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COMPARATIVE ANALYSIS OF MICROBIAL ACCUMULATION ON DIFFERENT TYPES OF SUTURE MATERIALS IN PERIODONTAL SURGERY AND IMPLANTOLOGY

КОМПАРАТИВНА АНАЛИЗА НА МИКРОБИОЛОШКА АКУМУЛАЦИЈА НА РАЗЛИЧНИ ТИПОВИ МАТЕРИЈАЛИ ЗА СУТУРИРАЊЕ ВО ПАРОДОНТАЛНА ХИРУРГИЈА И ИМПЛАНТОЛОГИЈА

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Abstract

Introduction: The suture material is an artificial material used for intimate approximation of the wound edges until they can naturally adhere through collagen fibers. The accumulation of microbes varies depending on the quality and macrostructure of different suture materials. The ideal suture material should induce minimal tissue injury, resist bacterial contamination, and provide adequate tissue support. **Aim of the study:** The goal of this study is the evaluation of microbiological findings and the healing of the tissue by using 4 types of suture materials in various periodontal and implant surgical interventions. To achieve this objective, a comparative analysis of clinical and microbiological findings was conducted. **Material and methods:** The examination involved 20 participants divided into four groups. Each group received a different type of suture material: silk, polyamide, polyglycolic acid and poliglecaprone 25. The examinations were conducted 10 days after the surgery and comprised two parts: clinical and microbiological evaluations. **Results:** The highest number of colony-forming units (CFUs/ml) was observed with silk suture materials, followed by a decline in the subsequent groups: polyglycolic acid, poliglecaprone 25 and polyamide. The soft tissue healing index showed the best results with polyamide and poliglecaprone 25, while the worst results were associated with polyglycolic acid and silk. **Conclusions:** Monofilament suturing materials demonstrated lower bacterial accumulation and superior clinical characteristics compared to multifilament materials. **Key words:** Suturing materials, inflammation, bacterial accumulation, periodontal surgery, implantology.

Апстракт

Вовед: Материјалот за сатура претставува синтетички материјал кој се користи со цел интимно прилепување на рабовите на раната се додека истите не бидат оспособени за самостојно прилепување со природни колагени влакна. Микробиолошката акумулација се разликува кај различни видови материјали за сатура во зависност од квалитетот и макроструктурата на материјалот. Идеалниот материјал за сатура треба да врши минимална ткивна повреда, да има резистенција кон бактериска контаминација и да подржува соодветна ткивна потпора. **Цел:** Цел на оваа студија е евалуација на микробиолошкиот наод и мекоткивното заздравување при користење на 4 типови на материјали за сатура кај различни пародонтално хирушки и имплантолошки интервенции. За реализација на целта е спроведена компаративна анализа на клиничкиот и микробиолошкиот наод. **Материјал и метод:** Испитувањето беше изведено на 20 испитаници поделени во 4 групи. Во секоја група беше користен различен тип материјал за сатура: свила, полиамид, полигликолна киселина и полиглекапрон 25. Испитувањата се изведуваа 10 дена постоперативно, а истите беа реализирани во 2 дела: клинички и микробиолошки. **Резултати:** Бројот на колонии (CFUs/ml) беше најголем кај свилениите сатурни материјали, последователно опаѓајќи кај следните групи: полигликолна киселина, полиглекапрон 25 и полиамид. Индексот на мекоткивно заздравување покажа најдобри резултати кај материјалите од полиамид и полиглекапрон 25, додека најлоши резултати беа добиени при употреба на материјалите од полигликолна киселина и свила. **Заклучоци:** Монофиламентните материјали за сатурирање покажаа помала бактериска акумулација и супериорни клинички карактеристики во споредба со мултифиламентните материјали. **Клучни зборови:** материјали за сатурирање, инфламација, бактериска акумулација, пародонтална хирургија, имплантологија.

Introduction

Suturing represents the final stage of a surgical intervention, serving a purpose of closely approximating wound edges, controlling bleeding and facilitating primary wound healing¹. The delayed healing of surgical wounds is a significant concern for both patients and healthcare professionals, often leading to complications such as wound infections and dehiscence, thereby prolonging the wound healing period and increasing treatment costs².

The ideal suture material should possess qualities such as high strength, knot stability, flexibility, ease of manipulation, minimal tissue reactivity and resistance to infections³. Commercially available suture materials are classified according to different criteria, including three-dimensional structure (monofilament, multifilament), tissue stability (resorbable, non-resorbable) and origin of the material (natural, synthetic)⁴. The selection of suture material for a surgical intervention depends on several factors, including the duration of wound healing tension during the healing process, and the temporary or the permanent need for suture in order to provide mechanical support⁵.

Suturing materials pose a potential risk factor for occurrence of wound infections in periodontal surgery, and their success depends on the achievement of primary wound healing and the absence of bacteria at the healing site^{6,7}. Generally, monofilament materials are more acceptable due to the latter's propensity to facilitate bacterial colonization in the spaces between the filaments. Natural suture materials differ from the synthetic ones in that they degrade (if resorbable, as catgut) through proteolysis, whereas synthetic materials degrade through hydrolysis. Proteolysis triggers a more pronounced inflammatory response than hydrolysis, leading to greater inflammation when natural sutures are used⁸.

Varma et al.⁹ demonstrated that a certain quantity of microorganisms is necessary to initiate an infection in a surgical wound. The bacterial accumulation alters and creates a hypoxic environment within and around the wound, thereby inhibiting the activity of fibroblasts and causing delayed healing¹⁰. Experimental and clinical data indicate that tissue reactions primarily occur around the suture material within the wound. Furthermore, the rate of infection in contaminated tissue containing sutures is significantly higher than in contaminated tissue from needle puncture alone, without the presence of suture material¹¹. Although suture materials provide strength during wound healing, they also serve as a gateway for bacteria, and increasing the host's susceptibility to infection by up to 10,000 times¹². Allergic reactions and reactions to the chemical structure of suture materials that

can hinder proper healing, have been reported¹¹. Singh¹³, emphasizes the importance of minimizing bacterial accumulation around the suture materials in order to prevent soft tissue dehiscence and exfoliation of the membrane in periodontal surgery. This reduction of postoperative bacterial accumulation is especially important when performing mucogingival surgery, because the greater the bacterial accumulation, the greater the postoperative gingival recession is, which leads to aesthetically unacceptable results.

Aim of the study

The aim of this study is to evaluate the microbiological finding and soft tissue healing using 4 different types of suture materials in different periodontal and implant surgical interventions. For the realization of this aim, a comparative analysis of the clinical and the microbiological findings was conducted.

Material and method

Our study involved 20 participants who were divided into four groups as follows:

- 1 group** - sutures with non-absorbable SILK - silk suture materials (Medipac, Gr);
- 2 group** - sutures with non-absorbable POLYAMID - nylon suture materials (Medipac, Gr);
- 3 group** - sutures with absorbable P.G.A - polyglycolic acid suture materials (Medipac, Gr);
- 4 group** - sutures with absorbable MONOFAST - poliglecaprone 25, polyglycolic acid copolymer with polycaprolactone suture materials (Medipac, Gr).

Each group consisted of five participants.

Inclusion criteria:

The study included patients who underwent periodontal surgery and implant interventions.

Patients aged 18 and above who provided consent to participate in the study by signing a consent form.

Exclusion criteria

Patients with systemic diseases (diabetes, immune compromise and cardiovascular disease),

Pregnant women and nursing mothers.

Standard surgical protocols, evaluated within the periodontal surgery and implantology were used. All suture materials had an equal thickness of 4.0. The sutures were removed 10 days postoperatively. The results were segmented into two aspects: clinical and microbiological.

Clinical evaluation:

For clinical evaluation, the soft tissue healing index was used, according to Landry et al.¹⁴ For evaluation of the healing the following parameters were used: the color of the tissue, the bleeding upon palpation, the presence of granulation tissue, the features of incision margin, and the presence of suppuration. According to this index, the healing was graded on a scale from 1 (very poor healing) to 5 (excellent healing).

Microbiological evaluation:

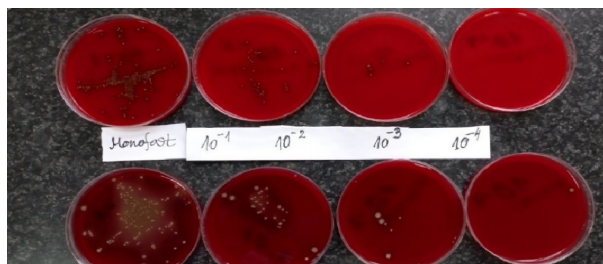
During the process of suture removal, 1 mm suture segments of the suture were transferred into sterile containers (Ependorf tubes) containing 1 ml of sterile glucose bouillon. The test tubes were then transported to the Institute of Microbiology and Parasitology at the Medical Faculty in Skopje.

Prior to planting, the specimens were vortexed for 10 seconds to ensure proper mixing. In the meantime, four test tubes containing 90 μ l of sterile saline solution were prepared for serial dilution, in which the bouillon with the sample was serially diluted. In the first test tube, 10 μ l of the sample were diluted, resulting in a 10 dilution. 10^{-1} . From the obtained dilution, another 10 μ l were transferred into the second test tube, and this process was repeated until a dilution of 10^{-4} μ l was obtained. 10 μ l of each tube were planted onto aerobic plates (Columbia agar) for the cultivation of Gram-positive and Gram-negative aerobic bacteria) and anaerobic plates (Schaedler agar) for cultivation of Gram-positive and Gram-negative anaerobic and facultative anaerobic bacteria. These plates were obtained from the company Oxoid, a manufacturer based in Great Britain.

Columbia agar plates were then incubated in a thermostat at 37° C for a duration of 24 hours. Schaedler

agar plates were placed in a separate pot containing AnaeroGen A (Oxoid UK) in order to create anaerobic conditions and were incubated for 48 hours.

At the completion of the incubation period, the number of colonies (CFU - colony forming units) was calculated from the bacteria that was diffused into the bouillon by vortexing of the suture materials.



Picture 1. Overview of the plates displaying the bacterial colonies formed on aerobic plates (top) and anaerobic plates (bottom), after the completion of the incubation period.

The number of colonies in the sample (CFU/ml) was calculated according to the following formula:

$$\text{CFU/ml} = \frac{\text{No. of colonies} \times \text{total dilution factor}}{\text{volume of culture plated in ml}}$$

Results and discussion

Tables 1 and 2 present the results obtained after the completion of the microbiological evaluation of the different types of suture materials. Table 1 displays the number of bacteria following the calculation of grown colonies (CFUs/ml) on Columbia agar plates. Table 2 shows the number of bacteria (CFUs/ml) on Schaedler agar plates.

