postulates established by Koch, and modified by Socransky[3]:

- The disease is associated with the presence of bacteria;

- The elimination of the bacteria reduces or eliminates the disease;

- The organism reacts to the bacteria;

- The bacteria also cause the disease in experimental animals;

- The bacteria possess virulent factors.

Of all so far scientifically backed up theories regarding the definition of the etiology of dental caries, we come to the most important for us, microbiological definition, according to which dental caries is defined as a localized destruction of dental tissues under the influence of microorganisms[5]. Some of them are normally present in the mouth and convert all nutrients, and especially sugars and starches, into acids[5,6,7]. The term sugar refers not only to sugar used in the household, disaccharide sucrose, but also to low-molecular carbohydrates, as well as starches[3,8,9]. Among the acids, the most important factor is the lactic acid that dissolves the mineral structure (hydroxyapatite crystals) of the teeth[10,11,12,13].

The bacteria, the acids formed by them, as well as the food and saliva residues, combine in the mouth and form a sticky substance, called plaque that adheres to the teeth. It is one of the main causes of dental caries, but also of the periodontal diseases[5,6,7,11,12,14,15,16]. The plaque is composed of gelatinous deposits of high molecular weight glucose, by which acidic bacteria are glued to the enamel. Above all, this includes Streptococcus mutans and Peptostreptococcus, possibly in association with actinomycetes[5,6,7].

Bacteria can rapidly metabolize carbohydrates in acids and their products are known under the name of acididogenic bacteria. The change in the pH value of the plaque that occurs as a result of the action of these bacteria over time is called the Stefan curve[17].

In usual clinical trials, Streptococcus mutans and Streptococcus sobrinus[3], which together with Lactobacillus species and Actinomyces are considered the most significant odontopathogens, are believed to be the main causes of dental caries[5,18]. Due to their association with dental diseases, estimating the number of mutans streptococci in the saliva and plaque can help to diagnose the caries activity[19].

Streptococcus mutans is a gram-positive bacteria forming colonies in the form of chains. It is an alpha-hemolytic blood agar and is catalase negative. A particular feature of Streptococcus mutans as a Gram+ bacterium is the production of its own antibiotics called mutacins, which inhibit the growth of other streptococci and of many other Gram+ microorganisms. Streptococcus mutans is a bacterium that is transferable, that is, it can only be transmitted through saliva[3,5]. Modern genetic techniques allow researchers to thoroughly investigate this phenomenon[20]. Studies of the microbiological composition and of the cariogenic potential of the plaque have shown that Streptococcus mutans is predominant among mutans streptococci[9,21,22,23]. It has been confirmed through immunofluorescence studies that Streptococcus mutans colonizes foremost certain specific sites within the proximal plaque. The presence of Streptococcus mutans is in very close relation to early carious lesions[24], that is, demineralization of teeth[25].

The lactobacilli constitute the second group of very important cariogenic microorganisms. Like the mutants streptococci, they produce acids that can dissolve teeth at very low pH values (acidogenicity and acido durability). They are often found in retention areas, such as fissures, cracked teeth and restoration, etc. They have been also found in the deep sections of the carious lesions where the pH value is acidic. The lactobacilli are strongly influenced by the dietary carbohydrates and sugars3. It can be concluded from certain analyzes that the dentine from the carious lesion is responsible for the sali-

vary hyper-contamination with lactobacilli[26]. The literature points to the existence of a positive correlation between the counts of lactobacilli in the saliva, plaque and dental caries[5,24,26,27,28,29,30].

The market for cosmetic products for oral hygiene is, as never before, overfilled with various products such as toothpastes, mouthwashes, dental brushes, interdental tips and brushes, etc. Many of them have established their own names and reputations over the years. Some of them have yet to penetrate the market, and some are of suspicious origin and quality. The consumers of these products find it difficult to make the right choice and decide which products to use in their everyday oral hygiene. Among the several long-established brands in the field of oral hygiene is the Lacalut toothpaste.

The name Lacalut has been derived from the main active substance, Aluminum lactate. Aluminum lactate is a lactic acid salt, which has a pronounced astringent and anti-inflammatory effect. Because of this unique effect, Lacalut is recommended primarily to people suffering from inflammatory periodontal diseases in the oral cavity, bleeding gums, and also for the prevention of caries and in the case of hypersensitive tooth enamel[31,32,33,34].

Aim of the study

The aim of this study was to obtain our own results regarding:

- The reduction of cariogenic flora, and consequently of dental caries;
- The determination of the quantitative presence of Streptococcus mutans and Lactobacillus species in the saliva before and after the use of the Lacalut toothpaste;
- The examination of the antimicrobial effect of the Lacalut toothpaste.

Material and methods

In order to accomplish our goal we used the Lacalut teens 8+ toothpaste®, a product of Arcam GmbH, Homburg, Germany.

The main components of this toothpaste are sodium fluoride (NaF) and amino fluoride. Fluorides have a strong affinity for enamel and increase the amount of fluoride in it even at low concentrations, having also an anti-enzyme effect on the microbial activity of the dental plaque. The 1400 ppm fluoride content provides double protection for young permanent teeth. The taste of lemon and spearmint (mint) in microcapsules turns teeth washing into a real feeling of freshness.

The study included 30 examinees aged 10-11 of both sexes at a primary school in the Centar municipality of Skopje, Republic of North Macedonia. For higher precision and accuracy of the tests, this group was also used as a control group. The examinees had a good general and oral health, with similar hygienic regimes and diets and with approximately equal DMF indexes. The examinees and their parents were advised not to take food for at least 12 hours before the examination. The pupils were also without any antibiotic therapy during the examination period. Saliva samples were taken before and 20 minutes after teeth brushing with the Lacalut teens 8+ toothpaste® in the morning, without no oral hygiene performed over at least 12 previous hours. In order to determine the total count of cariogenic microorganisms, the saliva was taken by spitting approximately 1-3 ml saliva in separate sterile plastic bottles intended for the purpose.

The samples for the determination of the quantitative presence of S. mutans and Lactobacillus species were taken with commercially procured CRT bacteria strips®, produced by Vivadent, Schaan, Liechtenstein, having a microbiological medium for selective isolation of S. mutans on their first side and for the isolation of Lactobacillus species on their opposite side. Thus, when a sample was taken, its planting was automatically performed. After an incubation period of 48 hours at 35-37°C, the grown colonies were counted, and these counts were used to determine the approximate number of bacteria cells, using the assumption that one cell gives rise to one colony, so this number was expressed as colony forming units (CFU). When using the aforementioned strips, the colonies of S. mutans are transparent on a blue background, and the colonies of Lactobacillus species are gray-white on a green background.

Results

The determination of the quantitative presence of Streptococcus mutans and Lactobacillus species in the saliva before and after the use of the Lacalut teens 8+ ® toothpaste, as well as the reduction of the cariogenic flora, determined by CFUs before and after using the same toothpaste, are shown in Tables 1 and 2, as well as in Charts 1, 2, 3 and 4.

Three examinees had an increased value of both analyzed cariogenic microorganisms, Streptococcus mutans and Lactobacillus species, before using Lacalut teens 8+® toothpaste. (Table 1; Chart 1, 2). After teeth brushing, 6 examinees for Streptococcus mutans and 7 examinees for Lactobacillus species were not registered with growth of colonies (Table 1; Chart 1, 2). According to the dynamic index, a registered tempo of growth is 100 %. (Table 2) Chart 3.

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Table 1. Number of examinees with CFUs of *Streptococcus mutans* and *Lactobacillus species* in 1 ml saliva before and after tooth brushing with Lacalut teens 8+® toothpaste

	Streptococcus mutans CFU/ml		Lactobacillus CFU/ml	
	before	after	before	after
No growth	3	6	3	7
10^2	0	3	0	1
10^3	7	10	9	13
10^4	6	5	4	7
10^5	9	6	14	2
10^6	5	0	0	0
N	**30**	**30**	**30**	**30**

Table 2. Determination of the indexes of dynamics in patients with a *Streptococcus mutans* before and after the use of the Lacalut toothpaste

	Streptococcus mutans		Lactobacillus	
	before	after	before	after
No growth	10%	20%	10%	23.30%
10^2	0%	10%	0	3.30%
10^3	23.30%	33.30 %	30%	43.30%
10^4	20%	16.70%	13.30%	23.30%
10^5	30%	20%	46.70%	6.7%
10^6	16.70 %	0%	0%	0%
N	**100%**	**100%**	**100%**	**100%**
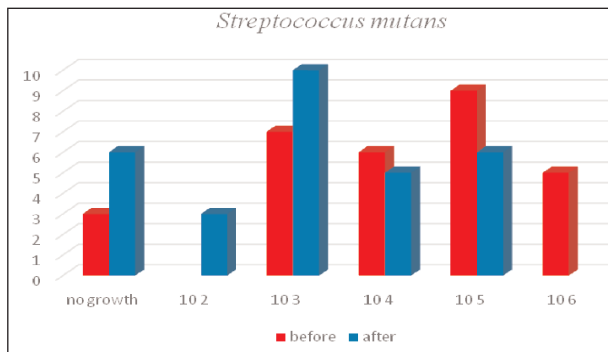
Chart 1. Number of examinees with CFUs of Streptococcus mutans in 1 ml of saliva before and after teeth brushing with the Lacalut toothpaste

With reference to Streptococcus mutans, the number of 103 CFUs were registered in 7 examinees before
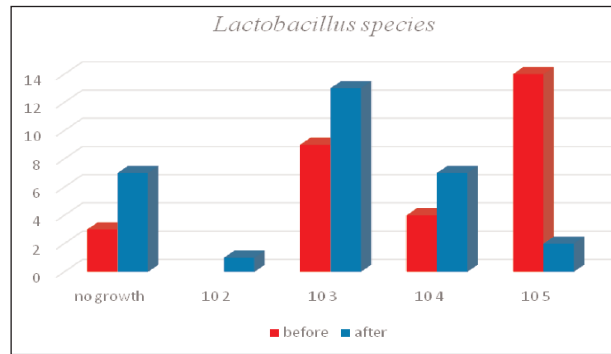
Chart 2. Number of examinees with CFUs of Lactobacillus species in 1 ml saliva before and after teeth brushing with the Lacalut toothpaste

Table 3. Number of examinees with logarithmic reduction factor for the Lacalut toothpaste

Log RF	Streptococcus mutans		Lactobacillus	
	Number	%	Number	%
0	8	26.7	10	33.30
1	15	50.0	12	40.0
2	4	13.30	4	13.30
3	2	6.7	3	10.0
5	1	3.3	1	3.3
N	**30**	**100.0**	**30**	**100.0**
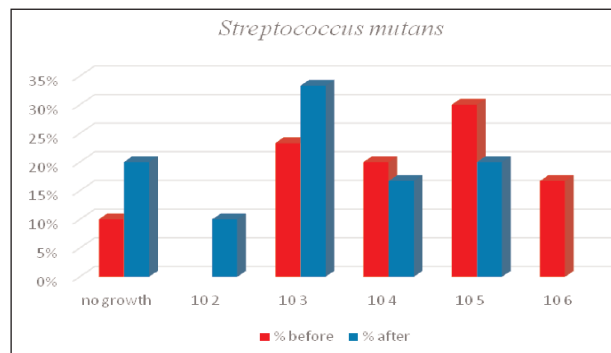
Chart 3. Determination of the indices of dynamics in examinees with a Streptococcus mutans number registered before and after the use of the Lacalut toothpaste

using the Lacalut teens 8+® toothpaste, and in 10 examinees after brushing the teeth with the same toothpaste. According to the dynamic index, there was a growth pace of 30% (Table 1, 2; Chart 2, 3).