Table 1. Number of colonies, grown on Columbia agar (CFUs/ml)

	Silk	Polyamide	Polyglycolic acid (P.G.A)	Poliglecaprone25 (Monofast)
1	8x10 ⁶ CFU/ml	5.5x10 ⁵ CFU/ml	8.3x10 ⁶ CFU/ml	3.9x10 ⁶ CFU/ml
2	4.5x10 ⁶ CFU/ml	9.7x10 ⁵ CFU/ml	4.2x10 ⁶ CFU/ml	4.5x10 ⁵ CFU/ml
3	9x10 ⁶ CFU/ml	4.3x10 ⁵ CFU/ml	4x10 ⁶ CFU/ml	7x10 ⁵ CFU/ml
4	7.7x10 ⁶ CFU/ml	4.8x10 ⁵ CFU/ml	2.8x10 ⁶ CFU/ml	4.8x10 ⁵ CFU/ml
5	10.2x10 ⁶ CFU/ml	6.8 x 10 ⁵ CFU/ml	5.5x10 ⁶ CFU/ml	4.3x10 ⁶ CFU/ml

Table 2. Number of colonies, grown on Schaedleragar (CFUs/ml)

	Silk	Polyamide	Polyglycolic acid (P.G.A)	Poliglecaprone 25 (Monofast)
1	9x10 ⁶ CFU/ml	3.2x10 ⁵ CFU/ml	4x10 ⁶ CFU/ml	3.8x10 ⁶ CFU/ml
2	6x10 ⁶ CFU/ml	6 x10 ⁵ CFU/ml	6.5x10 ⁶ CFU/ml	3.7x10 ⁵ CFU/ml
3	8x10 ⁶ CFU/ml	Poor growth 10 ⁻¹	5.5x10 ⁶ CFU/ml	3x10 ⁶ CFU/ml
4	11.5x10 ⁶ CFU/ml	5x10 ⁵ CFU/ml	3.3x10 ⁶ CFU/ml	4.8x10 ⁵ CFU/ml
5	9x10 ⁶ CFU/ml	6.2x10 ⁵ CFU/ml	3.5x10 ⁶ CFU/ml	3.3x10 ⁶ CFU/ml

All suture materials used in this study exhibited accumulated bacteria in every patient. In general, silk materials showed a higher number of colonies (CFUs/ml) compared to other materials. We assume that the obtained results are likely attributed to the quality of the materials and macro structure of the materials. The number of formed colonies (CFUs/ml) subsequently decreased in the following groups of materials: polyglycolic acid, poliglecaprone 25 and polyamide. Our in vivo results indicate that polyamide adheres the lowest number of bacteria and this is in correlation with previous studies on this matter.

Numerous authors have examined the bacterial accumulation around the suture materials in their studies. Asher et al.¹⁵ found out that the microbiological accumulation varied among different types of suture materials, depending on their quality and macrostructure. Similar results to ours were obtained in the study conducted by Yaltirik et al.¹⁶, which examined the colonization of various microorganisms on natural materials and noted that it was more signif-

icant in silk. Silk is a non-absorbable, multifilament and most commonly used natural suture material within the last 100 years¹⁷. Polyamide is the first synthetic suturing material and is characterized by minimal induction of cellular response and prolonged retention of suture hardness. Several studies have shown that polyamide suture gives the best biological results and the least inflammatory response^{18,19}. In today's market, a large number of synthetic resorbable suture materials with different designs are available to meet the requirements of modern surgery. Polyglycolic acid is a synthetic, resorbable, multifilament material. Some studies suggest that they are characterized by greater wound inflammation than resorbable monofilament materials²⁰. Poliglecaprone 25 is a monofilament suture and causes only a mild tissue reaction during absorption²¹.

Table 3 presents the results of the clinical evaluation of the soft tissue healing, using the soft tissue healing index according to Landry et al.¹⁴

Table 3. Evaluation of soft tissue healing

	Silk	Polyamide	Polyglycolic acid (P.G.A)	Poliglecaprone 25 (Monofast)
1	2	5	3	4
2	2	3	2	4
3	1	5	3	3
4	1	4	3	4
5	2	5	2	5

From the table we can see that the weakest healing occurs when silk is utilized as a suture material. On the other hand, significantly better results are observed with the use of polyglycolic acid, while the best results are achieved when employing poliglecaprone 25 and polyamide. These findings support previous studies that have demonstrated that silk causes a more intense inflammatory response and delayed healing compared to other healing materials. In contrast, tissue reactions are minimal when using polyamide and poliglecaprone 25 suture materials^{22,23}.

Conclusion

In conclusion, the results indicate that monofilament suture materials exhibit lower bacterial accumulation and promote better healing of the soft tissue compared to multifilament materials. Among the examined materials, the most favorable results were obtained with polyamide, while the most unfavorable results were obtained with silk as a suturing material.

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THE ASSOCIATION BETWEEN LIFESTYLE AND PERIODONTAL HEALTH

ПОВРЗАНОСТА ПОМЕГУ НАЧИНОТ НА ЖИВОТ И ПАРОДОНТАЛНОТО ЗДРАВЈЕ

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Abstract

Introduction: It is well known that microorganisms from dental plaque, immunological and genetic factors play a significant role in the etiology of periodontal disease. However, the influence of lifestyle and psychological factors as risk factors for periodontal disease is also mentioned in the literature. Periodontal disease is associated with cigarette smoking, alcohol consumption and physical activity. **Aim of the study:** To determine the relationship between lifestyle and periodontal health. **Material and methods:** A cross-sectional epidemiological study was conducted over a period of 3 months at the Clinic for Oral and Periodontal Diseases at UDCC „St. Panteleimon” in Skopje, as well as in three other private dental institutions. The study included 420 subjects who came for dental examination and treatment. A lifestyle questionnaire was administered to them, and the following clinical parameters were recorded: Loe and Silness index of gingival inflammation, Silness-Loe dental plaque index, Ramfjord index, depth of periodontal pockets; clinical attachment loss and number of extracted teeth. The collected data were statistically analyzed using Chi-square and Mann-Whitney U tests in SPSS Statistica 20 for Windows. A confidence interval (CI) $p < 0.05$ was considered significant. The results were tabulated. **Results:** We registered a statistically significant association between lifestyle and the Ramfjord index (Pearson Chi-square: 50.2193, $p = 0.000000$). During the study, we registered higher average values of the number of extracted teeth, dental plaque index, gingival inflammation index, depth of periodontal pockets, and the clinical attachment loss in subjects with unhealthy lifestyle compared to those with a healthy lifestyle. According to the Mann-Whitney U test, the observed difference was found to be statistically significant for $p < 0.05$. **Conclusion:** Lifestyle factors such as cigarette smoking, alcohol consumption, physical activity and diet type, play a significant role not only in the occurrence and progression of periodontal disease but also in the prognosis and treatment planning of this disease. **Key words:** lifestyle, alcohol, cigarettes, physical activity, periodontal health.

Апстракт

Вовед: Добро е познато дека микроорганизмите од денталниот плак, имунолошките и генетските фактори имаат значајна улога во етиологијата на пародонталната болест, но, сепак во литературата се споменува и влијанието на начинот на живот и на психичките фактори како фактори на ризик за пародонтална патологија. Пародонталната болест се поврзувана со пушењето на цигари, конзумирањето на алкохолни пијалоци и физичката активност. **Цел на трудот:** Да се утврди поврзаноста помеѓу начинот на живот и пародонталното здравје. **Материјал и методи:** На Клиниката за болести на устата и пародонтот при УСКЦ „Св. Пантелејмон” во Скопје, како и во други три приватни стоматолошки установи, беше спроведена епидемиолошка студија на пресек, во период од 3 месеци. Во студијата беа вклучени 420 испитаници кои доаѓаа за стоматолошки преглед и третман. Кај нив беше спроведен прашалник за начинот на живот и беа нотирани следниве клинички параметри: индекс на гингивална инфламација Лое и Силнес; индекс на дентален плак по Силнес-Лое; индекс на Рамфорд; длабочината на пародонталните џебови; клиничкиот губиток на припојот; бројот на екстрахирани заби. Колекционираните податоци беа статистички обработени во SPSS Statistica 20 for Windows, со користење на Хи-квадрат и Mann-Whitney U тестовите. За confidence interval (CI) беше земено $p < 0.05$. Резултатите беа прикажани табеларно. **Резултати:** Регистриравме статистички сигнификантна асоцијација помеѓу начинот на живот и индексот на Рамфорд (Pearson Chi-square: 50.2193, $p = 0.000000$). Во текот на истражувањето регистриравме повисоки просечни вредности на бројот на екстрахирани заби, на индексот на дентален плак, на индексот на гингивална инфламација, на длабочината на пародонталните џебови и на клиничкото губење на припојот, кај испитаниците кои имаат нездрав начин на живот во споредба со испитаниците кои имаат здрав начин на живот. Според Mann-Whitney U тест, разликата која се регистрира е статистички сигнификантна за $p < 0.05$. **Заклучок:** Начинот на живот, односно, пушењето на цигари, конзумирањето на алкохол, физичката активност и типот на исхрана, имаат значајна улога не само во настанувањето и прогресијата на пародонталната болест, туку и во прогнозата и планот на терапија на ова заболување. **Клучни зборови:** Начин на живот, алкохол, цигари, физичка активност, пародонтално здравје.

Introduction

Chronic periodontitis is an inflammatory disease affecting the supporting structure of the teeth. It is pri-

marily caused by bacteria present in the supragingival and subgingival biofilm. The bacterial products lead to the destruction of periodontal connective tissue and alveolar bone. If left untreated, this disease can result in

premature tooth loss for many individuals. Moreover, periodontal disease has long-term consequences on general health. The disease can be a risk for type 2 diabetes, certain metabolic syndromes, cardiovascular diseases, premature delivery and lower birth weight in infants.

The etiology of periodontal disease is multi factorial, with numerous risk factors associated with its development. In addition to inadequate oral hygiene, smoking, age, diabetes and socio-economic status of the individual have been indicated as potential risk factors for the initiation and progression of periodontal disease.

A large number of epidemiological studies¹⁻⁹ have highlighted the prevalence of periodontal diseases in a significant portion of the population. While it is well established that microorganisms from dental plaque, immunological and genetic factors play a significant role in the etiology of periodontal disease, these studies also emphasize the influence of lifestyle and psychological factors as risk factors for periodontal disease¹⁰. Research has shown an association between periodontal disease and cigarette smoking, consumption of alcoholic beverages, and physical activity¹¹.

The association between a healthy lifestyle and overall health has been emphasized in several studies¹²⁻¹⁶. These studies have shown that individuals who maintain a healthy lifestyle experience fewer issues with their teeth and gums compared to individuals who lead an unhealthy lifestyle. Rupasree and Vijay¹⁷ demonstrated a positive correlation between lifestyle and periodontal condition in their study. Similar results were obtained by Rajala et al.¹¹, indicating a positive association between dental health and healthy lifestyle indicators. Individuals with an unhealthy lifestyle have a poorer condition of their periodontal tissues due to lack of regular tooth brushing and the detrimental effects of smoking, which is a very common habit among them. According to Revicki et al.¹⁸, smokers can be considered as leading an unhealthy lifestyle. Therefore, the association between smoking and periodontal disease is not solely attributed to poorer oral hygiene in smokers, but also to their overall unhealthy lifestyle.

In neighboring countries, Pejic et al.¹⁹ conducted a study indicating a higher prevalence of periodontal disease among individuals with higher body weight. Their findings suggest that lifestyle factors influence the condition of the periodontium. Specifically, patients with periodontal disease had elevated lipoprotein concentrations, engaged in less physical activity, and had lower socio-economic status.

Considering the literature indicating the influence of lifestyle on periodontal health, the aim of our research was to determine the relationship between lifestyle and periodontal health.

Materials and method

To achieve the set objective, an epidemiological cross-sectional study was conducted at the Clinic for Oral and Periodontal Diseases at UDCC „St. Panteleimon“ in Skopje, as well as in three other private dental institutions located in the neighborhoods of Chair and Shuto Orizari. The study was conducted over a period of 3 months, specifically - March, April and May, 2013. The study included patients who visited the Clinic and private dental facilities for examination and treatment. Patients of both sexes, regardless of their current periodontal status, were included in the study. The patients were randomly selected, and their informed consent was obtained for participation in the study. The following criteria had to be met for patients to be included in the research:

- The patients had to be over 35 years of age;
- The patients had to have more than 15 teeth present in their mouth;

For all patients the following procedures were performed:

1. A survey was conducted¹⁷, consisting of questions related to lifestyle. Based on their responses, the patients were divided into two categories: patients who lead a healthy lifestyle and patients who do not lead a healthy lifestyle.
2. The following indices were determined, including the Silness-Loe dental plaque index²⁰, the Loe and Silness gingival inflammation index²¹, and the Ramfjord index²².
3. Measurements of periodontal pocket depth and attachment loss were taken on the Ramfjord's group of teeth (16, 21, 24, 36, 41, 44) using a graduated periodontal probe.
4. The number of extracted teeth was recorded.

The collected data were statistically analyzed using Statistica 20 for Windows. The statistical tests employed for analysis included the Chi-square and Mann-Whitney U tests. A confidence interval (CI) of $p < 0.05$ was considered significant. The results of the analysis were tabulated.

Results

A total of 420 respondents participated in the study. Among them, 48.8% were male, and 51.2% were female (Table 1). The percentage difference between the sexes was not found to be statistically significant for $p > 0.05$, indicating that the study population was homogeneous in terms of gender.

Table 1. Distribution of respondents by gender

Sex	Number of respondents	%
Male	205	48.8
Female	215	51.2
Total	420	100.0

Table 2. Presentation of average age of the respondents in total, by gender and by age

Age	Number of respondents	Average	Min.	Max.	St.Dev.
Total	420	53.5	35.0	77.0	11.5
Male	205	53.2	35.0	77.0	11.9
Female	215	53.7	35.0	75.0	11.0

The average age of the respondents is 53.5 ± 11.5 years. The difference registered in the average age between male and female gender was not found to be statistically not significant for $p > 0.05$ (Table 2).

Table 3. Distribution of respondents by smoking status

Smoking status	Number of respondents	%
Smoker	130	30.9
Non-smoker	290	69.1
Total	420	100.0

Table 3 shows the distribution of respondents according to smoking status. 69% of respondents are non-smokers and 31% are smokers.

Table 4. Distribution of respondents by alcohol consumption

Alcohol	Number of respondents	%
Heavy consumer	20	4.8
Moderate	118	28.1
Non-consumer	282	67.1
Total	420	100.0

67% of the respondents reported not consuming alcohol, while 28% were moderate consumers, consuming less than 7 drinks per week. Additionally, 5% of the respondents were classified as heavy consumers of alcohol, consuming more than 7 drinks per week (Table 4).

Table 5. Distribution of respondents by lifestyle

Lifestyle	Number of respondents	%
Unhealthy	223	53.1
Healthy	197	46.9
Total	420	100.0

According to respondents' answers to questions regarding their lifestyle, it was found that 53% of them reported living unhealthy lifestyles, while 47% reported living healthy lifestyles (Table 5).

Table 6. Distribution of respondents by lifestyle and Ramfjord index

Ramfjord	Unhealthy	Healthy	Total
1	4	2	6
2	3	19	22
3	0	7	7
4	65	85	150
5	132	84	216
6	19	0	19
Total	223	197	420

A statistically significant association was observed between Ramfjord's index and lifestyle (Pearson Chi-square: 50.2193, $p = 0.000000$).

Table 7 shows the average values of dental plaque, gingival inflammation, periodontal pocket depth, clinical attachment loss and the number of extracted teeth in relation to lifestyle.

During the research, higher average values were recorded for the number of extracted teeth, the dental plaque index, the gingival inflammation index, the depth of periodontal pockets and the clinical attachment loss in subjects with an unhealthy lifestyle compared to those with a healthy lifestyle (Table 7). According to the

Table 7. Presentation of the average values of dental plaque, gingival inflammation, periodontal pocket depth, clinical attachment loss and number of extracted teeth in relation to lifestyle

Lifestyle/ Dental plaque	Average	Number of respondents	St.Dev.	Min.	Max.
Unhealthy	1.9	223	0.463521	1.0	3.0
Healthy	1.6	197	0.360432	1.0	2.6
Gingival inflammation					
Unhealthy	2.1	223	0.489736	1.0	3.0
Healthy	1.7	197	0.348014	1.1	2.5
Periodontal pocket depth					
Unhealthy	3.0	223	1.068049	1.4	8.0
Healthy	2.4	197	0.608216	1.5	4.16
Clinical attachment loss					
Unhealthy	4.1	223	1.586144	0.0	7.1
Healthy	3.0	197	1.628562	0.0	5.5
Number of extracted teeth					
Unhealthy	6.6	223	3.885881	0.0	14.
Healthy	3.8	197	3.162867	0.0	13.0

Table 8. Mann-Whitney U test plot between lifestyle and dental plaque, gingival inflammation, periodontal pocket depth, clinical attachment loss and number of extracted teeth

	Rank Sum	Rank Sum	U	Z	p-level
Dental plaque	32189.50	56220.50	12686.50	-7.47421	0.000000
Gingival inflammation	32024.50	56385.50	12521.50	-7.60712	0.000000
Periodontal pocket depth	32984.50	55425.50	13481.50	-6.83384	0.000000
Clinical attachment loss	33494.00	54916.00	13991.00	-6.42344	0.000000
Number of extracted teeth	32514.00	55896.00	13011.00	-7.21282	0.000000

Mann-Whitney U test, the difference registered between the two groups was found to be statistically significant for $p < 0.05$ (Table 8).

Discussion

The term "lifestyle" is used to describe the conditions in which people live, their habits as well as their patterns (models) of behavior that are related to by the socio-cultural characteristics of the individual's living environment.

An individual's lifestyle can be characterized as a pattern that is beneficial or harmful to health. Numerous studies, including the study of Wiley et al.¹² have confirmed the positive correlation between a healthy lifestyle and overall health, including dental health. It has also been confirmed that people who lead an active, healthy lifestyle have fewer problems with teeth and gingival/periodontal diseases.

Our research included a total of 420 subjects, with, 48.8% being male, and 51.2% female (Table 1). The difference in percentages between the sexes is statistically insignificant for $p>0.05$. The average age of the respondents was 53.5 ± 11.5 years. The difference that was registered in the average age between male and female gender is statistically insignificant for $p>0.05$ (Table 2). The absence of a significant difference between the gender and age of the respondents included in this study indicates that it is a homogeneous group.

In addition to alcohol consumption and cigarette smoking, nutrition and physical activity also play a role in an individual's lifestyle. Therefore, it is essential to include questions about diet and physical activity to determine whether an individual leads a healthy or unhealthy lifestyle. We believe that these factors influenced the results regarding the lifestyle of our respondents. Despite of the relatively low percentage of consumers of cigarettes (31%), and alcohol consumers (5%), the percentage of individuals with an unhealthy lifestyle is higher, amounting to 53% (Table 3, 4 and 5).

In order to assess the lifestyle of our respondents, a survey questionnaire was conducted in which, apart from smoking and alcohol, questions related to nutrition and physical activity were also included. By assigning appropriate cores to these parameters, a cumulative score was calculated to assess whether a particular respondent leads a healthy or unhealthy lifestyle. Our findings revealed a statistically significant association between lifestyle (unhealthy and healthy) and the Ramfjord index (Pearson Chi-square: 50.2193, $p=0.000000$).

Among respondents with an unhealthy lifestyle, 67.7% exhibited Ramfjord index values of 5 and 6, indicating a distance over 3mm from the enamel-cement junction to the bottom of the periodontal pocket. From the group of respondents who have a healthy lifestyle, 42.6% have an index value according to Ramfjord 5 (distance from the enamel-cement junction to the bottom of the periodontal pocket over 3mm). In contrast, among those respondents with a healthy lifestyle, we did not register a single respondent with the highest Ramfjord index value (Table 6). The percentage difference registered between respondents with Ramfjord index values 5 and 6, who had a healthy lifestyle, compared to respondents with the same Ramfjord index values who have an unhealthy lifestyle, was statistically significant for $p=0.0000$.

Table 7 provides the average values of dental plaque, gingival inflammation, periodontal pocket depth, clinical attachment loss and the number of extracted teeth in relation to lifestyle. Our study revealed significantly higher average values for the number of extracted teeth, dental plaque index, gingival inflammation index, the depth of

periodontal pockets and the clinical attachment loss among subjects with an unhealthy lifestyle compared to subjects with a healthy lifestyle. According to the Mann-Whitney U test, the difference registered is statistically significant for $p<0.05$ (Table 8).

Our findings are consistent with the findings of Rupasree¹⁷, Revicki¹⁸ and Rajala¹¹. The authors' research has confirmed an association between bad habits, unhealthy lifestyle and poorer periodontal health. In our study, we confirmed the association between alcohol and cigarette consumption and periodontal status. The detrimental effects of smoking on the periodontium have been extensively discussed. Individuals who consume a large amount of alcohol and cigarettes not only experience the direct harmful effects of these habits but also tend to have poorer oral hygiene habits. Consequently, a greater amount of bacterial bio film accumulates on the surface of the teeth. Furthermore, lifestyle choices, including dietary habits, play a significant role. Individuals who consume softer and less abrasive foods, tend to have higher amounts of dental plaque. On the other hand, the composition of the ingested nutrients also has an impact on periodontal health. If a sufficient amount of natural minerals and vitamins, which possess an antioxidant effect, is not included in the diet, it can negatively affect the reparative and regenerative processes of periodontal tissues. The harmful effects of free radicals in the pathogenesis of periodontal disease have been well-established. Based on our findings, we believe that the worse poorer clinical characteristics of periodontal disease in our respondents with an unhealthy lifestyle are due to the harmful effects of smoking and alcohol consumption, as well as the insufficient intake of natural antioxidants through the diet. Physical activity is inversely associated with periodontal disease in cross-sectional²³⁻²⁷ and prospective studies²⁸. Physical activity has been hypothesized to affect periodontal health by increasing insulin sensitivity^{24,27,28} reducing inflammation²⁹, and reducing obesity^{24,29}. Finally, physical activity could reduce stress which has also been associated with a higher prevalence of periodontitis^{23,30}.

Conclusion

The statistically significant higher representation of respondents with Ramfjord index values of 5 and 6 among respondents who have an unhealthy lifestyle, as well as the statistically significantly higher average values of the other parameters (number of extracted teeth, dental plaque index, gingival inflammation index, depth of periodontal pocket and clinical attachment loss) in subjects, indicate the influence of lifestyle on periodontal health.

Specifically, based on the data from the literature and the results of our research, we can conclude that the lifestyle factors, namely, cigarette smoking, alcohol consumption, physical activity and diet type, have a significant role not only in the occurrence and progression of periodontal disease but also in the prognosis and treatment planning for this disease.