In respect of the Lactobacillus species, the number of 103 CFUs were registered in 9 examinees before using

Chart 4. Determination of the indices of dynamics in patients with Lactobacillus species number registered before and after the use of toothpaste Lacalut

Discussion

Over the last 20 years most papers dealing with the Lacalut toothpaste have proven its caries-inhibitory effect in all three stages of progression development of dental caries (initial, advanced and deep caries), as well as its astringent action at very small concentrations of its main active ingredients, which are: aluminum lactate, aluminum fluoride, hydroxylapatite, calcium lactate, phosphate, zinc chloride and sodium fluoride[31,32,33,35,36].

The essential active ingredient in Lacalut toothpastes (dentifrices) is aluminium lactate, a substance with good astringent properties even in low concentrations. This does not only have an immediate favourable effect on the gingiva and the oral mucosa, but also a prophylactic effect against inflammations of the gums and parodon-topathies. Lacalut toothpastes have excellent cleansing properties proven in many in vitro tests and in vivo trials which are also attributed to the intensive, astringent effect of aluminium lactate[31].

Apart from aluminium lactate, Lacalut toothpastes also contain aluminium fluoride. Both fluoride, as a chemical element, and its reduced form – fluoride anion (F-), possess certain antimicrobial properties. Different concentrations of fluorides, which could bring about an inhibition of both dental plaque and oral microorganisms clear culture have been analysed. According to Tatevossijan[37], a concentration of 0.005 ml/l is capable of reducing the generation of dental plaque. Duguid and Senior[38] have investigated a number of cultures of Streptococcus sanguis, and have shown that a fluoride concentration below 0.005 ml/l has a lower effect on the investigated bacteria. The growth of bacterial cells can be reduced with concentrations between 0.01 and 0.05 ml/l, whereas it can be stopped completely with concentrations of 0.1 ml/l of fluoride. Bowden has confirmed that fluorides can kill streptococci in vitro with concentrations within the range from 0.16 to 0.31 ml/l[39].
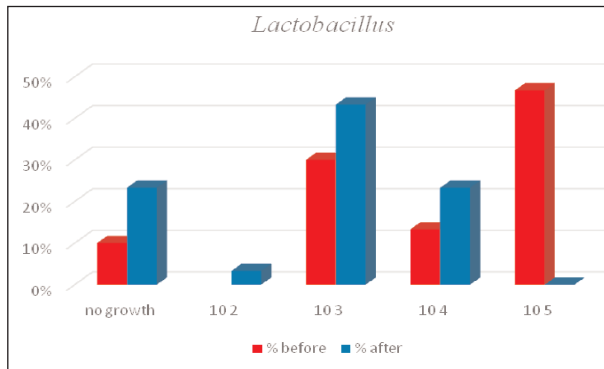
It seemed therefore advisable to test this toothpaste for its caries-reducing effect. For this purpose a test with animals was performed. This test showed unmistakably, that the toothpaste under examination[31] inhibits dental caries in all stages of severity (initial, advanced, severe). This effect is mainly attributed to the characteristic ingredient aluminium lactate, although aluminium fluoride is also an important but not decisive component for the caries inhibiting effect[31].

G. Neuman et al.[32] concluded that fluoride ions also remain bio-available after prolonged storage times of the toothpaste, and this is an important precondition for an effective tooth-decay prophylaxis with fluoride-containing dental care products. Fluoride ions must not be inactivated by cleansing particles or other toothpaste ingre-

the Lacalut teens 8+® toothpaste, and in 13 examinees after brushing the teeth with the same toothpaste. According to the dynamic index, there was a growth pace of 44% (Table 1, 2; Chart 2, 4).

The total number of CFUs of 105 before using the Lacalut teens 8+® toothpaste is registered in 9 examinees for Streptococcus mutans and in 14 examinees Lactobacillus species. After tooth brushing, the number of examinees with this CFUs decreased by two for Streptococcus mutans even by 12 for Lactobacillus species. According to the dynamic index, a decline trend of 33% was found for Streptococcus mutans and 85% for Lactobacillus species (Table 2; Chart 1, 2, 3 and 4).

The number of 106 CFUs before using the Lacalut teens 8+® toothpaste, is registered only for Streptococcus mutans where 5 examinees have this number of colonies. The results have shown drastic decline after using this toothpaste where there was no subject with CFUs. (Table 1, Chart 1).

Due to the large differences obtained by determining the quantitative presence of cariogenic microorganisms before and after the use of the Lacalut teens 8+® toothpaste, ranging from 0 to > 1,000,000, the values in the following table 3 are shown logarithmically. In order to perceive the exact number of examinees in the table, in which the reduction of cariogenic microorganisms occurred, a summary is given of the number of examinees in which colonies were isolated, expressed through the logarithmic reduction factor (logRF) of 0 to > 5, specifically for Streptococcus mutans, and specifically for Lactobacillus species with logRF = logCFU before - logCFU after the use of the Lacalut teens 8+® toothpaste. The examinees with no isolated colonies were not taken into account and the total number (N) is given for the actual number of examinees who entered the analysis (Table 3)

dients. By means of a special measuring device the content and stability of the fluoride ions in several fluoride containing toothpastes were determined, with relation to the cleansing particles (abrasives) and the fluoride compounds used in the product. It could be demonstrated that the specific combination of active ingredients aluminium fluoride complex and aluminium lactate has a very high stability of ionogenic fluoride and a completely satisfactory result was achieved, particularly in view of the used cleansing particles aluminium oxide hydrate and also the combination of aluminium-oxide hydrate and silica. Toothpastes which also contain aluminium ions, apart from the biologically available fluoride, have a particular importance for caries prophylaxis, since they do not only incorporate fluoride but also aluminium in the dental enamel. This increases the protective effect[32].

P. Riethe[33] investigated the caries-inhibiting effect of the aluminium fluoride hydroxide complex and of aluminium lactate, alone or in combined use and in different toothpastes in rats. Both aluminium and fluoride inhibit the formation of caries. The caries-inhibiting effect of both compounds totaled up in the combined use[33].

Christoph Gaasch et al.[36] compared two toothpastes with different formulations and showed that the ingredient aluminium lactate with its astringent, i.e. protein-coagulant effect leads to a desensitisation of sensitive dental necks[36].

Conclusion

From the results obtained by determining the quantitative presence of the cariogenic microorganisms Streptococcus mutans and Lactobacillus species we found that in all subjects there was a decrease in the number of colonies after the use of the Lacalut teens 8+® toothpaste.

This study is the first scientific attempt to examine the antimicrobial effect of the Lacalut teens 8+® toothpaste which provides additional mineralization and protection against cavities through an optimal concentration of organic and inorganic fluorides in its composition.

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APPLICATION OF IOTN AND DAI INDICES FOR ASSESSMENT IN NEED OF ORTHODONTIC TREATMENT

ПРИМЕНА НА IOTN И DAI ИНДЕКСИ ЗА ПРОЦЕНКА ВО ПОТРЕБА НА ОРТОДОНТСКИ ТРЕТМАН

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Abstract

Communication in human population is realized through the appearance, symmetry and regularity of the face, which is connected with aesthetics and personal self-esteem. Therefore, there is a need for a beautiful smile in everyday life regardless of the age of the population. Due to the more frequent requirement of patients to improve their smile in everyday clinical practice, therapists face aesthetic requirements of patients, on the one hand and functional balance of the entire facial part, on the other. Our research showed the self-assessment of respondents in stricter terms and criteria in relation to the obtained objective finding. The positive correlation between the DH IOTN and the DAI index was confirmed, but it also proved that the degree of malocclusion assessed by the DH component of the IOTN does not correlate with the degree of self-assessment of the subjects through the AC (aesthetic) component of the IOTN index. An important segment in the self-evaluation of the respondents for their "orthodontic anomaly" depends on the level of education of the parents. Respondents with highly educated parents were more critical in self-assessment compared to respondents who indicated high or low education of their parents. **Key words:** IOTN, DAI, incides, orthodontic treatment, aesthetics

Апстракт

Комуникацијата во хуманата популација се реализира преку изгледот, симетријата и правилноста на лицето, што е поврзано со естетиката и личната самодоверба. Од таму и потребата од убава насмевка претставува секојдневие независно на возраста во популацијата. Поради се почестото барање на пациентите за подобрување на нивната насмевка во секојдневната клиничка пракса терапевтите се соочуваат со естетските барања на пациентите од една страна и функционална рамнотежа на целиот фацијален дел од друга страна. Нашето истражување го покажа самооценувањето на испитаниците во построги рамки и критериуми во однос на добиениот објективен наод. Се потврди позитивната корелација помеѓу DH IOTN и DAI индексот, но и се покажа дека степенот на малоклузија оценет со DH компонента од IOTN не корелира со степенот на самооценување на испитаниците преку AC (естетска) компонента од IOTN. Важен сегмент во самооценувањето на испитаниците за нивната „ортодонтска аномалија" зазема степенот на образование на родителите. Испитаниците со високо образовани родители беа покритични во самооценувањето во однос на испитаниците кои за своите родители навеле средно или ниско образование. **Клучни зборови:** IOTN, DAI индекси, ортодонтски третман, естетика

Introduction

Today, the desire and the need of patients for an aesthetically beautiful smile have imposed the requirement for a normative determination of the true need for orthodontic treatment, which as such, will contribute to skeletal, dental and soft tissue balance within normal occlusion. Because orthodontic treatment is complex, long-lasting and expensive, an appropriate patient selection protocol is required (this is emphasised in public healthcare where treatment is covered by the Health insurance fund) that there is a real need, not just a wish for a beautiful smile without underlining the function of the dentist. The imperative of every dentist is the harmonization of the aesthetic moment and the proper function of the orophacial system. Although there is no absolute consensus on the individual and occlusal characteristics to be assessed, in order to objectively determine the need for orthodontic treatment, in the contemporary literature, indices on the need for orthodontic treatment used in epidemiological studies of malocclusion, in different countries tend to comply on a number of levels, to equate the criteria and to be recognized by various international associations[1]. One of those indices is the Index of

Orthodontic treatment need, described by Brook and Shaw (1989) and modified by Richmond (1990) as a method for objectively assessing the need for orthodontic treatment. This index is also used to assess the need and the patient's eligibility for orthodontic treatment in public healthcare[2]. The first part of this index is Dental Health Component (DHC), is composed of 5 degrees:

1st degree - almost perfect dentition, no treatment is needed

2nd degree - minimal irregularities

3rd degree - major irregularities that do not require treatment

4th degree - more serious irregularities requiring treatment

5th degree - more serious dental problems, treatment is needed

The second part of the IOTN is the Aesthetic Component (AC) which is a scale of 10 colour photos showing various levels of dental abnormalities. This part of the IOTN index is used when the patient is assessed to have 3rd degree deviations according to the Dental Health Component (DHC).

To assess the need for orthodontic treatment, the Dental Aesthetic Index (DAI), adopted as an international index, is recommended by the World Health Organization, and its accuracy and validity is documented in a number of studies[3,4,5]. With this parameter, an evaluation of 10 occlusal features is carried out: tooth loss, overjet, negative overjet, median diastema, width of the anterior irregularities (mandible and maxilla), anterior open bite, anterior crowding, anterior diastema and antero-posterior spring relationship. The DAI index evaluates 4 degrees of malocclusion severity: a score lower than or equal to 25 (no or slight treatment needed), a score between 26 and 30 (treatment of choice), a score between 31 and 35 (a great need for treatment), and score higher than 36 (treatment without exception)[3].