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DETERMINATION OF THE STRUCTURE OF THE DECAYED, MISSING AND FILLINGS OF THE TEETH INDEX FOR THE FIRST PERMANENT MOLARS AT TWELVE-YEAR-OLD CHILDREN IN THE POLOG REGION

ОДРЕДУВАЊЕ НА СТРУКТУРАТА НА ИНДЕКСОТ НА КАРИЕС, ЕКСТРАКЦИИ И ПЛОМБИ НА ПРВИТЕ ТРАЈНИ МОЛАРИ НА ДВАНАЕСЕТ ГОДИШНИ ДЕЦА ВО ПОЛОШКИОТ РЕГИОН

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Abstract

Aim: The aim of this study is to evaluate the condition of the first permanent molars and determine the prevalence of caries, extraction and fillings in these molars in the Polog region. **Materials and method:** A total of 2736, 12-year-old children from the municipalities of Tetovo and Gostivar were included in the examination. The dental status of the children was systematically assessed through comprehensive examinations. **Results:** The prevalence of dental caries in the first permanent molars among the examined children in Tetovo and Gostivar municipalities, was found to be 39.4%. Specifically, carious lesions were observed in 19.35% of children in Tetovo, and 18.68% of children in Gostivar. The percentage of extracted teeth, as indicated by the DMF - index for the first permanent molars, was 1.33%, in Tetovo and 1.14% in Gostivar. **Discussion:** the obtained results showed no statistically significant difference in the DMF-index structure between the municipalities of Tetovo and Gostivar. However, a significant difference was observed in relation to caries, with girls demonstrating greater attention to oral hygiene. **Conclusion:** Urgent implementation of enhanced preventive measures and procedures outlined in the National Strategy for improving the oral health in the Republic of North Macedonia is necessary. **Key words:** dental caries, first permanent molar, structure of the DMF-index, oral health, preventive measures.

Апстракт

Цел: Целта на оваа студија е да се провери состојбата на првите трајни молари и преваленцата на кариес, екстракција и пломби на првите перманентни молари во Полошкиот регион. **Материјал и метод:** Вкупно 2736, 12 годишни деца од општините Тетово и Гостивар беа испитувани. Истражувањето беше спроведено на терен во школските амбуланти и училиници, преку систематски прегледи кај деца за проценка на денталниот статус. **Резултати:** Преваленцата на денталниот кариес на првите трајни молари во општините Тетово и Гостивар, изнесува 39.4%. Процентот на застапеност на кариозни лезии на заби во градот Тетово изнесува 19.35%, во градот Гостивар е нешто понизок и изнесува 18.68%. Процентот на екстрахирани заби претставени со КЕП-индексот за првите трајни молари кај испитаниците од Тетово изнесува 1.33%, а кај испитаниците во Гостивар изнесува 1.14%. **Дискусија:** Од добиените резултати се согледува дека не постои статистички сигнификантна разлика на структурата на КЕП-индексот во однос на општините Тетово и Гостивар. Беше утврдена статистички сигнификантна разлика на структурата на КЕП-индексот по пол, во однос на кариес, каде девојчињата посветувале поголемо внимание на оралната хигиена. **Заклучок:** Потребно е ургентно преземање на засилени превентивни мерки и постапки на компоненти од Националната стратегија за подобрување на оралното здравје во Република Северна Македонија. **Клучни зборови:** дентален кариес, прв траен молар, структура на КЕП-индекс, орално здравје, превентивни мерки.

Introduction

The first permanent molars hold great significance in over all oral health as they are considered the most important teeth in the permanent dentition. Their speci-

fications require special attention due to their role in occlusion, articulation and mastication. These molars typically erupt around the age of six, marking the beginning of the period of the mixed dentition^{1,2}. Their proper positioning is of crucial significance for the subsequent

development of occlusion. Concurrently, as these molars erupt, there is a vertical growth of the alveolar ridge, resulting in the elevation of the bite and a secondary physiological change.

The first permanent molars play a vital role in occlusion^{3,4} and are crucial for the proper development of orofacial functions, particularly mastication. These teeth have an important role in the intercuspitation and the alignment with other teeth. The premature loss of these molars can lead to adjacent teeth tilting and angulation towards the empty space, potentially causing orthodontic malocclusion. Extensive research in the literature⁵ shows that the first permanent molars facilitate the correct alignment of the other permanent teeth, ensuring the proper length of the dental arch, bite height, intercuspitation, of the teeth, masticatory function, and the stability of occlusion. Given their pivotal role in occlusion, it is essential to retain these teeth within the oral cavity to prevent dental morbidity and to carry out preventive and therapeutic procedures by dental professionals. Dentists should prioritize the prevention of caries of these teeth and, when necessary, provide conservative treatments.

The statements above highlight the significant role of the permanent molars in intercuspitation of the teeth. These molars are characterized by their large mesio-distal chewing surfaces and are subjected to the highest masticatory pressure. Chronologically, they erupt before the other permanent teeth and, along with deciduous teeth contribute to chewing function. The occurrence of caries, indicated by the formation of cavities, disrupts the balance between the factors that influence the process of remineralization and demineralization of enamel in the oral cavity. Caries is caused by the presence of oral bacterial flora as well as other factors such as tooth structure and saliva. Recent studies⁶ reveal a consistent reduction in caries prevalence in developed countries due to robust health education initiatives focused on improving the hygiene practices, dietary habits, reducing pure sucrose and sugar consumption, and preventive programs.

Preventing caries involves implementing measures such as maintaining proper oral hygiene practices and receiving fluoride treatments. Indices that describe the prevalence of caries and periodontal disease are commonly used to describe the proper oral status of populations. One important index-parameter that is introduced for identification of certain subjects and groups with appropriate involvement of caries or decay is the decay, missing teeth and fillings on the teeth index (DMF-index)⁷ and its structure is a relevant indicator of the oral health and reflects the socioeconomic status of a population^{8,9}. However, countries undergoing development in Europe are still coping with a high prevalence of dental caries (cavities), particularly among school-aged children.

The first permanent molars are particularly susceptible to caries. When these teeth erupt, they are exposed to an environment that is contaminated with different microorganisms, especially those from carious deciduous teeth. During this period, the enamel is immature and has a porous crystal structure, making it prone to rapid occurrence of caries. The teeth have pronounced tubercles, deep fissures and difficult-to-reach areas that hinder cleaning and self-cleaning. Additionally, the tooth crown remains covered by the gingiva for a long time, allowing food retention. Being the first permanent teeth to emerge, they are exposed to harmful environmental factors and their position behind the similar looking second deciduous molars often leads parents to overlook them or mistake them for deciduous teeth that will be replaced.

According to the research conducted in the city of Prilep¹⁰, in 2015, among 6-year-old school-aged children in both urban and rural areas, the prevalence of dental caries in the examined group was 58.66%. In an urban environment the risk was 52.29%, and in a rural environment it was slightly higher by about 5%. The first permanent molar had the highest caries prevalence among all remaining teeth in the permanent dentition from 40% to 60%. Furthermore, more than 50% of children over the age of 11 had some form of caries, regardless of whether it was superficial, intermediate or complicated¹¹.

According to the American Dental Association¹², the oral health encompasses functional, structural, aesthetic, physiological and psycho-social well-being, and it significantly influences the general state of health and quality of life of each individual. The World Health Organization (WHO) and the World Dental Association (FDI) have established average values for the structure of the DMF-index in 12-year-old children, characterized as follows: too low 0.0-1.1; low 1.2-2.6; medium 2.7-4.4; high 4.5-6.5 and too high > 6.5.¹³

Aim of the study

The aim of this study is to evaluate the condition of the first permanent molars, determine the prevalence of decay, missing teeth and fillings and analyze the structure of the DMF-index among male and female participants (school pupils) in the municipalities of Tetovo and Gostivar, located in the Polog region.

Materials and method

To achieve the objective of this study, dental examinations were carried out on a total of 2.736 sixth grade students at the age of 12, including 1.449 male and 1.287 female pupils from the Polog region. A total of 1.838 children were examined from the municipality of

Tetovo, comprising 955 boys and 883 girls, while 494 boys and 404 girls were examined from the municipality of Gostivar. The research was conducted and realized between September 2017 and May 2018. The examinations took place at the PHI "Health Center" in Tetovo and the PHI "Health Center" in Gostivar, as well as in school clinics and classrooms. A systematic approach was followed to assess the dental status of the children.

These examinations were carried out in accordance with criteria set by the WHO, using a recommended dental chart for marking. The pupils were examined with appropriate instruments (probe and dental mirror). Sixth-grade students at the age of twelve were selected, as it corresponds to the eruption of all permanent teeth, with the exception of the third molars. This age is also determined as the age of global caries monitoring, as well as international monitoring of dental caries trends.

All the examined children were found to be in good health condition. Based on the obtained data, the structure of the DMF-index for the first permanent molars was calculated for every examinee, using the Klein-Palmer system. The structure of the DMF-index represents the sum of the total number of Decayed (carious), total number of Missing (extracted) and total number of teeth with Fillings. Carious teeth are defined as those in which the probe falls and there is a visible cavity or cavitation on the tooth surface. The structure of the DMF-index for the first permanent molars represents the average number of affected first permanent molars per pupil.

Results

This study included a total of 2.736 examinees, who were 12-year-old children from the municipalities of Tetovo and Gostivar in the years 2017 and 2018. Out of the total number of examinees, data was obtained for

1.448 male children (52.96%) and 1.287 female children (47.03%). Regarding the distribution according to the living environment, 1.838 (67.17%) of the respondents were from Tetovo, and 898 (32.82%) were from Gostivar (table 1).

The structure of the DMF-index shows the risk of the occurrence of a disease of the hard dental tissues, dental caries, within a certain population, as shown in Table 2. The value of this indicator is calculated by dividing the number of examinees with a structure of the DMF-index value greater than zero (indicating the presence of dental disease) by the total number of examinees. It was shown that the structure of the DMF-index especially for the first permanent molars when the whole studied group is considered is 39.4%. In Tetovo, the risk is 38.01%, while in Gostivar it is slightly higher, with an increase of approximately 4%.

In terms of gender, female examinees exhibit a higher risk, with a prevalence of 40.16%, compared to male examinees, where the risk of occurrence of dental diseases is 39.07%. In addition, within the municipality of Tetovo, the risk is higher for female examinees (38.69%) in comparison to male examinees (36.86%), while in Gostivar, the risk for the occurrence of the disease is 43%, which is almost equal for both genders. The female gender in the city of Gostivar (43.3%) shows a slightly higher risk compared to Tetovo and in relation to the overall risk for this gender.

The statistical analysis of the data did not reveal a significant difference in the value of the structure of the DMF-index between the children from Tetovo and Gostivar ($p < 0.50$).

The composition of the structure of the DMF-index can be clearly observed in Table 2.