These enclosed indexes, IOTN and DAI, contain aesthetic and clinical criteria and they accept the premise that the significant benefit of orthodontic treatment refers to improved aesthetics and ultimately social and psychological well-being.

The treatment decision is particularly challenging for the orthodontists, when malocclusion is at the borderline treatment level, and the patient's desire is mainly due to aesthetic corrections[6].

In order to determine the need for orthodontic treatment, as well as to provide insight into the concept of acceptable occlusion, a number of epidemiological studies have been performed for dental defects in different countries over the last two decades.[7] At present, however-er, generally accepted criteria that they will define from an orthodontic aspect, normality or abnormality with regard to occlusal status[7]. The goal of orthodontic treatment is to achieve the desired aesthetics with an improved function[8]. In 2001, Beglin et al. makes a comparison of the IOTN and DAI index with a number of orthodontic therapists and summarize that these two parameters are credible measures to assess the need for orthodontic treatment[8].

According to the findings of Hlongwa et al. in 2004, both indices can be used continuously to identify the need for orthodontic treatment in different ethnic groups[9]. In most studies, both indices (IOTN and DAI) are used together to evaluate the representative sample and compare the results obtained[10].

Dogan et al.[11] found that there is a significant correlation between DHC and an estimate of an IOTN by the orthodontist, which means that the orthodontist's ability to perceive the patient's disorder is more precise and comprehensive than that in terms of the orthodontic clinical skills.

Of all the previous studies and trials that have been made in order to obtain a response to the true need for orthodontic treatment, results have been obtained that support the aesthetics or function. All this points to the necessity of further investigations that will determine the need for orthodontic treatment based on aesthetic indices on the one hand and noticed occlusal contacts on the other.

The actuality of the problem, the more frequent use of orthodontic appliances and their representation in children and youth, require clarification and a clear definition of the need for orthodontic treatment.

This research will be conducted in order to analyse and determine the condition of the patient's dentition assessed by the DH component of the IOTN index and the DAI index and subjects will be self-assessed according to the aesthetic component of the IOTN index.

We shall assess the percentage of the match between the self-assessment of the respondents and the objective estimate with the IOTN and DAI indices, to see if there is a difference between gender self-esteem and by which percentage it is represented.

Material and methods

For the realisation of the goals of this paper, 80 adolescents, aged between 16 and 18, will be examined with equal gender representation.

The survey will include only subjects without an orthodontist apparatus (fixed or removable).

The choice of this category of examinees coincides with the age where permanent dentition is present, and at

the same time, it coincides with the period of self-consciousness, conscientiousness and attention they dedicate to the physical appearance, the smile and the dental situation.

The design of the study consists of several components:

- Questionnaire (interview),
- Self-assessment of respondents according to the aesthetic component of the IOTN index,
- Taking an imprint of the respondents with a print-out,
- Filling out the printouts and obtaining workstation models in the laboratory and analysis of the DH (dental component) IOTN index and DAI index

The first part of the questionnaires (Figure 1) contains the basic data of respondents (number of questionnaire, name and surname and date of birth), then the education of the parents (high, secondary, elementary education), occupation (manager of a company or a private business-man, a civil servant and occasionally employed or unemployed).

The second part of the questionnaires will note: the self-assessment of respondents according to AC from the IOTN index, objective finding according to DH (dental component) of the IOTN index and the DAI index.

In the second part, each respondent will receive the 10 photos that represent the aesthetic component of the IOTN Index (Figure 2) and each of them will be self-assessed according to one of those ten photos.

Every examinee will be taken an anatomical imprint with the Alligat Heraeus printout, and the next stage will be spilled into the dental laboratory to obtain a studio model for further analysis and evaluation.

On the obtained studio models, an analysis of all irregularities in sagittal, transversal and vertical aspect as well as notifying the irregularities of individual teeth will be performed. Measurements in mm will be done with a CPI probe for that purpose. Regarding the results, the respondents will be categorized from the 1st to the 5th degree according to the DH (dental component) of the IOTN index.

Once the measurements of the studio models are executed and the values are based on the DAI index (Table 1), they will be mathematically calculated by adding and finally added constant of the DAI index, which is 13. Thus, the obtained value will be compared to what extent the DAI index belongs.

Four degrees of malocclusion severity:

- Score less than or equal to 25 (no or slight treatment needed),
- Score between 26 and 30 (optional treatment),
- Score between 31 and 35 (a great need for treatment), and
- Score higher than 36 (treatment without exception).

Table 1. The standard DAI regresion equation.

DAI Components	Weight
1. Number of missing visible teeth (incisors, canines and premolars teeth in maxillary and mandibular arches).	6
2. Crowding in the incisal segment (0=no segment crowded; 1=1 segment crowded; 2=2 segments crowded).	1
3. Spacing in the incisal segment (0=no spacing; 1=1 segment spaced; 2=2 segment spaced).	1
4. Midline diastema in millimeters.	1
5. Largest anterior irregularity on the maxilla in millimeters.	1
6. Anterior maxillary overjet in millimeters.	2
7. Anterior mandibular overjet in millimeters.	4
8. Vertical anterior openbite in millimetrs.	4
9. Anterior-posterior molar relation (largest deviation from normal either left or right): 0=normal; 1=1/2cusp either mesial or distal; 2=one full cusp or more either mesial or distal.	3
10. Constant.	13
Total	DAI score

WHO, 1997.

Results

The total number of respondents in this study was 30, with equal distribution of sex and age (16, 17, 18) (Graphs 1 and 2) and different level of education of the parents (Graph 3).

This study showed that the degree of malocclusion assessed by the DH component of the IOTN has a significant statistical value with the degree of self-assessment of the respondents through the AC (aesthetic) component of the IOTN. At the same time, it confirmed the positive correlation between DH IOTN and the DAI index.

1. Elementary 2. Secondary 3. Higher education

Graph 3. *Degree of education of the parents of the respondents*

Most of them (10) or 33.30% were rated with a photo (grade 3) of AC from the IOTN index, and only one (3.30%) of the respondents was rated with a degree (photo) 7 (Figure 4). Abdullah M S, Rock W P 9 received a score indicating that 47.9% of their respondents were rated grade 4 and 5 of DH IOTN and 22.8% with grade 8-10 of AC IOTN.

1. male   2. female

Graph 1. *Gender representation of respondents*
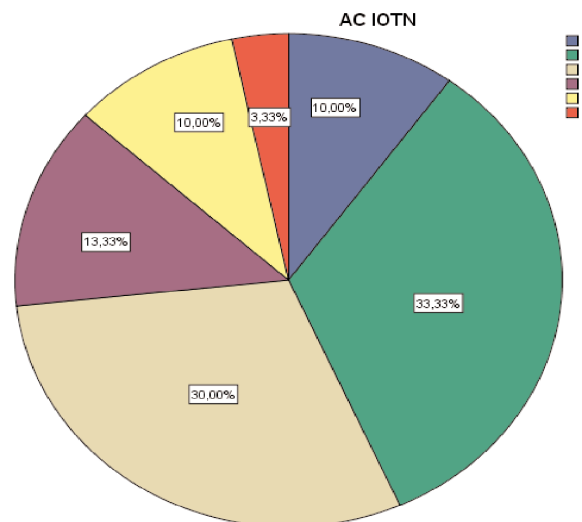
Graph 4. *Self-assessment of respondents according to AC IOTN*

Graph 2. *Age representation of respondents*

15 respondents or 50% gave objective assessments with grade 3 according to DH IOTN, i.e. major irregularities that do not require treatment (Figure 5).
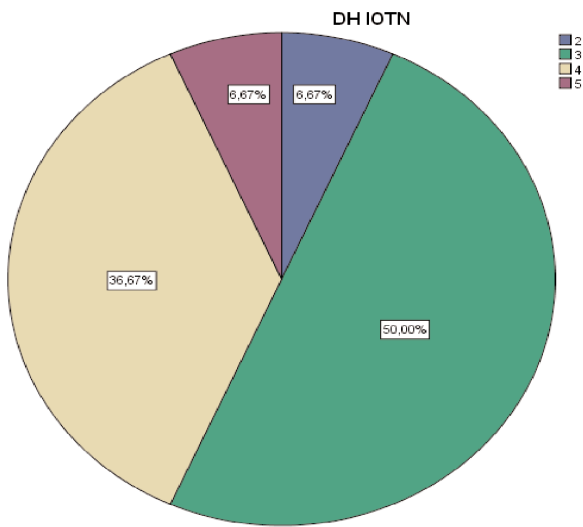
Graph 5. An objective finding according to DH IOTN

17 respondents or 56.70% gave objective assessments with degree 2 according to the DAI Index or Optional Treatment (Figure 6), and only 2 respondents or 6.70% with degree 4. Considering that degree 3 and degree 4 indicate a clear need for orthodontic treatment, the percentage of respondents who needed it was 21.2% of the research done by D. Manzanera et al.
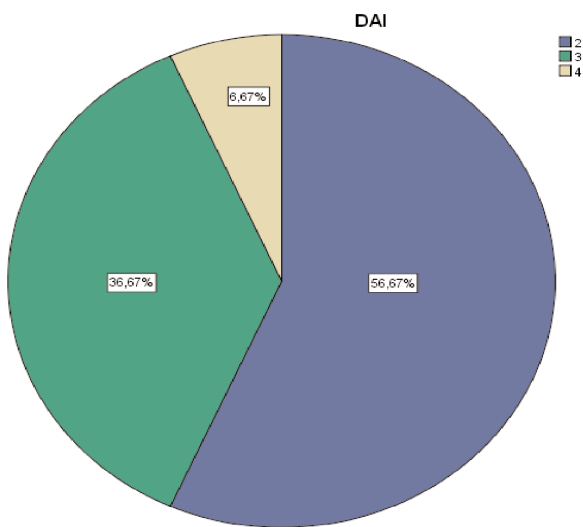
Graph 6. Objective findings according to the DAI index

Pursuant to our research and results, we can see that there is a significant statistical value (p <0.05) between AC IOTN and DH IOTN (Table 2), results that correlate with research done by other researchers[12].

Table 2. Frequency and percentage expression of all parameters

N=30			Frequency	Percentage
Age				
	16 y		10	33%
	17 y		10	33%
	18 y		10	33%
Gender				
	Male		15	50%
	Female		15	50%
Parent's education				
	Elementary		1	3.30%
	Secondary		10	33.30%
	High		19	63.30%
Self-assessment with AC IOTN				
	2		3	10%
	3		10	33.30%
	4		9	30%
	5		4	13.30%
	6		3	10%
	7		1	3.30%
Objective findings with DH IOTN				
	2		2	6.70%
	3		15	50%
	4		11	36.70%
	5		2	6.7%
Objective findings with DAI				
	2		17	56.70%
	3		11	36.70%
	4		2	6.70%

Table 3. Correlation between AC IOTN and DH IOTN

		AC IOTN	DH IOTN
AC IOTN	Pearson Correlation	1	,496**
	Sig. (2-tailed)		,005
	N	30	30
DH IOTN	Pearson Correlation	,496**	1
	Sig. (2-tailed)	,005	
	N	30	30

Table 4. Correlation between *AC IOTN and Parent's education*

		AC IOTN	Parent's education
AC IOTN	Pearson Correlation	1	,328
	Sig. (2-tailed)		,077
	N	30	30
DH IOTN	Pearson Correlation	,328	1
	Sig. (2-tailed)	,077	
	N	30	30

Table 3 shows the correlation between AC IOTN and the parent's education, which although there was a tendency for positivity during the test itself, after statistical processing we obtained p> 0.05, that is, this correlation is not statistically significant.

Discussion

Out of the total number of respondents (30) with equal distribution of gender and age (16, 17, 18) and different education level of the parents, most teenagers (10) or 33.30% were evaluated with a photo degree 3 of AC from the IOTN index, and only one (3.30%) of the respondents was rated with degree (photo) 7. Abdullah M.S., Rock W.P. received a score indicating that 47.9% of their respondents were rated degree 4 and 5 of AC IOTN and 22.8% with degree 8-10 of AC IOTN[10]. 15 respondents or 50% gave objective assessments with degree 3 according to DH IOTN, with major irregularities that no treatment is needed for. Abdullah M. et al. obtained a result which showed that 57.9% of their respondents were rated with degree 5 of DH IOTN. 17 respondents or 56.70% were objectively assessed with grade 2 according to the DAI Index or Optional Treatment, and only 2 respondents or 6.70% with degree 4. Considering that degree 3 and degree 4 indicate a clear need for orthodontic treatment, the percentage of respondents who needed it was 21.2% of the research done by D. Manzanera et al.[1] The correlation between AC IOTN and the parents' education, which although showed a positive tendence during the test itself, after the statistical processing we obtained p> 0.05, that is, this correlation is not statistically significant. In Dogan A.A at al.[11] research results obtained showed that education and socio-demographic characteristics have an impact in self-evaluation.

From the studies we have so far, we have come to the conclusion that the greatest motive for visiting the orthodontist is aesthetics. This study showed the self-assessment of the examinees in stricter terms and criteria in relation to the obtained objective findings. In a complex situation, such as the decision to orthodontic treatment, the therapist is right before a real challenge. On the one hand, we have respondents who have a desire for a more beautiful smile and a strong motive, but without a true indication of it (on the basis of some of the indexes). On the other hand, we have respondents with a real need for treatment, but who are not aware of the same need. The HIF of the Republic of North Macedonia is paying the costs for a mobile orthodontic device up to 18 years of age for the patient. The question is whether this money is used properly? In order to have a successful treatment, the patient's motive and cooperation is of the primary importance.. On the other hand, the indices are a quite clear indicator about which patients need orthodontic treatment.

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CLINICAL EFFECTS OF FIDELIS III ND:YAG LASER IN PERIODONTAL DISEASE TREATMENT

КЛИНИЧКИ ЕФЕКТИ НА FIDELIS III ND: YAG ЛАСЕРОТ ВО ТРЕТМАН НА ПАРОДОНТАЛНАТА БОЛЕСТ

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Abstract

Experimental studies show that the achieved therapeutic results in patients with clinical manifestation of periodontal disease where laser treatment is used along with standard conventional therapy are significantly better. **Purpose:** The purpose of this study is to see the effect of FIDELIS III ND:YAG LASER optic fiber through clinical studies as an additional therapeutic method to the conventional periodontal procedure and their comparison. **Material and method:** The study included 15 patients of both sexes, aged 28 - 74 years, with diagnosed periodontal disease with at least 18-20 remaining teeth, and at least 2 periodontal pockets with a depth ≥ 5mm in different quadrants. The clinical studies included: Determining the degree of gingival inflammation through the Lóe & Sillnes index, Assessment of periodontal pocket bleeding through Lóe & Sillnes bleeding index, Average depth of periodontal pockets (PPD), Determining the level of clinical loss of the periodontal attachment. All clinical studies, as well as the comparison of the conventional and laser treatment of all patient participating in this study was realized at the Clinic of Oral Diseases at the PHO Dental University Clinic and all of them were statistically analyzed. **Results:** After finishing the combined therapeutic procedure (conventional mechanic and laser periodontal treatment), the results showed significant improvement in the clinical manifestation of the chronic periodontal disease, significant reduction of bleeding and gingival inflammation. In comparison, the average depth of the periodontal pocket and the average attachment loss in the test and control teeth after finishing the combined therapeutic procedure show unaltered values. These results are explained by the need of a longer observation period in order to create new fibrose attachment. **Conclusion:** The use of FIDELIS III ND: YAG LASER as an additional therapeutic method to the conventional periodontal treatment reduces recidivism and maintains therapeutic results for a longer time period which allows an efficient quality and modern therapy of periodontal disease. **Key words:** periodontal disease, conventional therapy, laser therapy.

Апстракт

Експерименталните студии говорат дека кај пациентите со клиничка манифестна пародонтопатија кај кои покрај стандардната конвенционална терапија дополнително е користена и ласерска терапија, постигнатите терапевтски резултати се значително подобри. **Цел на трудот:** Целта на овој труд е преку клинички испитувања да се проследи ефектот на Fidelis III Nd: Yag ласерското оптичко влакно како дополнителна терапевтска метода на конвенционалната пародонтолошка процедура и да се компарира со истата. **Материјал и метод:** Во испитувањето беа вклучени 15 пациенти од обата пола на возраст од 28 - 74 години со дијагностицирана хронична пародонтална болест кои имаа најмалку 18 - 20 заби, и најмалку два пародонтални џеба со длабочина ≥ 5 мм во различни квадранти. Клиничките испитувања вклучија: Определување на степенот на гингивалната инфламација преку индексот на Lóe & Sillnes, Проценка на присутното крварење на пародонталните џебови при сондирање, преку индексот на крварење по Lóe & Sillnes, Проследување на просечна длабочина на пародонталните џебови (PPD), Определување на ниво на клинички губиток на пародонталниот припој. Сите клинички испитувања, како и споредувањето на конвенционалниот и ласерскиот третман на пациентите учесници во оваа студија се реализираше на Клиниката за Болести на уста и пародонт при ЈЗУ Универзитетски Стоматолошки Клинички Центар и истите подлежат на статистичка обработка и анамнеза. **Резултати:** По спроведената комбинирана терапевтска процедура (конвенционален механички и ласерски пародонтален третман), резултатите покажаа значително подобрување на клиничката слика на хроничната пародонтална болест поточно значително намалување на крварењето и гингивалната инфламација. За разлика од ова, просечната длабочина на пародонталниот џеб и просечниот губиток на припој кај испитуваниот и контролен заб по спроведената комбинирана терапевтска процедура покажаа непроменети и исти вредности. Овие резултати ги појаснуваме со потребата од подолгорочен период на опсервација потребен за создавање на ново сврзноткивен атачмен. **Заклучок:** Примената на Fidelis III Nd: Yag ласерот како дополнителна терапевтска метода на конвенционалниот пародонтолошки третман ги намалува рецидивите и ги одржува терапевтските резултати подолг временски период со што овозможува ефикасна, квалитетна и современа терапија на пародонталната болест. **Клучни зборови:** пародонтална болест, конвенционална терапија, ласерска терапија.

Introduction

Continuous lack of oral care by the patient, such as week and inadequate oral hygiene resulting in increased plaque accumulation is the main reason for clinical manifestation of periodontal disease. The etiology of this disease is of multicausal nature, but dental plaque is the most significant etiological factor, which represents a complex ecosystem where a large number of microorganisms exist. Thetreatment of periodontal disease significantly varies by the type of periodontal disease[1].

The dental plaque that isn't removed from the surface of the tooth for a longer time mineralizes with the help of inorganic materials from the saliva and develops into dental stone which later requires special therapeutic approach.

Mechanical removal of solid tooth plaque is done with the help of ultrasonic instruments, but they cannot completely remove the sub-gingival plaque and concrements in deep periodontal pockets[2,3].

Laser technology has been recently increasing in popularity[4,5]. The versatility of laser technology is in the design, or in its use. There are caries removing lasers and soft tissue lasers which are used mainly because of their haemostatic properties. Their main goal is to replace manual instruments in treatment of sub-gingival surfaces and periodontal pockets[6,7,8,9].

Purpose of the study

Motivated by the desire to develop and improve the quality of periodontal disease treatment we decided to analyze the effects of the use of FIDELIS III ND: YAG LASER optic fiber as an additional therapeutic method to the conventional periodontal procedure and make a comparison between them through the clinical studies.

Material and method

The study included 15 patients of both sexes, aged 28 -74 years, with diagnosed periodontal disease with at least 18 - 20 remaining teeth, and at least 2 periodontal pockets with a depth ≥ 5mm in different quadrants. The diagnosis was determined through clinical exam and x-ray.

The test group was comprised of patients who had conventional periodontal treatment (mechanical debridement) in combination with laser therapy. The control group was comprised of patients who were treated only with conventional periodontal treatment. The clinical studies included:
- Determining the degree of gingival inflammation through the Lóe & Sillnes index
- Assessment of periodontal pocket bleeding through the Lóe & Sillnes bleeding index
- Average depth of periodontal pockets (PPD)
- Determining the level of clinical loss of periodontal attachment

The protocol of the conventional periodontal treatment of chronic periodontal disease was conducted in several stages:
- Supra-gingival removal of all hard and soft plaque with the help of an ultrasound, a brush and an abrasive paste;

- Mechanical debridement of periodontal pockets conducted in several stages, with the use of specially designed Gracey curettes, deep rinse with local antiseptics and application of medicaments and a protective bandage as needed;
- At the end of treatment, patients were motivated to maintain oral hygiene.

The protocol of the laser treatment of periodontal pockets was conducted in the following way:
- The use of a laser optic fiber with thickness of 200 nm, with the power and frequency of the laser beam adjusted on a computer before the intervention (close curettage);
- The laser optic fiber was applied to the deepest point of the pocket, following the tooth axis, with circular movements around the tooth. The procedure was repeated so every periodontal pocket would be treated for at least 30 seconds during one treatment.
- The laser treatment war repeated in a subsequent session during the next two or three days. According to the recommended precautionary measures for working with lasers, all treated patients and doctors wore protective goggles.

The procedure of the periodontal treatments was explained to all patients and instructions for maintaining proper oral hygiene were given. The level of oral hygiene was followed through determining the Lóe & Sillnes plaque index. During this visit, the stage of conventional therapy was started, which includes supragingival removal of hard and soft plaque. At the next visit, the conventional treatment continued with mechanical curettage of the periodontal pockets during which two deepest periodontal pockets from different quadrants were chosen for further studies. One of them was additionally treated with a laser optic fiber after completing the traditional treatment. Three days after the laser treatments, the clinical parameters were measured again.

All clinical studies and both the conventional and the laser treatment were carried out at the Clinic of Oral Diseases at the PHO Dental University Clinic. The collected results were statistically analyzed and shown in a graph.

Results

The average Lóe & Sillnes gingival index in the test and control tooth (which is equal in both) before treatment is 2.2 ± 0.4, i.e. 2 - moderate inflammation, with bleeding of probing.

The Lóe & Sillnes in the test and control tooth after treatment in average is 2.2 ± 0.4, I.e. 0 - normal healthy gingival, without bleeding on probing (Table 1).

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Table 1. Average value of Lóe & Sillnes gingival inflammation index before and after treatment

Gingival inflammation - Lóe & Sillnes	Number	Average	Minimum	Maximum	Standard deviation
Test tooth before treatment	15	2.2	2.0	3.0	0.414039
Test tooth after treatment	15	0.2	0.0	1.0	0.414039
Control tooth before treatment	15	2.2	2.0	3.0	0.414039
Control tooth after treatment	15	0.2	0.0	1.0	0.414039

	Status
0	Normal, healthy gingival
1	A slight change in color and contour, without bleeding of probing
2	Moderate inflammation, with bleeding of probing
3	Severe inflammation with signs of spontaneous bleeding

Table 2. Periodontal pocket bleeding on probing before and after treatment

Bleeding /tooth	Test tooth Before treatment		Test tooth After treatment		Control tooth Before Treatment		Control tooth After Treatment	
	No.	%	No.	%	No.	%	No.	%
No bleeding			12	80.0			12	80.0
1-minor bleeding on probing	1	6.7	3	20.0	1	6.7	3	20.0
2-moderate bleeding on probing	8	53.3			8	53.3		
3-spontaneous bleeding	6	40.0			6	40.0		
Total	15	100.0	15	100.0	15	100.0	15	100.0

Before the treatment, in both the test and the control tooth, the index of gingival inflammation was registered in 80% i.e. 2 - moderate inflammation, with bleeding of probing and index gingival inflammation in 20% i.e. 3 - Severe inflammation with signs of spontaneous bleeding (Table 1).