Similarly, the analysis of the research did not indicate a significantly different structure of the DMF-index

Table 1. A distribution of examinees categorized by gender and municipalities

	Gender			Municipalities		
	Male	Female	Total	Tetovo	Gostivar	Total
Frequency	1449	1287	2736	1838	898	2736
Percentage %	52.96	47.03	100	67.17	32.82	100

Table 2. A presentation of the index of caries, extractions and fillings

Municipality	Decayed teeth	Missing teeth	Filled teeth	Sealed teeth
Gostivar %	18.68	1.14	23.29	56.8
Tetovo %	19.35	1.33	17.21	61.11
Total %	19.13	1.27	19.27	60.33

Table 3. A presentation of the index of caries, extractions and fillings (DMF-index) for first permanent molar with respect to gender

Gender	Decayed teeth	Missing teeth	Filled teeth	DMF-index
Male	0.78	0.04	0.73	1.55
Female	0.74	0.04	0.81	1.59

Table 4. An analysis of descriptive statistics and an independent samples t-test to compare genders

	Gender	N	Mean value	t-test	Significance
Decayed teeth	male	1449	0.78	0.981	0.604
Decayed teeth	female	1287	0.74		
Missing teeth	male	1449	0.04	0.211	0.807
Missing teeth	female	1287	0.04		
Filled teeth	male	1449	0.73	2.523	0.012*
Filled teeth	female	1287	0.81		
DMF-index	male	1449	1.55	0.275	0.608
DMF-index	female	1287	1.59		

*significant at $p < 0.05$; ** significant at $p < 0.005$; *** significant at $p < 0.001$
not significant at $p > 0.05$

Table 5. A presentation of the DMF-index for first permanent molars specifically for the municipalities of Tetovo and Gostivar

	Decayed teeth	Missing teeth	Filled teeth	DMF-index
Tetovo	0.78	0.05	0.68	1.51
Gostivar	0.70	0.04	0.94	1.68

Table 6. A descriptive analysis and an independent samples t-test comparing the municipalities of Tetovo and Gostivar

Tetovo and Gostivar	Localization	N	Mean value	t-test	Significance
Decayed teeth	Tetovo	1843	0.78	0.445	0.651
Decayed teeth	Gostivar	892	0.70		
Missing teeth	Tetovo	1843	0.05	0.138	0.807
Missing teeth	Gostivar	892	0.04		
Filled teeth	Tetovo	1843	0.68	1.021	0.316
Filled teeth	Gostivar	892	0.94		
DMF-index	Tetovo	1843	1.51	0.996	0.324
DMF-index	Gostivar	892	1.68		

*significant at $p < 0.05$; ** significant at $p < 0.005$; *** significant at $p < 0.001$
not significant at $p > 0.05$

Table 7. A presentation of the DMF-index for the first permanent molars in male children in the municipalities of Tetovo and Gostivar

	Decayed teeth	Missing teeth	Filled teeth	DMF-index
Tetovo	0.76	0.04	0.66	1.46
Gostivar	0.81	0.05	0.86	1.72

Table 8. A descriptive analysis and an independent samples t-test conducted to compare examinees from the male gender between the municipalities of Tetovo and Gostivar

Tetovo and Gostivar	Localization	N	Mean value	t-test	Significance
Decayed teeth	Tetovo	960	0.76	0.494	0.622
Decayed teeth	Gostivar	488	0.81		
Missing teeth	Tetovo	960	0.04	0.238	0.812
Missing teeth	Gostivar	488	0.05		
Filled teeth	Tetovo	960	0.66	0.307	0.759
Filled teeth	Gostivar	488	0.86		
DMF-index	Tetovo	960	2.54	0.689	0.491
DMF-index	Gostivar	488	2.28		

*significant at $p < 0.05$; ** significant at $p < 0.005$; *** significant at $p < 0.001$
not significant at $p > 0.05$

Table 9. A presentation of the DMF-index for the first permanent molars in female children in the municipalities of Tetovo and Gostivar

	Decayed teeth	Missing teeth	Filled teeth	DMF - index
Tetovo	0.77	0.05	0.71	1.53
Gostivar	0.67	0.02	1.03	1.72

Table 10. A descriptive analysis and an independent samples t-test comparing the examinees from the female gender between the municipalities of Tetovo and Gostivar

Tetovo and Gostivar	Localization	N	Mean value	t-test	Significance
Decayed teeth	Tetovo	883	0.77	1.021	0.093
Decayed teeth	Gostivar	404	0.67		
Missing teeth	Tetovo	883	0.05	0.205	0.838
Missing teeth	Gostivar	404	0.02		
Filled teeth	Tetovo	883	0.71	0.500	0.617
Filled teeth	Gostivar	404	1.03		
DMF-index	Tetovo	883	1.53	0.598	0.550
DMF-index	Gostivar	404	1.72		

*significant at $p < 0.05$; ** significant at $p < 0.005$; *** significant at $p < 0.001$
not significant at $p > 0.05$

between male and female pupils, as evidenced by the Person Chi-square value of 0.50 and $p > 0.47$.

Table 3 and 4 present the results of the analysis between the pupils' genders, irrespective of the place of residence. The average values of carious, extracted and filled first permanent molars, representing the DMF-index in the male gender were 0.78; 0.04; 0.73 and 1.55, respectively. It was observed that the highest average value in the male examinees refers to the number of carious teeth compared to the average number of extracted teeth and filled teeth. The female gender is characterized by the following average values: carious teeth 0.74,

extracted teeth 0.04, filled teeth 0.81 and a DMF-index structure of 1.59 (Table 3).

The results of the data analysis and comparative statistics based on the place of residence are presented in Table 5 and 6. The average values for carious, extracted and filled teeth, in the first permanent molars, among the examinees from the city of Tetovo were 0.78, 0.05, and 0.68, respectively. The DMF-index value was 1.51, and the average number of sealed or healthy fissures was 2.49. In the city of Gostivar, the average values for carious teeth were 0.70, for extracted teeth were 0.04, for filled teeth were 0.94. The structure of the DMF-index

was 1.68 and for the sealed-healthy teeth was 2.32. It has been observed that the highest average value among examinees from the municipality of Tetovo and the municipality of Gostivar refers to the number of filled teeth compared to the average number of carious and extracted teeth.

Table 7 represents the structure of the DMF-index for male pupils, which is 1.46 in the municipality of Tetovo, and 1.72 in the municipality of Gostivar.

Descriptive analysis and the t-test for independent samples were used to compare the examinees from male gender between the municipalities of Tetovo and Gostivar (Table 8).

The t-test results did not represent statistical significance.

The DMF-index in female pupils was 1.53 in the municipality of Tetovo, and 0.67 in the municipality of Gostivar, as shown in Table 9.

Similarly, the descriptive analysis and the t-test for independent samples for comparison between examinees from the female gender between the municipalities of Tetovo and Gostivar, did not yield statistically significant results (Table 10).

Discussion

Based on the results obtained, we can discuss several aspects of the structures of the DMF-index. Firstly Table 1 illustrates its distribution by municipalities, namely Tetovo and Gostivar, as well as by gender of the pupils. The total number of examinees in both municipalities was 2.736.

This study provides insights into the dental health of the examinees throughout the values of the DMF-index on their first permanent molars. The analysis indicates that there was no statistical significance in the structure of the DMF-index between the examinees from Tetovo and Gostivar municipalities. The structure of the DMF-index is 43.2% in Gostivar and 37.9% in Tetovo municipality, respectively.

There are significant differences in the measured indices among other similar studies conducted in different states. For instance, in the surveys conducted between 1991 and 1995, the mean value of the DMF-index of the deciduous dentition in children aged 5-7 years ranged between 0.9 and 8.5¹⁴ in Spain (DMF-index 1.0), and in Denmark (DMF-index 1.3). National mean values of the structure of the DMF-index below 2.0 were also reported in Finland, the Netherlands and Norway. Ireland had the lowest value of the structure of the DMF-index of 0.9¹⁴. These findings highlight the disparity between our study and those conducted in developed

countries. Developed countries place significant emphasis on prevention, resulting in lower DMF-index values, low, whereas our study reflects a higher DMF-index values. We need to take inspiration from countries like Finland, the Netherlands and Norway to improve dental and systemic health among our children.

When considering gender differences among children, a notable disparity is observed in the number of teeth with fillings. As shown in Table 3, the male pupils have an average of 0.73 fillings, while female pupils have an average of 0.81 fillings. Our study also revealed that female pupils expressed a more stringent attitude towards visiting the dental office. This observation is further supported by the results in Table 4, where the descriptive analysis and the t-test were analyzed for independent samples for comparison between genders. The p value of 0.012 indicates a great significance in favor of the female gender.

Hua Xi, Kou Qiang¹⁵ et al. conducted a study to investigate the prevalence of caries of the first permanent molar among 7-9 year-old children in Tangshan city. They found that the prevalence rate of caries in the first permanent molar was 47.49% with a mean value of the structure of the DMF index of 1.30 ± 1.59 , while the rate of teeth with fillings was only 2.35%. The prevalence rate and the mean value of the structure of the DMF index of the first permanent molars showed significant difference between children's ages and their gender ($p < 0.05$), which aligns with our study.

Furthermore, our analysis and the conducted student t-test, showed that the average values of all investigated parameters between the examinees in the municipalities of Tetovo and Gostivar did not differ significantly, as presented in Table 5 and 6.

Many therapists try to find comparison between different groups for the prevalence of caries. Maltz M. et al.¹⁶ conducted a study aimed at determining the relationship between socio-economic status, caries, gingivitis and fluorosis among school-aged children in Brazil. The study included 1000, 12-year-old pupils from both private and public schools, and the structure of the DMF-index was calculated. The socio-economic status was determined according to the family income and educational level of the parents. No association was found between the prevalence of caries, gingivitis and fluorosis in this study. However, there were notable differences in the structure of the DMF-index between children in private and public schools. The structure of the DMF index for children in private schools was 1.54 ± 2.02 , while for children in public schools it was 2.48 ± 2.51 . The prevalence of fluorosis was 60.8% and 49.9% respectively, in accordance with the previous results.

These results were statistically significant ($p < 0.05$). Carious surfaces were observed in a larger number of participants in this research from public schools.

Waltimo et al.¹⁷ in 2011 followed the frequency of caries in children from Basel-Landschaft Canton, Switzerland, aged 7, 12 and 15 years, over a 20-year period from 1992 to 2011. During this research, they determined that the overall caries frequency decreased from 1992 to 2006 but increased later again. In 2011, the average structure of the DMF-index was 0.83, while 63% of the children were caries-free.

Davidović et al.¹⁸ conducted a study to determine the dental health of children aged 12 and 15 living in the cities of Foča, Čajnice and Kalinovik in Bosnia and Herzegovina. A total of 506 students were included in the research and the following results were obtained: the DMF-index was 6.17, and caries (decay) was registered in 96.05% of the examined children. The prevalence rate of the decay-index was 23.04%. These findings are very similar to our study. To compare the data, we analyzed the structure of the DMF-index with localization in Tetovo and Gostivar in Tables 7 and 8 in order to compare them with the data from Table 9 and 10.

First, we divided the decayed teeth, the missing teeth and the filled teeth among the pupils from male gender in the municipalities of Tetovo and Gostivar. We then conducted the statistical analysis with usage of the descriptive analysis, t-test, mean value and test of significance.

The same statistical operations were performed for the pupils of female gender. This enabled us to discuss several aspects of the structure of the DMF-index for the first permanent molars.

Although there were differences observed in certain parameters when analyzing the overall data between genders, regardless of the city they come from, the statistical analysis of the values among the male gender examinees, considering the place of residence, and among the female gender examinees, did not show significant differences ($p > 0.05$) (tables 7, 8, 9 and 10). However, it is worth noting that the male gender examinees from the municipality of Gostivar had slightly higher mean values for all the examined parameters compared to the male gender examinees from the city of Tetovo. In relation to the female gender examinees, this difference was particularly noticeable for the parameter of filled teeth.

Considering the data from the literature and our everyday clinical practice, we can discuss that over the last forty years, the prevalence of caries, especially in developed countries, has decreased, leading to an improvement in the overall dental health worldwide. This decrease in the prevalence of caries can be attributed to lifestyle changes, dietary improvements, better

hygiene practices, widespread application of fluoride prophylaxis and emphasis on the preventive measures.

Conclusion

Based on the obtained results, it can be concluded that age of 12 is a critical and significant period for the implementing preventive-prophylactic measures to maintain the health of the first permanent molars which are biologically and functionally very important teeth. Based on the analysis of the results obtained from this research, it can be concluded that the structure of the DMF-index for the first permanent molars between examinees from the municipalities of Tetovo and Gostivar did not represent statistical significance. The same applies for the percentage of decayed, missing teeth and fillings of the teeth. However, the structure of the DMF-index in terms of gender distribution, shows a statistically significant difference in relation to the filled first permanent molars, which are in greater representation among girl pupils, which can be attributed to their interest in appearance and overall health.