Before treatment bleeding was recorded on probing in most cases. After treatment bleeding wasn't recorded on probing – 80% (Table 2).

According to the index of bleeding dynamics from the periodontal pocket on probing 1-light bleeding on probing, an increase of 200% is registered before, between and after the treatment.

The average periodontal pocket depth in the test and control tooth before and after treatment is unchanged at 6.3 ± 0.6 mm, with the minimum at 5.0 mm, and the maximum at 7.0 mm (table 3).

From all measurements taken of the periodontal pocket depth before and after treatment, the depth of 6 mm is most common at 53.3% frequency, followed by depth 7 mm at 40% frequency.

Average clinical attachment loss in the test and control tooth (which is equal and unchanged) before and after treatment is 5.9 ± 1.8 mm, with the minimum at 2.0 mm, and the maximum at 8.0 mm (table 4).

From all measurements taken of the clinical attach-

Table 3. Average value of periodontal pocket depth before and after treatment

Gingival inflammation - Lóe & Sillnes	No.	Average	Minimum	Maximum	Standard deviation
Test tooth before treatment	15	6,3	5,0	7,0	0.617213
Test tooth after treatment	15	6,3	5,0	7,0	0.617213
Control tooth before treatment	15	6,3	5,0	7,0	0.617213
Control tooth after treatment	15	6,3	5,0	7,0	0.617213

Table 4. Average value of clinical attachment loss before and after treatment

Gingival inflammation - Lóe & Sillnes	No.	Average	Minimum	Maximum	Standard deviation
Test tooth before treatment	15	5,9	2,0	8,0	1.751190
Test tooth after treatment	15	5,9	2,0	8,0	1.751190
Control tooth before treatment	15	5,9	2,0	8,0	1.751190
Control tooth after treatment	15	5,9	2,0	8,0	1.751190

ment loss before and after treatment, the most common depth is 7.0 mm at 26.7% frequency, followed by depth of 5.0 mm and 8.0 mm at 20% frequency.

Discussion

The results in Table 1 and 2 show that there is a statistically significant reduction in the gingival inflammation index and bleeding index by Lóe & Sillnes for $p<0,05$, in the test and control group during the first visit and three days after the last stage of the conservative and combined conservative - laser therapy. Gingival inflammation bleedingin the periodontal pockets was reduced more significantly in the test group.

These obtained results indicate that conservative periodontal treatment with the addition of laser therapy gives a significant improvement of the clinical manifestation of periodontal disease[10,11,12], by reducing the quantity of periodontogenic microorganisms responsible for the inflammatory gingival changes. These microorganisms produce enzymes and toxins that stimulate the destructive processes in the periodontal tissues. The results obtained regarding the periodontal pocket depth and the average attachment loss in the test and control group were equal and unchanged before and after the treatment (Table 3 and 4). These results do not concur with those of the referencing authors[13,14,15]. The results we

obtained can be explained by the reduced re-colonization or re-colonization with less harmful bacteria in lasered pockets, and for that purpose long term studies are necessary for more relevant results of the administered laser therapy.

Conclusion

1. Close curettage of the periodontal pocket with the use of laser optic fiber of the Nd: YAG laser in combination with the conventional mechanical periodontal treatment improves the clinical manifestation of chronic periodontal disease. The significant reduction of bleeding and gingival inflammation confirms the anti - inflammatory and antibacterial effects of the laser.

2. After conducting the combined therapeutic procedure (conventional and laser treatment), the average depth of the periodontal pocket and the average attachment loss in the test and control tooth show unchanged values. These results can be explained by the need of a longer observation period which is necessary for creating a new fiber attachment and formation of a new periodontal attachment, as a result of the bio-stimulating potential of the laser assisted procedure.

3. The use of Nd:YAG laser as an additional thera-peutic method to the conventional periodontal treatment reduces recidivism and maintains ther-apeutic results for a long time. This method has a great potential in antimicrobial control of more aggressive forms of periodontal disease with deep and narrow periodontal pockets.

4. With the use of high energy Fidelis III Nd:YAG laser, patients are offered an efficient, quality and modern therapy of periodontal disease. We hope that the use of this method as an addition to the conventional mechanical treatment of periodontal disease will become a part of everyday dental routine and practice.

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EVALUATION OF DENTOALVEOLAR CHANGES IN MIXED AND PERMANENT DENTITION

АНАЛИЗА НА ДЕНТОАЛВЕОЛАРНИТЕ ПРОМЕНИ ВО МЕШОВИТА И ТРАЈНА ДЕНТИЦИЈА

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Abstract

The dimensions of dental arches and occlusion have always been of concern to anthropologists, orthodontists and other specialists in the field of maxillofacial and reconstructive surgery. Encouraged by the individual variations of the normal size and shape of the dental arches developed under the influence of genetic factors and factors from the external environment, we set the following **goals**: by analyzing studio models of respondents aged 6-8 and 12-14 years of age, to determine the statistical significance of the defined parameters in the maxilla and the mandible. The study was performed on a sample of studio models in 55 subjects with normal occlusion of both sexes, divided in two age groups, 6-8 years with mixed dentition and 12-14 years with permanent dentition. Measurements were performed on the following parameters: anterior arch curve in maxilla and mandible (AC1, AC2), posterior arch curve in maxilla and mandible (PC1, PC2), the intermolar distance in maxilla and mandible (MM1, MM2), inter-canine distance in maxilla and mandible, palatal depth (PD), palatal length (PL) and mandibular length (ML). The obtained **results** from the comparative analysis of dental varnishes, in relation to age (6-8 and 12-14 years) of both sexes, showed larger values for certain parameters with statistical significance in the group from 12-14 years of male sex. In **conclusion**, the knowledge of the growth factors in occlusal and craniofacial variations is of great importance for basic research, but there is also clinical relevance in predicting growth in planning orthodontic treatment. **Keywords:** gnathometric variables of dental arches; gender; age.

Апстракт

Димензиите на денталните лакови и оклузијата од секогаш биле предмет на интерес на антрополозите, ортодонтите како и останатите специјалисти од областа на максилофацијалната и реконструктивна хирургија. Поттикнати од индивидуалните варијации на нормалната големина и форма на денталните лакови кои се развиваат под дејство на генетските фактори и факторите од надворешната околина,ги поставивме следните **цели**: преку анализа на студио модели на испитаници на возраст од 6-8 и 12-14 годишна возраст,да се утврди статистичка сигнификантност на дефинираните параметри во максила и мандибула. Испитувањето беше вршено на примерок од студио модели кај 55 испитаници со нормална оклузија од двата пола,поделени во две возрасни групи, од 6-8 год.со мешана дентиција и од 12-14 год. со перманентна дентиција. Беа извршени мерења на следните параметри:антериорна лакова облина во максила и мандибула(АЦ1, АЦ2), постериорна лакова облина во максила и мандибула(ПЦ1, ПЦ2), интермоларното растојание во максила и мандибула (ММ1, ММ2), палатинална длабина(ПД), палатинална должина (ПЛ) и мандибуларна должина (МЛ). Добиените **резултати** од компаративната анализа на денталните лакови, во однос на возраст (8-10 и 12-14 год.) кај двата пола,покажа за поедини параметри поголеми вредности со статистичка сигнификантносто групата од 12-14 год. од машки пол. Како **заклучок** познавањето на факторите кои ги регулираат оклузалните и краниофацијалните варијации е од голема важност за основните истражувања, но има и клиничка релевантност во предвидувањето на растот при планирање на ортодонтскиот третман.

Introduction

Orthodontic science has always been willing to find out the secrets of growth processes of the craniofacial complex. The growth and development of a person is a dynamic and complex process which leads to skeletal and muscular changes of the components of the craniofacial system. The morpho-functional association of cortex and muscular tissue in the last period has been developed in accordance with the biological maturation of the unit, conducted by the genetic message, the epigenetic factors and the influence of the environment in which it lives.

This established dynamic framework and harmony is not a basic guarantee for the proper growth and development of the cranial complex. The aesthetics of the teeth was of great significance in the life of human beings. Based on the dental appearance, the overall

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physiological attraction of the person is of great importance for the social, physiological and psychological life of the person Dimberg[1].

The numerous and diverse definitions encountered in the professional literature for normal occlusion should not be interpreted as a law, but as a starting point in determining the normal occlusion. Every normal occlusion, along common general features has its own personal characteristics, the expression of the genetic variation Bayome[2], Ferro[3]. The normal occlusion is characteristic for each individual and varies, depending on the period of life, and the type of dentition Trivino[4]. In the case of dysfunction or suppression, only one of these factors develops disorders in the individual somatic development and creates favoritism for the appearance of dental and craniofacial anomalies with the consequent morphological, functional and aesthetic deviations of Markovic[5].

The dimensions of the dental arches and the occlusion have been subject to the interest of anthropologists, orthodontists and specialists of maxillofacial and reconstructive surgery. Knowing the factors that regulate occlusal and craniofacial variations is of great importance for basic research, but they also have clinical relevance in predicting growth in planning orthodontic treatment.

The empirical experience points to the necessary need for determining and studying all the postulates that define the normal base and the relationships in the orofacial system. Individual variations in the size and shape of dental arches depend on genetic factors, internal causes, postnatal conditions in the environment, as well as ethnic and racial backgrounds. Angle (Markovic[5], Zuzelova[6]) concluded that the only way to achieve a balanced appearance should be a complete dentition. The shape of the dental arches during growth is strongly influenced by the function of lingual and mimic musculature.

From Broka (1873), various methods of dental analysis of studio models began to be used: Graber[7], Moyers, Bolton, Lundstrom, Korhaus, Adler, Combel (titled Salzman[8]). Correlative morphological and developmental analyzes of changes in postnatal growth and development are based on phylogenetic correlations[9], anthropometric studies[10] and serial cephalometric radiographs[11]. These studies largely determined the nature and direction of growth and development with its minor changes. Smaller changes for orthodontists have practical relevance, especially when it comes to changes in the width of the dental arches. In the longitudinal study of Goldstain[10], Salzman[8], Sato[12], Odajima[13], Mikami[14], normal changes in dental arches appear during growth and development. In recent years, Scher's[15], Brodie's[11], Scott's[16] reflection on dental arches has been largely driven by mathematical morphogenesis.

Channing and Wissler (titled from Björk)[17] were among the first examiners of the width of dental arches using the biometric technique. They state that the width between the canines after the age of eight and the width between the molars after their eruption is not increased. Sodermanns[18] points out that the width of the dental arches is inherited.

There are many studies in the literature about normal changes in the width of dental arches Lavelle[19] and ass., Sodermanns[18], Mills[20], Moorrees[21], Sillman[22], which can be summarized in such a way that: the increase in the dental arch width occurs in both groups of 9 to 13 years of age. In males, the arch width is 1.5 mm for the maxilla and 0.4 mm for the mandible. In female subjects, the maxillary arch width increases by only 0.8 mm, while the mandibular by 0.5 mm. The difference in the dimensions of the arch width between the maxilla and the mandible is interpreted by the divergent inclination of the maxillary alveolar procesus in comparison with the convergent inclination of the mandibular alveolar procesus. Sodermanns[18] points out that the width of the dental arches is inherited. Based on the above-mentioned facts, we find that the image that morphologically presents malocclusion, especially in the lower level, under the influence of the functional adaptation, is transformed into normal occlusion. In other cases, the morphological words of the ideal occlusion may be associated with serious functional disturbances, and accordingly, it cannot be referred to as a "normal occlusion".

Purpose

Inspired by the individual variations of the normal size and form of dental arches that occur during growth, and which depend on the hereditary and environmental factors, we set the following goals: by analyzing studio models from individuals with normal occlusion, at the age of 6-8 and 12-14 years, of both sexes from the Private dental practices "Euro Orthodonci" Gostivar, to determine whether there is statistical significance for the defined parameters in the maxilla and the mandible: anterior arch curves in maxilla and mandible (AC1, AC2); posterior arch curves in maxilla and mandible (PC1, PC2); intermolar distance in maxilla and mandible (MM1, MM2); palatal depth (PD); palatal length (PL) and mandibular length (ML) among adult groups, as well as gender polymorphism.

Material and methods

The examination was performed on a sample of studio models in 55 subjects with a normal occlusion of both sexes, divided in two groups according to age: 6-8
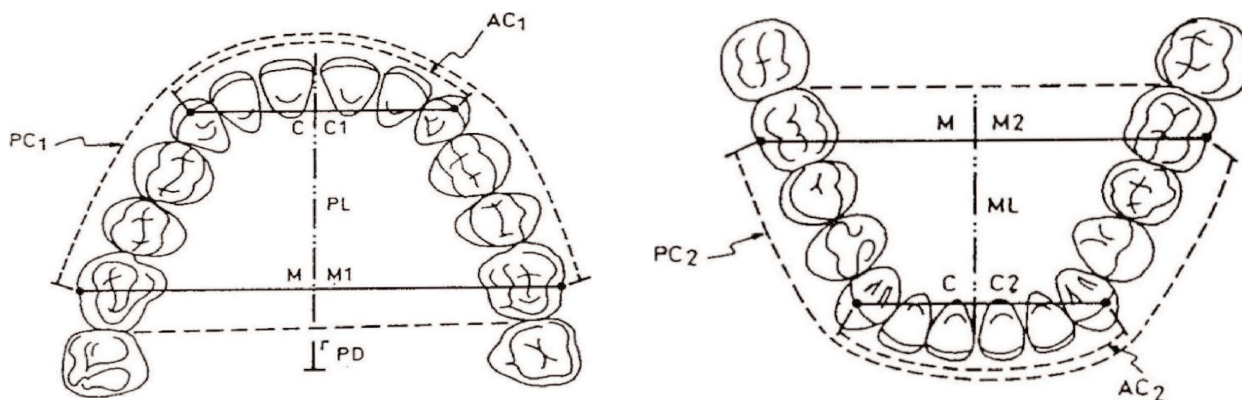
Figure 1. *Schematic display of the parameters in the upper and lower dental arch*

years old- mixed dentition and 12-14 years - permanent dentition, from Gostivar (Republic of North Macedonia).

The linear parameters were used in the research are the following,

- ➢ Interior arch curve in maxilla and mandible (AC1, AC2)
- ➢ Posterior arch curve in maxilla and mandible (PC1, PC2)
- ➢ Inter-canine distance in maxilla and mandible (CC1, CC2)
- ➢ Intermolar distance in maxilla and mandible (MM1, MM2)
- ➢ Palatinal length (PL)
- ➢ Palatinal depth (PD)
- ➢ Mandibular length (ML)

The parameters were measured with a flexible gauge and a calibrated ribbon used to measure the anterior and posterior arch form in the centimeters approximately to the first decile, a compass by Corkhaus. The following statistical methods are applied: Descriptive Statistics (Mean; Std.Deviation; ± 95.00% CI; Minimum; Maximum); Kolmogorov-Smirnov test, Lillifors test, Shapiro-Wilks W test (p), depending on the distribution of data; Differences in the analyzed parameters between two independent samples were tested with t-test - independent samples (t) and Mann-Whitney U Test (Z). The significance is determined with $p < 0.05$.

Results

The comparative analysis among the older group of males shows higher values in the 12-14 age group, with statistical significance for the parameters: AC2, PC1,

Table I. Comparison between male 6.0-8.0 years (1) & male 12.0-14.0 years (2)

Parameter	Mean 1	Mean 2	t-value	df	P	Valid N 1	Valid N 2
AC2	32.76667	34.07143	-2.40886	27	0.023096	15	14
PC1	87.90000	92.57143	-3.75853	27	0.000835	15	14
PC2	84.43333	85.07143	-0.38580	27	0.702671	15	14
CC1	33.53333	34.85714	-1.78161	27	0.086066	15	14
CC2	26.96667	27.64286	-0.85973	27	0.397506	15	14
MM1	48.36667	53.03571	-5.96064	27	0.000002	15	
MM2	44.63333	48.28571	-5.09202	27	0.000024	15	14
PD	15.20000	14.60714	0.86906	27	0.392477	15	14
PL	41.02000	38.00000	2.86014	27	0.008072	15	14
ML	31.72000	31.75000	-0.04186	27	0.966921	15	14

Table I.1. Comparison between male 6.0-8.0 years (1) & male 12.0-14.0 years (2)

Parameter	Rank Sum 1	Rank Sum 2	U	Z	p-level	Valid N 1	Valid N 2
AC1	166.5000	268.5000	46.50000	-2.55315	0.010676	15	14

Table II. Comparison between female 6.0-8.0 years (3) & female 12.0-14.0 years (4)

Parameter	Mean 3	Mean 4	t-value	df	P	Valid N 3	Valid N 4
AC2	31.86667	33.90909	-2.24874	24	0.033980	15	11
PC1	89.00000	90.72727	-3.22531	24	0.003612	15	11
PC2	80.93333	83.09091	-2.12278	24	0.044284	15	11
CC1	30.26667	33.18182	-4.51229	24	0.000144	15	11
CC2	23.23333	26.86364	-4.71010	24	0.000087	15	11
MM1	50.23333	52.22727	-2.26423	24	0.032876	15	11
MM2	43.10000	47.54545	-6.61297	24	0.000001	15	11
PD	1560000	13.27273	3.05684	24	0.005420	15	11

Table II.1. Comparison between female 6.0-8.0 years (3) & female 12.0-14.0 years (4)

Parameter	Rank Sum 6	Rank Sum 8	U	Z	p-level	Valid N 6	Valid N 8
AC1	185.5000	165.5000	65.50000	-0.882299	0.377616	15	11
PL	198.0000	153.0000	78.00000	-0.233550	0.815335	15	11
ML	204.0000	147.0000	81.00000	0.077850	0.937948	15	11

Table III. Comparison between male 6.0-8.0 yrs. (1) & female 6.0-8.0 yrs. (3)

Parameter	Mean 5	Mean 6	t-value	df	P	Valid N 1	Valid N 3
AC2	32.76667	31.86667	2.13932	28	0.041269	15	15
PC1	87.90000	89.00000	-1.73822	28	0.093160	15	15
PC2	84.43333	80.93333	4.82791	28	0.000044	15	15
CC1	33.53333	30.26667	6.40255	28	0.000001	15	15
CC2	26.96667	23.23333	8.64466	28	0.000000	15	15
MM1	48.36667	50.23333	-3.02120	28	0.005330	15	15
MM2	44.63333	43.10000	3.45618	28	0.001766	15	15
PD	15.20000	15.60000	-0.76443	28	0.451008	15	15
ML	31.72000	31.23333	1.52107	28	0.139456	15	15

Table III.1. Comparison between male 6.0-8.0 years (1) & female 6.0-8.0 years (3)

Parameter	Rank Sum 1	Rank Sum 3	U	Z	p-level	Valid N 1	Valid N 3
AC1	339.0000	126.0000	6.000000	4.417414	0.000010	15	15
PL	345.0000	120.0000	0.000000	4.666283	0.000003	15	15

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Table IV. Comparison between male 12.0-14.0 yrs (2) & female 12.0-14.0 yrs (4)

Parameter	Mean 2	Mean 4	t-value	df	P	Valid N 2	Valid N 4
AC2	34.07143	33.90909	0.160007	23	0.874273	14	11
PC1	92.57143	90.72727	1.357139	23	0.187907	14	11
PC2	85.07143	83.09091	0.977310	23	0.338584	14	11
CC1	34.85714	33.18182	1.844751	23	0.077991	14	11
CC2	27.64286	26.86364	0.706680	23	0.486863	14	11
MM1	53.03571	52.22727	0.765760	23	0.451607	14	11
MM2	48.28571	47.54545	0.778557	23	0.444177	14	11
PD	14.60714	13.27273	1.439373	23	0.163517	14	11

Table IV.1. Comparison between male 12.0-14.0 yrs (2) & female 12.0-14.0 yrs (4)

Parameter	Rank Sum 2	Rank Sum 4	U	Z	p-level	Valid N 2	Valid N 4
AC1	231.5000	93.5000	27.50000	2.709872	0.006731	14	11
PL	206.0000	119.0000	53.00000	1.313877	0.188888	14	11
ML	185.0000	140.0000	74.00000	0.164235	0.869547	14	11

MM1, MM2 and PL. Similarly, the AC1 parameters shows significant differences for Z = -2.55 and p <0.05 (p = 0.01) (Table I.1)

Although female respondents aged 6.0 to 8.0 years have a higher palataldepth (PD) compared to the age group of 12.0-14.0 years, the difference for t = 3.06 and p <0.01 (p = 0.005) is significant (Table II). While the remaining parameters were higher with a statistical significance in the group of 12-14 years, the parameters AC1, PL and ML did not show any differences (Table II.1).

Table III and Table III.1 show the differences in the analyzed parameters between male and female respondents aged from 6.0 to 8.0 years.

Male subjects have higher average values with statistical significance for: AC2; PC2; CC1; CC2; MM1 and MM2 in relation to female respondents. While female respondents have higher average PC1 values compared to male respondents, the difference for t = -1.74 and p> 0.05 (p = 0.09) is not significant.

Also, male subjects have higher average values with statistical significance of the anterior arch curve of the maxilla (AC1), the difference Z = 4.42 ip <0.001 (p = 0.000), as well as for the palatal length (PL), the difference for Z = 4.67 ip <0.001 (p = 0.000) is significant (Table III.1).

The comparative analysis between males and females aged 12-14 years is shown in Table IV. Male

respondents, although having higher average values than female respondents, however, do not show any statistically significant differences.

While male subjects showed higher average values with statistical significance of anterior arch curve in the maxilla (AC1) compared to female respondents, the difference for Z = 2.71 ip <0.01 (p = 0.007) is significant (Table IV.1).

Discussion

During growth and development, the craniofacial system shows changes in the dimensions of individual bones and their relationship[11]. The neonatal face is characteristically small in relation to the cranium. However, the person undergoes postnatal progressive increase, and its various proportions noticeably change with age. All skeletal changes represent a response to the primary changes in the growth of the functional matrix.