Oral hygiene practices, and dietary habits are correlated with the incidence of caries in the first permanent molars. Insufficient health education, poor oral hygiene, inadequate dietary regime, as well as inadequate fluoride exposure, result in a high percentage of carious first permanent molars. Therefore, it is imperative to implement strengthened preventive measures and procedures, as in the National Strategy for improvement of the oral health of children of the Republic of North Macedonia. These efforts are essential for creating a healthier future population.

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GENDER DIFFERENCES IN DIAGNOSTIC AND OCCLUSAL VARIABLES AND TMJ DYSFUNCTIONS

ПОЛОВИ РАЗЛИКИ ВО ДИЈАГНОСТИЧКИТЕ И ОКЛУЗАЛНИТЕ ВАРИЈАБЛИ И ДИСФУНКЦИЈИТЕ НА ТМЗ

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Abstract

Aim: The aim of this study is to investigate whether there are gender differences in diagnostic and occlusal variables and TMJ dysfunctions. It is important to note that these gender differences are based on general trends and may not be applicable to every individual. **Material and methods:** Twenty-six individuals (12 males; 14 females; mean age 28 years) with healthy jaw function were recruited from the UBT University Dental Clinic in Prishtina, Kosovo, for this study. The participants had an underbite of less than 3 mm, no history of extractions other than premolars, and exhibited some signs of TMJ discomfort and/or mild pain. Anamnestic data and inspection were used to collect data for the diagnostic variables. **Results:** Gender differences were observed in variables such as jaw protrusion or lateral movement, chewing gum, and resting the chin in the hands. Female participants experienced pronounced difficulties with open locking in the jaw, whereas males did not exhibit this issue. Furthermore, a significant percentage of females (over 66%) experienced closed locking of the jaw, while only 8.3% of the male participants encountered this problem. The variable of sleeping on the stomach displayed negative correlations with yawning and oral habits. **Conclusion:** The findings of this study highlight gender differences in specific diagnostic variables related to jaw position and habits. Women demonstrated a higher inclination towards chewing gum, holding their jaws forward or to the side, and resting their chin on their hands compared to men. This study provides insights into gender differences in jaw-related behaviors and occlusal variables. **Key words:** Occlusal variables, TMJ dysfunctions, chewing gum, oral habits, open locking of the jaw, closed locking of the jaw.

Апстракт

Цел: Целта на оваа студија е да открие дали постојат разлики помеѓу половите во дијагностичките и оклузалните варијабли и дисфункции на ТМЗ. Важно е да се забележи дека овие разлики се врз основа на општи трендови и не се однесуваат на секој поединец. **Материјал и метод:** Во оваа студија учествуваа дваесет и шест испитаници (12 мажи; 14 жени; со средна возраст 28 години), со здрава функција на вилицата. Испитувањето беше извршено на Универзитетската стоматолошка клиника на УБТ во Приштина, Косово. Учесниците имаа преклоп помалку од 3 мм, немаа историја на екстракции освен премолари, и сите од нив имаа некои знаци на непријатност и/или блага болка во ТМЗ. **Резултати:** Разликите меѓу половите беа откриени со варијаблите при држење на вилицата напред или настрана, при цвакање на гуми за цвакање и потпирање на брадата со рацете. Варијаблите при отворање и затворање на вилицата покажале дека испитаниците од женски пол имале изразен проблем со закочување на вилицата при отворање, за разлика од мажите кои немале таков проблем. Над 66% од испитаниците од женски пол имале закочување на вилицата при затворање, додека само 8,3% од машките испитаници го имале овој проблем. Варијаблата при спиење на стомак има негативна корелација со просевањето и оралните навики. **Заклучок:** Резултатите покажаа разлики помеѓу половите во одредени дијагностички варијабли поврзани со положбата и навиките на вилицата. Испитаниците од женски пол имаа поголема тенденција да цвакаат гуми за цвакање, да ги држат вилиците напред или настрана и да ја потпираат брадата со рацете, во споредба со мажите. Оваа студија ги открива разликите помеѓу половите кои се поврзани со однесувањето на вилицата и оклузалните варијабли. **Клучни зборови:** оклузални варијабли, дисфункции на ТМЈ, гуми за цвакање, орални навики, закочување на вилицата при отворање, закочување на вилицата при затворање.

Introduction

Problem statement

Temporomandibular joint (TMJ) dysfunction is a prevalent condition that affects millions of individuals world wide, resulting in pain and dysfunctional impairment in the jaw and surrounding structures. Various factors have been linked to the development of TMJ dys-

function, including gender differences and occlusal variables. This research aims to investigate the relationship between gender differences, diagnostic and occlusal variables, and TMJ dysfunction.

The existing evidence regarding the relationship between dental occlusion and TMJ dysfunction is inconclusive. While there is limited evidence supporting a strong association between these factors, occlusal factors may contribute to TMJ dysfunction in specific individu-

als. Occlusal splints can serve as both a diagnostic tool and a treatment option for certain patients with TMJ dysfunction. However, further research is necessary to fully comprehend the interplay between gender differences, diagnostic and occlusal variables and TMJ dysfunction.

A substantial body of literature addresses the relationship between dental occlusion and temporomandibular joint (TMJ) dysfunction. Dental occlusion pertains to the alignment of the teeth when the jaws are closed. TMJ dysfunction encompasses a range of conditions that affect the temporomandibular joint, which connects the jawbone to the skull.

Several studies suggest that inadequate dental occlusion can contribute to the development of TMJ dysfunction. For instance, improper teeth alignment can cause muscle tension and jaw imbalance, leading to symptoms such as TMJ pain, clicking or popping sounds, limited jaw movement, and other related manifestations.

However, other studies have failed to establish a significant correlation between dental occlusion and TMJ dysfunction. Some researchers argue that additional factors, such as stress, trauma, or genetic predisposition, may contribute to the development of TMJ dysfunction.

In conclusion, the relationship between dental occlusion and TMJ dysfunction remains a subject of debate among dental professionals and researchers. If you experience TMJ symptoms, it is important to consult a qualified dental professional to determine the underlying cause and develop an appropriate treatment plan.

Research suggests gender differences may contribute to variations in dental occlusion problems. For instance, studies have indicated that males have a higher likelihood of developing severe malocclusions, which involve misalignment of teeth and/or jaws, compared to females. Furthermore, females tend to experience more dental crowding and overbite problems in comparison to males.

However, it is important to acknowledge that individual factors, such as genetics, lifestyle, and habits, can also exert a significant influence on the development of occlusion problems. Therefore, further research is necessary to ascertain the precise causes and identify appropriate treatment options for dental occlusion problems.

Research Objectives and hypothesis

The objective of this study is to investigate whether there are gender differences in diagnostic and occlusal variables and TMJ dysfunctions. Dental occlusion problems can affect individuals of any gender, but there may be variations in the prevalence and types of occlusion problems between males and females.

For instance, studies have shown that females are more prone to Class II malocclusions, characterized by

upper teeth protruding over the lower teeth, where as males have a higher likelihood of Class III malocclusions, where the lower teeth protrude over the upper teeth. Additionally, females tend to have smaller jaws and dental arches compared to males, which can contribute to a higher risk of tooth crowding and misalignment.

It's important to note that these gender differences are based on general trends and may not be applicable to every individual. Conducting research on occlusion is essential to determine the specific causes of dental occlusion problems.

Hypothesis

We have developed two research hypotheses:

- H1 - There are differences between genders in both diagnostic and occlusal variables.
- H2 - Females have higher rates of occlusion problems.

Limitations of the study

One potential limitation of the research on gender differences in TMD is the lack of consistency in diagnostic criteria and outcome measures. Different studies may employ different diagnostic criteria or outcome measures, leading to difficulties in comparing results across studies. In addition, numerous studies have depended on self-report measures of pain and disability, which could be susceptible to bias and may not accurately reflect the severity of TMD.

Literature Review

Gender Differences in TMJ Dysfunction

Gender differences in diagnostic and occlusal variables and TMJ dysfunctions have been extensively researched. The temporomandibular joint, responsible for the lower jaw movement, is a complex structure surrounded by muscles, ligaments, and tendons. Dysfunction in the temporomandibular joint can lead to various symptoms such as pain, clicking, popping, and difficulties in chewing, speaking, and breathing (NIDCR, 2018).

Multiple studies suggest a higher prevalence of TMJ dysfunction in females compared to males. Manfredini et al.¹, discovered that women were 1.5 times more likely to develop TMJ dysfunction than men. Similarly, Fillingim et al.² found a higher prevalence of TMJ dysfunction in females. Okeson³ reported that TMD is more common in women, supported by studies, such as Kalamir et al.⁴, who observed that women had higher

levels of pain and disability related to TMD than men. Similarly, Wu et al.⁵ identified that female college students in China had a higher prevalence of bruxism, TMJ pain, and headaches compared to male students.

One potential explanation for the gender differences in TMD is related to occlusion variables. Occlusion refers to the alignment of teeth when the jaws are closed. Improper occlusion can stress the TMJ and surrounding structures, leading to dysfunction. Several studies have investigated the relationship between occlusion and TMD, with some suggesting that there is a correlation^{6,7}. However, other studies have failed to find a significant relationship^{8,9}.

One aspect of occlusion that has been studied in relation to TMD is the vertical dimension, which refers to the distance between the upper and lower teeth when the jaws are closed. Marpaung et al.⁸ conducted a systematic review of the literature and found that a decreased vertical dimension was associated with an increased risk of TMD. However, the authors noted the need for further research to confirm this relationship due to low-quality evidence.

Another potential contributing factor to the gender differences in TMD is the presence of malocclusion, which refers to any deviation from normal occlusion, such as crooked or crowded teeth. Machado et al.¹⁰ discovered that malocclusion was associated with an increased risk of TMD. However, the authors noted that the relationship between malocclusion and TMD is complex, requiring further research for a comprehensive understanding.

In addition to occlusion variables, other factors may also contribute to gender differences in TMD. For instance, psychosocial factors have been shown to play a role in the onset and progression of TMD. (11) Kalamir et al.⁴ found that women were more likely than men to report psychological distress and disability associated with TMD. This finding suggests that psychosocial factors may be a contributing factor to the gender differences observed in TMD.

Studies have suggested that women may have a higher likelihood of experiencing anxiety and depression, which could contribute to the development of TMJ dysfunction⁹. Furthermore, there is evidence to suggest that hormones may influence gender differences in TMD. Hormonal fluctuations during the menstrual cycle have been associated with an increased risk of TMD in women¹².

The menstrual cycle has been shown to influence pain perception and sensitivity, potentially influencing the development of TMJ dysfunction. Dao et al.¹³ found that women with TMJ dysfunction experienced more pain during their menstrual cycle compared to women without TMJ dysfunction. In addition, estrogen has been found to have a protective effect on the TMJ, and a

decrease in estrogen levels may lead to an increased risk of TMD¹⁴.

Diagnostic Variables and TMJ Dysfunction

Various diagnostic variables have been associated with the development of TMJ dysfunction. One notable variable is malocclusion, which refers to misalignment of the teeth and jaws. Malocclusion has been identified as a risk factor for TMJ dysfunction due to its potential to create an uneven distribution of forces on the TMJ, leading to inflammation and pain¹⁵.