Many attempts have been made to describe the ideal arch. It was done using deductive reasoning and measurable changes. Statistical analyzes were used to evaluate these changes and to describe the arch. Orthodontists are most aware of individual differences and variations in all people. It must be emphasized that a great deal of effort will be deducted from orthodontists if they formulate the plans and technique of treatment based on the average. It is not the intention to build the ideal arch as a clinical

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entity in its own right, but rather to have a tool for better development of arch structural problems. All orthodontic planning and constructions of the appliance must be individually tracked in order to ensure that the arch concept admirably helps the very appearance of the individual[19,20,12,22].

Many authors have described the changes in the dental arches during postnatal growth and development[23,24,25,10]. Our findings are mainly based on the findings of these authors. However, there are certain differences in terms of the time of greatest growth and development of dental arches in the width both in the maxillary and the mandible. The absolute values of the dental arch width are higher in this study than the examinations of Knott[26], Mills[27], Moyers[28], Ortega[29].

The mean values of the selected parameters in the examined groups were generally higher in boys than in girls, especially in the 12-14 year group, and we agree with the findings of[29,30]. The size and depth of the dental arches showed changes in comparison to 6-8 years, and 12-14 years in both groups. Our findings coincide with the findings of Silman[22], which showed that there are changes in the size and depth of dental arches from birth to 25 years. Also, Lavelle et al.[19] found that the biggest changes occur from 5-7 years and 11-13 years during the eruption of permanent teeth.

Dental eruption has a significant effect on the shape of the dental arches, the depth is determined directly by the growth of the alveolar bone and the size of the teeth[22,19,31]. Palatinal and maxillary length and mandibular posterior arch curve showed a decrease over the years.

The eruptive sequence of teeth, especially in the premolar region, according to Ash[24] is an important factor in reducing posterior arch parameters during mandible growth. However, the anterior and posterior arch curve also depends on the growth of the dental facial complex, and the degree of overbite and overjet expression. Appropriate maxillary and mandibular variables referring to inter-arch distances show a strong correlation between teeth eruption and the development of occlusion in relation to the development of oral motor functions.

The greatest increase in inter-canine distance occurs at the age of 12-15 in males and 9-11 years of age in female subjects. This difference is interpreted by the different times of peak puberty in male and female individuals. It is considered that the width of the dental arches is influenced by genetic and environmental factors, of which the most important is the genetic one. This examination confirms the findings of Sarhan[30], Gafni[32] and Bojaxiev[33].

Comparative analysis of male respondents between the two adult groups showed higher values in the group of 12-14 years, with statistical significance for the following parameters: AC2, PC1, MM1, MM2 PL and AC1 (Table I and II.1). Similarly, the comparative analysis in girls showed the existence of statistical significance for all examined parameters, that is, women respondents aged 12.0-14.0 years have higher average values (Table II). These findings agree with Bojaxiev[33] and ass. Argyropolus[23] i Goldstein[10]. Male respondents showed higher values in relation to girls with statistical significance for the following parameters: AC2, PC2, MM1, MM2 (Table III).Comparative analysis between male and female respondents aged 12.0-14.0 years does not show a statistical significance (Table IV), except for AC1 (Table IV.I).

Conclusion

The comparative analysis of dental arches, in relation to age (6-8 and 12-14 years), in both sexes shows higher values for individual examined parameters with statistical significance in the male group of 12-14 years.

Summing up all these results in the complete interaction of pre-emptive factors in relation to age and gender can support the fact that inheritance, external influence and individual growth are dominant in the creation of normal growth and the development of the orofacial system, that is, each individual needs to be analyzed separately, when orthodontists approach orthodontic treatment planning.

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ASSESSMENT OF PRIMARY AND SECONDARY IMPLANT STABILITY OF TWO DIFFERENT TYPES OF DENTAL IMPLANTS

ПРОЦЕНА НА ПРИМАРНАТА И СЕКУНДАРНАТА ИМПЛАНТНА СТАБИЛНОСТ КАЈ ДВА РАЗЛИЧНИ ТИПОВИ НА ДЕНТАЛНИ ИМПЛАНТИ

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Abstract

Implant stability plays a major role in the success of osteointegration. Taking into consideration this fact about the implant stability, the difference of the primary and secondary dental implant stability and their influence on the longevity of the implant therapy is the main aim of this study, which was established through the determination of the primary and secondary dental implant stability between patients with two different types of implants. This clinical study was performed in a private dental office called ,,Vita-Dent'' in Tetovo, Republic of North Macedonia. The study incorporates two types of implants, MIS Seven implants with internal hexagonal shape and Straumann Standard plus Bone level implants from the ITI Academy with internal octagonal form. The stability of the implants was measured by analyzing the resonance frequency using the instrument Osttell IDX TM. Implant Stability Quotient (ISQ) is the measurement unit of this diagnostic tool and the measurement units range from 1 to 100. For all 308 implants, the ISQ values for primary implant stability vary in the range 61.85 ± 6.40 units. The ISQ values for secondary implant stability vary in the range 71.70 ± 11.67 units. Primary stability of Straumann dental implants is insignificantly greater than the primary stability of MIS dental implants, in comparison to the secondary stability of Straumann dental implants that is significantly greater than the secondary stability of MIS dental implants. **Keyword:** dental implants, implant stability, RFA, ISQ.

Апстракт

Стабилноста на имплантите игра голема улога во успехот на остеоинтеграцијата. Имајќи го предвид овој факт за стабилноста на имплантот, постоењето на примарна и секундарна стабилност и нивното влијание на долговечноста на имплантната терапија, е главната цел на оваа студија – преку утврдување на примарната и секундарната стабилност помеѓу пациентите со два различни видови импланти. Оваа клиничка студија беше спроведена во ПЗУ ,,Вита-Дент" во Тетово, Република Северна Македонија. Студијата опфати два различни типови на импланти, MIS Seven импланти со внатрешна хексагонална форма и Straumann Standard plus Bone level импланти од Академијата ITI со внатрешна октогонална форма. Стабилноста на имплантите се испитуваше преку анализата на резонантната фреквенција со помош на инструментот, наречен Osttell IDX TM. Кочичник на имплантна стабилност (ISQ) е единицата за мерење, на оваа дијагностичка алатка и мерните единици се движат од 1 до 100. За сите 308 импланти, ISQ вредностите за примарната стабилност на имплантите варираат во опсегот 61,85 ± 6,40 единици. Вредностите на ISQ за истиот број на дентални импланти за секундарна стабилност на имплантите варираат во опсегот од 71,70 ± 11,67 единици. Примарната стабилност на имплантите на Straumann имплантите е незначително поголема од примарната стабилност на MIS денталните импланти, за разлика од секундарната стабилност на Straumann дентални импланти што е сигнификантно поголема од секундарната стабилност на MIS имплантите. **Клучни зборови:** дентални импланти, имплантна стабилност, RFA, ISQ

Introduction

The number of patients treated with dental implants is increasing and continues to grow, and dentists accept the challenges, which these complex restorations carry with them. Proper monitoring and maintenance of the implants in the patient's mouth is essential to ensure the longevity of the dental implant and its suprastructure through a combination of adequate control examinations, proper oral care and effective oral hygiene performed by the patient.

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Implant stability plays a major role in the success of osteointegration. Primary stability is a mechanical phenomenon, which is related to the quality and quantity of the local bone, the type of implant and the surgical technique. Secondary stability is increased by bone formation and tissue remodeling on the implant - tissue interface and surrounding tissues. It has been proven that stability during implantation, as well as after a certain period of time, has major significance for the success of implant therapy1.

The primary stability of a dental implant is related to the mechanical ratio and the contact of the implant with the surrounding alveolar bone, while bone regeneration and remodeling phenomena, affecting the alveolar bone, determine the secondary or biological stability of the implants. Secured and appropriate primary stability is in a positive correlation with the secondary stability2.

The method we will use in this research is the analysis of the resonant frequency. Meredith, Sennerby and Meredith first proposed the RFA method as a highly efficient qualitative method that serves to assess the stability of dental implants3,4.

Devices that perform a resonant frequency analysis, measure the resonance frequency through a transducer connected to the implant body, which is stimulated at different frequencies. The significance of these analyzes is enormous and according to a study by Sul et al., RFA is a reliable indicator of identifying the stability of the implant5, 6.

In their research, Nordin et al. conclude that SLA Straumann implants positioned in the maxilla represent a reliable alternative treatment in fresh extraction wounds. Radiographic analysis after 2-3 years showed that there were no changes in the height of the bone either from the mesial or the distal side7.

Taking into consideration the facts about the implant stability, the difference of the primary and secondary dental implant stability, and their influence on the longevity of the implant therapy are the main aims of this study. Our goal is to determine the difference between primary and secondary dental implant stability, between patients with two different types of implants (MIS and Straumann dental implants) and we will determine the summary of primary and secondary stability of all dental implants in the study.

Material and methods

This clinical study was performed in a private dental office "Vita-Dent" in Tetovo, Republic of North Macedonia, carried out in the period from 2014-2019. Implants were placed in edentulous patients who needed to restore one or more teeth. All of the patients were older than 18 years old. Patients with malignant, systemic diseases and patients with craniofacial anomalies (syndromes) were excluded from the study. The implants were surgically placed by one specialist - oral surgeon, and the stability of the implants was determined using a contemporary diagnostic instrument, which analyzes the resonant frequency.

The study incorporates two types of implants, MIS Seven implants with internal hexagonal shape and Straumann Standard plus and Bone level implants from the ITI Academy with internal octagonal form.

The stability of the implants was measured by analyzing the resonance frequency using the instrument Osttell IDX (Osttell AB, Gothenburg, Sweden). Implant Stability Quotient (ISQ) is the measurement unit of this diagnostic tool and the measurement units range from 1 to 100. In cases when higher values are displayed on the instrument, those implants have better stability. The results of the conducted analyzes will be appropriately recorded in the implantological and anamnestic charts for every subject, which were necessary for statistical analysis.

All implants were surgically placed according to the protocol of two-phase implantation, where the implant is surgically placed in the first phase. In this phase, the primary stability with the Osttell IDX RFA (Resonance Frequency Analyze) was determined. In the second phase after six months, appropriate x-rays were done to confirm the positioning of the implanted dental implants and to assess how close they are to the vital anatomical structures and whether sufficient bone tissue around the implant is formed. In this phase, adequate measurements were carried out to determine secondary stability and osteointegration.

The measurement technique is based on a small transducer screwed on the implant and tightened, according to the manufacturer's specifications, with a 10 N-cm torque. The wireless probe device was approached several millimeters to the transducer without touching it. The obtained ISQ values represent the resonance frequencies of the electromagnetic waves. Four measurements will be performed for every implant, on the mesial, distal, buccal and palatial/lingual side and they will be recorded in the instrument. The same data were registered on a computer connected with a USB cable to the Osttell IDX Data Manager.

Data obtained from the clinical investigation was appropriately and statistically processed. For statistical analysis, we used special software for statistical analysis of data- Statistica 7.1 for Windows and SPSS Statistics 17.0.

Results

This section of the paper will present the results obtained from the research related to the assessment of primary and secondary stability of implants performed in the period from 2014-2019 in the private dental office "Vita Dent" -Tetovo. The total number of participants was 100.

The clinical examiantion covered an equal number of respondents according to which implant they were given. From the total number of subjects, 48 (48 %) were female, while the remaining 52 (52 %) were male. The median age of patients varied in the interval of 54.18 ± 10.67 years ($\pm$ 95.00CI: 51.15-57.21).

1. Results for MIS Seven dental implants

Table 1. and Figure 1. present the descriptive statistics of the ISQ values of primary implant stability as well as the secondary stability of implants examined 6 months after implantation. In 185 implants, the ISQ values of primary implant stability vary in the range 61.66 ± 7.43 units ($\pm$ 95.00CI: 60.59-62.74), the minimum value is 41 units and the maximum value is 82 units. ISQ values of secondary implant stability vary in the range of 68.94 ± 9.91 units ($\pm$ 95.00CI: 67.50-70.37), the minimum value is 0.00 units and the maximum value is 88 units.