Another diagnostic variable linked to TMJ dysfunction is bruxism, characterized by the grinding or clenching of teeth during sleep. Bruxism has been shown to be associated with TMJ dysfunction as it can lead to excessive force on the TMJ, resulting in pain and inflammation¹¹.

Additional diagnostic variables associated with TMJ dysfunction include jaw trauma, arthritis, and stress. Jaw trauma can cause damage to the TMJ, leading to inflammation and pain. Arthritis can also contribute to TMJ dysfunction by causing inflammation and damage to the joint. Stress has been shown to increase muscle tension, which can lead to TMJ dysfunction¹⁶.

Several studies have investigated gender differences in the diagnosis of TMD. For instance, Yap et al.¹⁷ found that women were more likely than men to be diagnosed with TMD. The authors noted that this discrepancy may be related to differences in pain perception and reporting between men and women. Similarly, La Touche, R et al.¹⁸ found that women with TMD were more likely to report pain in multiple locations than men with TMD.

Occlusal Variables and TMJ Dysfunction

Occlusal variables, specifically the relationship between the upper and lower teeth, have also been associated with the development of TMJ dysfunction. Several studies have suggested that malocclusion can contribute to the development of TMJ dysfunction by causing an uneven distribution of forces on the TMJ¹⁵.

One specific occlusion variable that has been linked to TMJ dysfunction is the vertical dimension of occlusion (VDO). The VDO refers to the distance between the upper and lower teeth when the jaws are in a relaxed position. Several studies have suggested that a decreased VDO may be associated with the development of TMJ dysfunction as it can result in increased muscle tension in the jaw and surrounding structures¹⁹.

Other occlusion variables that have been associated with TMJ dysfunction include occlusal interferences, tooth wear, and tooth loss. Occlusal interferences refer to

areas where the teeth do not meet properly, causing uneven pressure on the TMJ. Tooth wear can also contribute to TMJ dysfunction by altering the way the teeth come together, leading to an uneven distribution of forces on the TMJ. Tooth loss has also been linked to TMJ dysfunction as it can lead to changes in the way the remaining teeth come together, creating an imbalance in the force distribution on the TMJ Machado et al.¹⁰

Treatment of TMJ Dysfunction

The treatment of TMJ dysfunction typically involves a multidisciplinary approach that addresses the underlying cause of the disorder. Conservative treatment options may include lifestyle modifications, such as stress management techniques, and physical therapy. Medications, such as nonsteroidal anti-inflammatory drugs (NSAIDs), may also be prescribed to manage pain and inflammation associated with TMJ dysfunction²⁰.

In more severe cases of TMJ dysfunction, surgical intervention may be required to correct the underlying cause of TMJ dysfunction. Surgical options may include arthroscopy, which involves the insertion of a small camera into the joint to visualize the area and perform necessary repairs, or open-joint surgery, which involves making an incision to access the joint and make any required repairs²¹.

Methodology and data collection

Study Population/Sampling

Twenty-six individuals (12 males; 14 females; mean age of 28 years) with healthy jaw function participated in the study at the UBT University Dental Clinic in Prishtina, Kosovo. The participants had an under bite of less than 3 mm, no history of extractions other than premolars, and all of them had some signs of TMJ discomfort and/or mild pain. Anamnestic data and inspection

were used to collect data for the diagnostic variables: holding the jaw forward or to the side, chewing gum, resting the chin in the hands, sleeping on the stomach, tightness of the muscles without clenching, chewing food on one side.

The study was conducted in accordance with the Helsinki Declaration and good clinical practice and each participant signed an informed consent document.

Data Collection Methods/Instruments

The data involved the use of the statistical software SPSS for Windows Version 26. Non-parametric statistical methods were employed to analyze the ordinal and categorical data. The Mann-Whitney test was utilized to examine the differences between genders. Correlations between variables that are indicators of diagnostic criteria and those that are indicators of occlusion were analyzed through Spearman's correlation. The validation of associations between occlusion variables based on gender was assessed using the Chi-square test. A p-value of less than 0.05 is considered statistically significant, for the Mann Whitney test and the chi-square test, while for Spearman's correlation, only a value of $p < 0.01$ is considered statistically significant

Data Analysis

Gender Differences in Diagnostic Variables

Table 1 presents the differences between genders through the Mann Whitney test for diagnostic variables. Differences between the males and females were found only in the variables holding the jaw forward or to the side ($U=44.5$, $sig=.032$), chewing gum ($U=42$, $sig=.039$), and resting the chin in the hands ($U=37$, $sig=.019$). These results demonstrate that women have a higher inclination to chew gum, hold their jaws forward or to the side, and exhibit a habit of resting their chin on their hands more frequently than men.

Table 1. Mann-Whitney Test Results for Gender Differences in Diagnostic Variables

	Gender	U	Mean Rank	Sum of Ranks	U	Sig.
Holding the jaw forward or to the side ²⁰	Female	10	17.05	170.50	44.5	.032
	Male	16	11.28	180.50		
Chewing gum	Female	10	17.30	173.00	42	.039
	Male	16	11.13	178.00		
Resting the chin in the hands	Female	10	17.80	178.00	37	.019
	Male	16	10.81	173.00		

Table 2. Chi-square Test Results for Gender Differences in Occlusion Variables

		F n (%)	M n (%)	P value
Open Locking of the jaw	PO	4 (44.4)	0(0.0)	X ² =6.11
	JO	5(55.6)	11(100)	sig=.013
Closed Locking of the jaw	PO	6(66.7)	1(8.3)	X ² =7.87
	JO	3(33.3)	11(91.7)	sig=.005

Table 3. Correlation of diagnostic variables with occlusion

	Yawning	Oral Habits	Chewing	Other habits	Closed locking of the jaw
Sleeping on the stomach	-.523*	-.587*			
Tighten of the muscles without clenching			.609**		
Resting of the chin on the hands					-.592**
Chewing food on one side				-.767**	

* Correlation is significant at p<0.05,

** Correlation is significant at p<0.01

Correlation coefficients of diagnostic variables with occlusion

Table 3 displays the correlation coefficients between select diagnostic variables and occlusion variables. Only significant correlations ($p < 0.05$) are presented in the table. The variable "Sleeping on stomach" demonstrates negative correlations with yawning ($r = -.523$) and oral habits ($r = -.587$). The variable "Tightening of the muscles without clenching" shows a correlation with chewing ($r = .609$). The variable "Resting of the chin on the hand variable exhibits a negative correlation with closed locking of the jaw ($r = -.592$). Furthermore, the variable "Chewing food on one side only" displays a negative correlation with other activities of the jaw, such as talking, opening the mouth, or kissing.

Discussion, conclusion, and recommendation

The results revealed gender differences in certain diagnostic variables related to jaw position and habits. Specifically, women showed a higher tendency to chew gum, hold their jaws forward or to the side, and rest their chin on their hands in comparison to men. These find-

ings suggest the existence of gender-specific behaviors or preferences related to these activities.

Furthermore, the chi-square test indicated significant differences between genders in occlusion variables, specifically open locking, and closed locking of the jaw. Female respondents exhibited a higher prevalence of open locking of the jaw, while closed locking of the jaw was more prevalent among female respondents as well. On the other hand, male respondents had a lower incidence of both open and closed locking of the jaw. These outcomes indicate that gender may have an influence on the occurrence of specific jaw-related problems.

The correlation analysis demonstrated significant associations between diagnostic variables and occlusion. Specifically, sleeping on the stomach was negatively correlated with yawning and oral habits, suggesting that individuals who adopt this sleeping position may experience less frequent yawning and engage in fewer oral habits. The variable indicating the tightening of muscles without clenching exhibited a positive correlation with chewing, indicating that individuals who tighten their muscles without clenching may also exhibit a tendency to chew more frequently. Additionally, resting the chin on the hand was negatively correlated with closed locking of the jaw, implying that individuals who frequently rest their chin on

their hand may have a lower likelihood of experiencing closed jaw locking. Finally, the variable representing chewing food on one side only showed a negative correlation with other jaw activities, such as talking, opening the mouth, or kissing, suggesting a possible connection between chewing preferences and overall jaw movement.

The results of this study highlight gender differences in specific diagnostic variables and occlusion among respondents. Women exhibited a higher tendency to chew gum, position their jaws forward or to the side, and rest their chin on their hands compared to men. Moreover, female respondents were more prone to open and closed locking of the jaw. These findings suggest that gender may influence jaw-related behaviors and problems.

Furthermore, the correlation analysis revealed connections between certain diagnostic variables and occlusion. Sleeping on the stomach was associated with reduced yawning and oral habits, while the tightening of muscles without clenching was linked to increased chewing. Resting the chin on the hand was negatively correlated with closed locking of the jaw, and chewing food on one side only showed a negative association with other jaw activities. These findings provide insights into the potential relationships between different behaviors and jaw-related issues.

Based on the findings of this study, several recommendations can be proposed. Firstly, healthcare professionals should take into account gender differences when evaluating and treating patients with jaw-related conditions. Understanding the specific behaviors and habits more prevalent in women, such as chewing gum or resting the chin on their hands, can assist in developing customized treatment approaches.

Secondly, individuals who frequently experience open or closed locking of the jaw, particularly females, may benefit from targeted interventions aimed at managing and preventing these issues. This could involve exercises to improve jaw mobility, stress management techniques, or the use of oral appliances, depending on the underlying causes.

Additionally, the associations between certain behaviors and occlusion variables should be considered. For instance, individuals who tend to chew on only one side may benefit from guidance on proper chewing techniques to minimize the risk of developing imbalances or jaw discomfort.

Further research is needed to explore the underlying factors contributing to the observed gender differences and associations between diagnostic variables and occlusion. Longitudinal studies could provide valuable insights into the development and progression of jaw-related conditions, aiding in their refinement of diagnostic criteria and treatment strategies.

Overall, this study sheds light on gender differences in jaw-related behaviors and occlusion variables, emphasizing the significance of considering these factors in clinical practice and further research endeavors.

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A-PRF AS A SOLO GRAFT MATERIAL IN SOCKET PRESERVATION

A-PRF КАКО САМОСТОЕН ГРАФТ МАТЕРИЈАЛ ВО ПРЕЗЕРВАЦИЈА НА ПОСТЕКСТРАКЦИОНА АЛВЕОЛА

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Abstract

Introduction: The changes in residual alveolar ridge dimensions are a time-dependent process following tooth extraction. To maintain the width and height of residual alveolar ridge, various bone grafts, substitutes or biomaterials are utilized. A-PRF, as an autologous blood derivative, is employed because of its histomorphometric composition, which includes a dense fibrin mesh with a number of platelets. These properties make it suitable for achieving the desired outcomes in this context. **Aim:** The utilization of A-PRF in socket preservation, dimensional changes and bone density in newly formed bone. **Case report:** A patient with indication of tooth extraction, followed by socket preservation using solo PRF as a graft material. Analysis of changes in the width and height dimensions of the alveoli, also as well as an assessment of bone density of de novo formed bone in the socket. **Conclusion:** Recommendation to use A-PRF as an autologous blood derivative for socket preservation procedures. **Key words:** A-PRF, CBCT, GBR, socket preservation.