The results in Table 2. show the difference between the ISQ values of primary and secondary implant stability.

Six months after the implantation, the ISQ values for secondary implant stability for $Z = 11.02$ and $p < 0.001$ ($p = 0.000$) are significantly higher than the values of primary implant stability.

For $R = 0.87$ and $p < 0.05$ in the examined relationship between the ISQ values for primary and secondary implant stability, a very strong positive correlation was established.

2. Results for Straumann dental implants

Table 3. and Figure 2. present the descriptive statistics of the ISQ values of primary implant stability as well as the secondary implant stability examined 6 months after implantation of Straumann dental implants.

Of the total number of 123 implants, the ISQ values of primary implant stability vary in the range 62.14 ± 4.46 units ($\pm$ 95.00K: 61.34-62.93), the minimum value is 51 units and the maximum value is 79 units. Of the same 123 implants, the ISQ values of secondary implant stability vary in the range 75.86 ± 12.87 units ($\pm$ 95.00K: 73.56-78.16), the minimum value is 0.00 units and the maximum value is 89 units.

Table 1. Primary stability & Secondary stability/ISQ Values /Descriptive Statistics MIS. Seven dental implants.

Primary stability & Secondary stability	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
Primary stability	185	61.66	60.59	62.74	41.00	82.00	7.43
Secondary stability	185	68.94	67.50	70.37	0.00	88.00	9.91

Figure 1. *Primary stability & Secondary stability/ISQ Values/Descriptive Statistics MIS Seven dental implants*

Table 2. Difference/Primary Stability & Secondary Stability

Implant stability	Valid	T	Z	p-level
Primary Stability & Secondary Stability	185	536.00	11.02	0.000

The results of Table 4. refer to the difference between the ISQ values of the primary and secondary implant stability.

Six months after the implantation, the ISQ values of the secondary implant stability for $Z = 8.70$ and $p < 0.001$ ($p = 0.000$) are significantly higher than the values of the primary implant stability.

Table 3. Primary Stability & Secondary Stability/ISQ Values/Descriptive Statistics Straumann dental implants

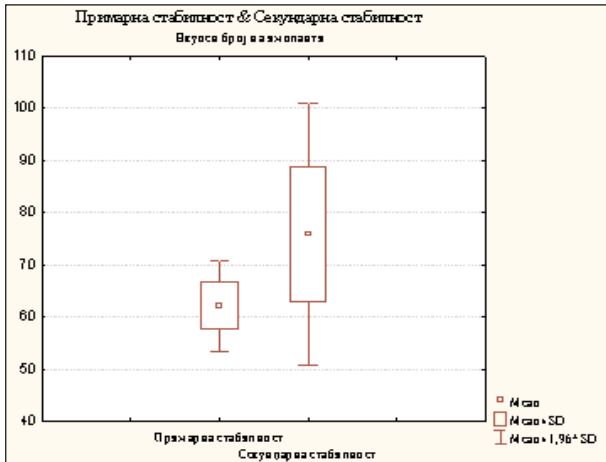| Primary stability & Secondary stability N	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
Primary stability	123	62.14	61.34	62.93	51.00	79.00	4.46
Secondary stability	123	75.86	73.56	78.16	0.00	89.00	12.87

Figura 2. Primary Stability & Secondary Stability/ISQ Values/Descriptive Statistics Straumann dental implants

For R = 0.49 and p <0.05 in the examined relationship between the ISQ values of primary and secondary implant stability, a mean strong positive correlation was discovered.

3. Both types of dental implants

Below are the results where a comparison of primary and secondary stability was made for both types of implants.

Table 4. Difference/Primary Stability & Secondary Stability

Implant stability	Valid	T	Z	p-level
Primary Stability & Secondary Stability	123	366.00	8.70	0.000

So, for Z = - 0.83 and p> 0.05 (p = 0.41) the primary stability of Straumann dental implants (x = 62.14) is insignificantly greater than the primary stability of MIS dental implants (x = 61, 66) (Table 5).

For Z = - 8.29 and p <0.001 (p = 0,000), the secondary stability of Straumann dental implants (x = 75.86) is significantly greater than the secondary stability of MIS dental implants (x = 68,94) (Table 6.).

Table 7. and Figure 3. show descriptive statistics on the ISQ values of primary implant stability as well as secondary implant stability examined 6 months after implantation for all placed dental implants. For all 308 implants, the ISQ values for primary implant stability vary in the range 61.85 ± 6.40 units (± 95.00CI: 61.14-62.57), the minimum value is 41 units and the maximum value is 82 units. The ISQ values for the same number of dental implants for secondary implant stability vary in the range 71.70 ± 11.67 units (± 95.00CI: 70.39-73.01), the mini-

Table 5. Primary Stability/Difference/MIS dental implants & Straumann dental implants

	Rank Sum Mis	Rank Sum Straumann	U	Z	p-level	N Mis	N Straumann
Primary stability	27947.00	19639.00	10742.00	-0.83	0.41	185	123

Table 6. Secondary Stability / Distinction / MIS dental implants & Straumann dental implants

	Rank Sum Mis	Rank Sum Straumann	U	Z	p-level	N Mis	N Straumann
Primary stability	22239.50	25346.50	5034.50	-8.29	0.000	185	123

Table 7. Primary Stability & Secondary Stability/All dental implants

Primary stability & Secondary stability N	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
Primary stability	308	61.85	61.14	62.57	41.00	82.00	6.40
Secondary stability	308	71.70	70.39	73.01	0.00	89.00	11.67
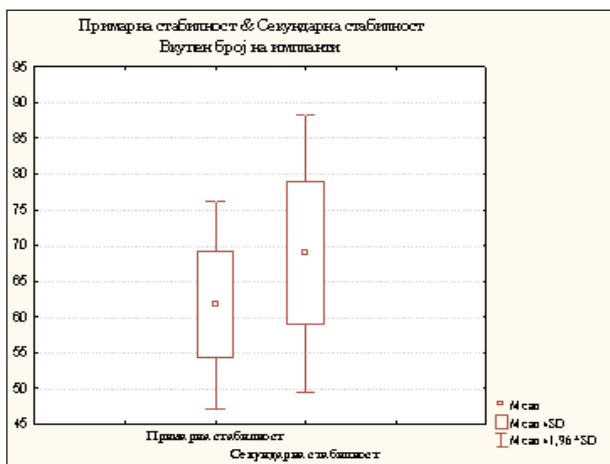
Figura 3. Primary Stability & Secondary Stability/All dental implants

Table 8. Primary Stability & Secondary Stability/Difference/All dental implants

	Valid	T	Z	p-level
Primary Stability & Secondary Stability	308	1709.50	14.09	0.000

mum value is 0.00 units and the maximum value is 89 units.

The secondary implant stability (for all dental implants installed) for Z = 14.09 and p <0.01 (p = 0.00) is significantly higher than the primary implant stability (for all dental implants installed) (Table 8.).

In the course of this study, the determination of the dental implants stability was done in order to meet the stated aim. It is a clinical study and all the results presented in it are original.

Contemporary international literature abounds with numerous data and papers dealing with the primary and secondary stability of dental implants, longevity of the implants and suprastructures on them.

The success of the dental implant depends on the osteointegration, the direct adhesion of the implant to the bone. Osteointegration is associated with a reduction in inflammation and increasing the gene expression associated with osteogenesis, angiogenesis, and neurogenization during the early stages of wound healing[8].

By analyzing the primary implant stability, Mihoko Atsumi et al. made a classification of the following factors that influence the primary stability: quantity and quality of the alveolar bone in which the implants are placed, surgical technique and procedure, method, including the sur-

geon skills, the implant design (shape, geometry, length, diameter and surface characteristics)[9].

In literature, a positive correlation was found between the primary implant stability and the thickness of the alveolar bone[10].

Implant stability is one of the most important parameters that influence the successful osteointegration of the implant, and thus the longevity of prosthetic structures placed over the implants[11].

The high value indicates greater stability, while the low value implies instability. The manufacturer's instructions indicate that the successful implant usually has an ISQ greater than 65. ISQ values, less than 50 may indicate a potential failure or an increased risk of failure of the implant[12].

Some authors found a negative correlation between the length of dental implants and the primary stability measured by RFA (resonant frequency analysis). Other authors, on the other hand, did not establish any significant correlation between the value of ISQ and the length, diameter or position of the implant in the mouth of patients. Recent research suggests that the use of wider and cone implant designs will result in high primary stability[13-15].

Reiner conducted research on the surface morphology of MIS implants with the help of SEM Microscopy. Through continuous controls with the help of SEM, it was concluded that MIS implants or their surfaces meet the highest surface quality standards with a 99.8-100% pure titanium oxide surface. The specific way of modifying the implant surface eliminates various surface contaminants, increases the surface of the implant, and generates a hydrophilic surface with micro and nanostructures suitable for optimum osteointegration[16].

In a study by Zabaras et al. covering over seven thousand implants and a five-year follow-up period, they

noticed that the MIS SEVEN implant system is safe and easy to use in all cases and in all indications for implant placement. The results of the study showed an extremely high rate of osteointegration of 99.71%17.

The Straumann implant system - Bone level implants (Institute Straumann AG, Basel, Switzerland) was introduced in 2007 on the market. This implant system offers various features claimed to improve the survival of the implant, reduce alveolar bone loss, and improve aesthetic results. Straumann Bone level implant is equipped with a SLActive implant surface18.

Based on the data presented and processed in this study, it can easily be seen that the secondary stability in the two types of implants is significantly higher than the primary stability in both types. Also, on the basis of the research, it was found that the primary stability of Straumann dental implants is insignificantly greater than the primary stability of MIS dental implants, in contrast to the secondary stability of Straumann dental implants that is significantly greater than the secondary stability of MIS dental implants.

If we make a comparison of the results relating to the primary stability obtained in our research, we can easily notice that the values obtained in our study are slightly lower compared to the data from Han et al, and from Ramakrishna and Nayar19, 20.

In contrast to the previously presented data, it should be noted that the results of our examination show a greater secondary stability than the data presented by Ramakrishna and Nayar. Tanaka et al. presented a higher value for secondary stability 21.

Thus, Frieberg et al have shown a significant correlation between initial and secondary stability. Also, these authors found that implants placed in low density alveolar bone reach higher levels of stability over time compared with implants placed in an alveolar bone showing greater bone density. However, Cornelini et al., found that primary stability was observed between 72 to 74.5 ISQ, and after one year, the ultimate stability of all implants was almost the same. Simunek et al. found a link between the type of alveolar bone and initial stability as well as between initial and secondary stability. In contrast to the previously presented data, Cehreli et al. in their study noted that there is no correlation between these two factors of longevity of implant therapy. It can be concluded that there seems to be no unifying view among scientists that confirms or defects the relationship between initial and secondary quality of bone quality. In his study, Degidi implicated that all implants with initial stability (ISQ) lower than 46 will fail, while those with ISQ more than 60 were will be successful22-27.

Conclusion

Based on the data obtained from our research, it can be noted that 6 months after the implantation, the ISQ values of the secondary stability of all implants are significantly higher than the values of the primary implant stability. The secondary stability of Straumann dental implants is significantly greater than the secondary stability of MIS dental implants. Implant stability using Osstell IDX is a noninvasive and precise technique, which provides information on implant stability and reliable guidance for further and successful implant therapy.

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