Апстракт

Вовед: Димензионалните промени на резидуалниот алвеоларен гребен после екстракцијата на забите се временски зависен процес. Во цел на сочуввање на висината и ширината на резидуалниот алвеоларен гребен се користат коскени графтови, супституенти и биоматеријали. А- PRF како автологен крвен дериват се користи заради неговиот хистоморфометриски состав на густа мрежа на фибрински влакна во кои се заробени голем број на тромбоцити и неговите својства. **Цел:** Употребата на А-PRF за презервација на алвеола, димензионални промени и густина на новосоздадена коска. **Приказ на случај:** Пациент со индикација за екстракција на заб, и понатамошна презервација на алвеола со самостоен PRF чеп. Анализа на параметрите на ширина и висина на постекстракционата алвеола, како и густината на новосоздадената коска преку CBCT анализа. **Заклучок:** А-PRF се препорачува за презервација на алвеола како автологен крвен дериват. **Клучни зборови:** А-PRF, CBCT, GBR, презервација на алвеола.

Introduction

After tooth extraction, the wound healing process commences, culminating in the phases of bone modeling and remodeling, involving bone apposition and resorption¹.

The most significant resorption of the residual alveolar ridge occurs within the first six months following the tooth extraction, predominantly in the vestibulo-oral direction. The dimensional changes are time-dependent and persist throughout an individual's lifetime².

Preserving the volume of residual alveolar ridge is crucial for successful esthetic and functional teeth rehabilitation. This is accomplished through techniques such as Guided Bone Regeneration (GBR) and Guided Tissue Regeneration (GTR), Socket Preservation (SP) a com-

ponent of Alveolar Ridge Preservation (ARP), and Alveolar Ridge Augmentation (ARA) are part of the GBR technique. Socket preservation is recommended as an economical and reliable method^{3,4}.

Many bone grafts, bone substitutes and biomaterials are utilized in the field of oral surgery and implantology as a part of GBR techniques. These materials are categorized based on their origin, including autografts, allografts, xenografts and alloplastic materials, each with its own advantages and disadvantages. Autografts, known for their osteogenic potentials, or activity, are considered the gold standard in GBR procedures⁵.

Platelet Rich Fibrin (PRF), invented by Dr. Joseph Choukroun in 2001, represents the second generation of autologous blood derivatives. This method involves the simple and cost-effective process of performing the fib-

rin clot solely through centrifugation, without the need for anticoagulants⁶.

Upon completion of the centrifugation process, in specially designed A-PRF tubes, three layers are formed: the upper layer of Platelet Poor Plasma (PPP), the Fibrin clot (FC) and the Erythrocyte sediment (ES)⁷.

Histomorphologically, the PRF clot appears as a mesh of dense fibrin fibers containing numerous platelets and erythrocytes. Upon degranulation of platelet, plasma proteins, pro and anti-inflammatory cytokines (IL-1, IL-4, IL-6 and IL-8) and Growth Factors-GF (VEGF, PDGF, ILF, FGF) are released. These components have an active participation in the inflammatory response, neoangiogenesis, neoosteogenesis and neocolagenogenesis, thereby influencing post-operative morbidity⁸.

Due to its beneficial properties PRF has been widely used in many indications of oral and maxillofacial surgery over the last decade⁹. The aim of this case report is to evaluate the benefits of using A-PRF as a solo graft material for socket preservation.

Case report

A 47-year-old healthy patient, identified as TG, visited our clinic with a fractured irreparable root of tooth 25. During the examination, he complained of pain in the affected tooth, and denied any other relevant medical conditions. Clinical examination revealed erythema of the mucosa in the area near the apex of the tooth, pain on vertical percussion and pain on palpation in the maxillary vestibule corresponding to the root apex. An orthopantomogram was performed, which showed a residual gangrenous root with periapical changes, along with diffuse chronic periodontitis (Picture 1). After conservative treatment involving pulp extirpation and drainage, the local symptoms of acute odontogenic infection were relieved. A root extraction and socket preservation was recommended, followed by implant-prosthetic or prosthetic rehabilitation.

The patient was informed about the oral-surgical procedure and has signed informed consent form in accordance with the Helsinki Declaration of 1975, revised in 2013 for the implementation of the intervention.

Surgical tooth extraction was performed based on asepsis and antisepsis principles.

One hour before the intervention, a single dose of antibiotic prophylaxis with Amoxicillin plus clavulanic acid 2g was administrated. Venous blood was collected from the patient's cubital veins using the Vacutainer method, with 10 ml of blood collected in A-PRF tubes. The APRF tubes were then placed in a centrifuge

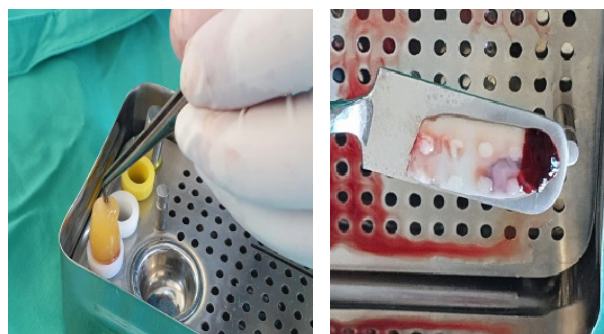
(Biobase LC-H4K centrifuge, BIOBASE, Jinjan, Guangdong, China), using the A-PRF+ protocol on 1300 rpm/8 min (Picture 2).



Picture 1. Orthopantomography



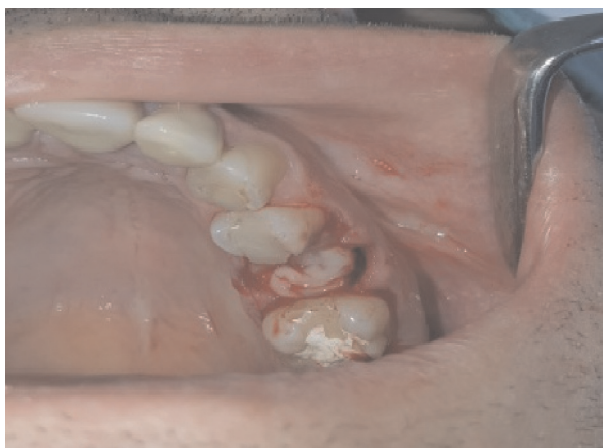
Picture 2. A-PRF tubes



Picture 3. PRF plug and membrane

Terminal anesthesia was applied using 2% mepivacaine with 1:100000 epinephrine. Atraumatic root extraction was performed, followed by surgical wound debridement, through irrigation with NaCl 0.9%.

The PRF clot, obtained from the centrifuged A-PRF tubes, was collected and the erythrocyte sediment was gently removed. Using a specially designed PRF box, a PRF plug was created from the first PRF clot, and a PRF membrane was obtained from the second PRF clot (Picture 3).

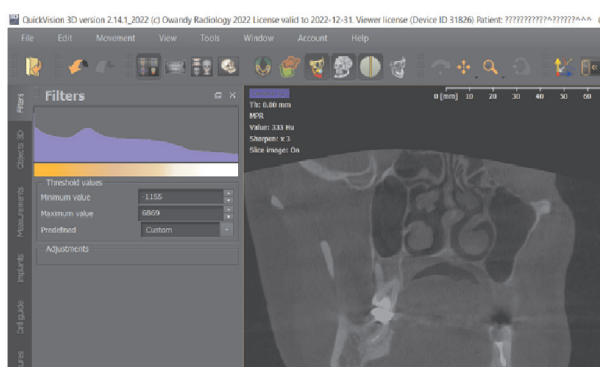


Picture 4. PRF plug and membrane application



Picture 5. Stabilization suture

The PRF plug was gently placed in the socket using a PRF plugger, followed by the application of the PRF membrane. Finally, a stabilizing suture was applied (Picture 4).



Picture 6. Bone density - CBCT

Immediately after the surgical intervention, clinical measurements were obtained to assess the horizontal dimension (socket width) using a bone measurement caliper. The vertical dimension was measured from the cement-enamel junction (CEJ) of the neighboring tooth to the edge of the interdental septa. The same measurements were repeated four months after the surgical treatment. The recorded data are presented in Table 1.

After the surgery, post-operative morbidity was evaluated by assessing the presence or absence of pain, swelling, hematoma, trismus, infection, loss of function, lymphadenitis and the use of pain killers.

Four months after the surgery, the bone density of the newly formed bone was evaluated in the post extraction socket and local periapical area using CBCT 3D imaging. The bone density was measured in Hounsfield Units (HU) (Picture 6), and the data are presented in Table 1.

The measured bone density in our case falls under D3 class (350-850HU) according to the classification by Misch10. The classification indicates thin, porous cortical bone on crest and fine trabecular bone within, which is considered to be the most suitable bone quality for implant placement.

Table 1. Clinical and CBCT measurements

	IMMEDIATE POSTOPERATIVE (mm)	FOUR MONTHS POSTOPERATIVE (mm)
HORISONTAL DIMENSION	15	12.5
VERTICAL DIMENSION	3	3
PAPILA HEIGHT	1	1
BONE DENSITY SOCKET	/	441 HU
PERIAPICAL BONE DENSITY	/	521 HU

Discussion

Maintaining an adequate volume of the alveolar ridge is essential for the successful placement of dental implants. Alveolar ridge preservation includes several techniques aimed at reducing the dimensional changes in both hard and soft tissues following tooth extraction. However, the high costs often limit the use of biomaterials. Moreover, the exposure of resorbable or non-resorbable membranes, often used in combination with bone substitutes, could compromise bone regeneration and impede wound healing.

A-PRF is an autologous blood derivative with a three and tetra molecular structure of fibrin mesh, facilitating the prolonged release of cytokines and growth factors. PRF effectively stabilizes blood clots in post-extraction wounds. Through its mechanism of action, it promotes the proliferation, migration and differentiation of mesenchymal stem cells, fostering neoangiogenesis, neostemogenesis and neocollagenogenesis, thus resulting in faster and improved wound healing¹¹.

The systematic review conducted by Enferest Dohan et al., describes the slow release of growth factors in PRF compared to the first generation of blood derives, specifically PRP. PRF exhibits a significantly slower release of growth factors and plasma proteins, leading to improved wound healing. Additionally, PRP membranes dissolve in five days, whereas PRF membranes remain intact for seven days¹².

Our clinical measurements of the immediate post-extraction socket and four-month follow-up showed a decrease in the intensity of residual alveolar ridge bone loss, which aligns with findings reported in the literature¹³.

In the systematic review conducted by Castro et al., a total of 14 articles were included and analyzed. Three subgroups were created based on the application of the techniques: sinus floor elevation (SFE), alveolar ridge preservation and implant therapy. In the subgroup focusing on alveolar ridge preservation, the collected data indicated a significantly slower bone resorption in both horizontal and vertical dimensions of preserved residual alveolar ridge¹⁴.

The evaluation of postoperative morbidity revealed the absence of postoperative sequelae, and the period of postoperative rehabilitation is shortened^{15,16}.

Improved neo-osteogenesis and architectural integrity of the de novo formed bone is evident through CBCT analysis^{17,18}.

The results of this report are consistent with previous studies¹⁹ where PRF showed to be effective in preserving both hard and soft tissues without interfering with physiological bone healing process. Ridge preservation tech-

niques are highly desirable when functional and aesthetic results are demanded. Moreover, such procedures also facilitate implant placement because of the beneficial effects of PRF in reducing dimensional changes in the post-extraction socket.

Considering the limitations of this report, our results support the utilization of A-PRF in alveolar ridge preservation when implant placement is scheduled following tooth extraction. However, additional larger-scale studies with randomized design are necessary to confirm our findings and investigate possible specific indications of A-PRF compared to other biomaterials.

Conclusion

Based on the obtained results of this study, A-PRF can be recommended as an economical autologous blood derivative for socket preservation methods.

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