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VERTICAL IRREGULARITIES INFLUENCE ON THE MAXILLARY AND MANDIBULAR DENTOALVEOLAR BASIC HEIGHT AND DEPTH

ВЛИЈАНИЕТО НА ВЕРТИКАЛНИТЕ НЕПРАВИЛНОСТИ ВРЗ МАКСИЛАРНАТА И МАНДИБУЛАРНАТА ДЕНТОАЛВЕОЛАРНА ВИСИНА И ДЛАБОЧИНА

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Abstract

The factors influencing the harmony and disharmony of the face are both inherited regardless of one another, not as a complex that leads to the creation of different facial configurations. The facial configuration and facial expression depend primarily on the constitutional build of the skeleton, the position of the upper and lower jaw, the bite type, the facial bones position and alignment, the soft-tissue components covering the facial base, as well as the nose, lip and chin size. The lower face height influence over the vertical facial proportions is strong. The goal of our research is to evaluate the maxillary and mandibular dentoalveolar basic height and depth in individuals with vertical irregularities. Realizing the set goal, we have conducted research over 90 individuals form both sexes aged 13-15. The respondents had no previous orthodontic treatment, had no great craniofacial disorders and had complete dentition. Depending on the vertical incisal rate characteristics - overbite, the respondents were divided in three groups: the first group consisted of respondents with open bite, meaning the overbite was smaller or equal to -1 mm, the second group consisted of respondents with deep bite, meaning the overbite was over +4 mm, and the third control group consisted of respondents with normal overlap, meaning the overbite was more than +1 mm, but lower or equal to +4 mm. The obtained results show that the maxillary parameters MxAABH and MxPABH, as well as the mandibular MdAABH and MdPABH are the biggest in respondents with open bite, while the length of MxAD is the greatest in respondents with deep bite. **Keywords:** overbite, maxillary and mandibular dentoalveolar height and maxillary alveolar depth.

Апстракт

Факторите кои влијаат врз хармонијата и дисхармонијата на лицето се наследуваат независно едни од други, а не како комплекс што доведува до создавање на различни конфигурации на лица. Конфигурацијата и изразот на лицето зависат првенствено од конституционалната градба на неговиот скелет, од положбата на горната и долната вилица, од видот на загризот, од положбата и склопот на коските на лицето, од мекоткивните компоненти кои ја покриваат основата на лицето како и од големината на носот, усните и брадата. Влијанието на долната лицева висина во формирањето на вертикалните лицеви пропорции е силно. Целта на нашето испитување е да се процени максиларната и мандибуларната дентоалвеоларна базална висина и длабочина кај индивидуи со вертикални неправилности. За реализирање на поставената цел се извршени испитувања кај 90 индивидуи од обата пола на возраст од 13-15 години. Испитаниците претходно не се ортодонтски третирани, без големи краниофацијални нарушувања и со присуство на комплетна дентиција. Во зависност од карактеристиките на вертикалната инцизална стапалка - overbite испитаниците беа поделени во три групи: првата група ја формираа испитаници со отворен загриз каде што overbite е помал или еднаков на -1 mm, втората група беа испитаници со длабок загриз каде overbite е над + 4mm, и трета контролна група со испитаници со нормален преклоп на инцизивите, каде што overbite е повеќе од +1 mm, но помалку или еднакво на +4 mm. Добиените резултати од испитувањето покажаа дека максиларните параметри MxAABH и MxPABH, како и мандибуларните MdAABH и MdPABH се најголеми кај испитаниците со отворен загриз, додека должината на MxAD е најголема кај испитаниците со длабок загриз. **Клучни зборови:** overbite, максиларна и мандибуларна дентоалвеоларна висина и максиларна алвеоларна длабочина.

Introduction

During growth and development of the craniofacial system, in the human face formation process, a large number of physiological variations are possible, caused by different physiological and especially genetic factors.

The facial configuration and facial expression depend primarily on the constitutional build of the skeleton, the position of the upper and lower jaw, the bite type, the facial bones position and alignment, the soft-tissue components covering the facial base, as well as the nose, lip and chin size.

Sassouni[19] and Schudy[20] designated two different types of face forms in literature known as: skeletal open bites or hyperdivergent and skeletal deep bites or hypodivergent face type. Both open and deep bites are vertical irregularities.

Bojadziev[5,6] estimates that the vertical dimension depends on the alveolar lateral segment development (their distal parts) and on the maxilla and mandibular condyle development. That way, one insignificant growth in the mandibular condyle development and insufficient development in the alveolar processes of the mandibular distal parts, over which a mandibular anterior rotation is attached, leads to vertical equilibrium with geometric sagittal components, even though the vertical and sagittal growth and development are independent of one another. Because of these reasons, he estimates that intermolar height conditions the anteroposterior relation of the chin to the mandible.

A connection between the structure of the front part of the maxilla and mandible and the lower part of the face exists, in the case of the open or deep bite the dentoalveolar development can be insufficient to compensate the oversized or undersized detachment of the jaw system. A connection between the structures of the front part of the maxilla and mandible with the lower face height can exist.

In open or deep bites, the vertical dentoalveolar development can be insufficient to compensate for the great or small distance between the jaws. Patient observation with long face usually shows tight medium sagittal projection from the maxilla and mandible. This compensation follows the mechanism of elongation of vertical dimensions, reducing the labiolingual dimensions from the basic and alveolar bone in the front part of both jaws, this way a normal or deep bite can occur even in individuals with elongated faces.

According to Fields[11], the skeletal differences in children with long and short faces originate from their mandibular morphology.

Harzer and Stockli[(cit.2,3)] found greater dentoalveolar height in front parts of both jaws in respondents with open bites, compared to respondents with normal and deep bites.

Ellis[10], Frost[12], Subtenly[21-22] and Lopez-Gavito[16] point to significant differences between patients with normal and deep bites, only in dentoalveolar region of the maxilla.

According to Beckmann[2,3] there is significant proportion between overbite and maxillary values and mandibular dentoalveolar height, symphysis size and maxillary and mandibular size.

Also, according to Beckmann[2,3] and Haskel[12] there is a connection between the size of the mandibular symphysis, the chin and the vertical dimension and morphological and dentoalveolar structure of both jaw systems. Determining this connection can be useful in predicting the treatment success in overbite problems.

Betzenberger[4] examined skeletal and dentoalveolar changes in cases with open and deep bites, concluding that differences in anterior and posterior vertical facial height exists and posterior maxillary and mandibular dentoalveolar height in groups with different vertical incisal rate exist. The respondents with deep and normal bite have significantly different process lengths for the maxillary anterior, alveolar and basic height parameters.

The goal of our research is to evaluate the maxillary and mandibular dentoalveolar basic height and depth in individuals with vertical irregularities and normal occlusion.

Material and method

For the realization of the set goal, examinations were conducted on 90 individuals from both sexes, aged 13-15, randomly chosen from the Clinic of Orthodontics at PHO – Dental Clinical Centre “St. Pantelejmon” in Skopje.

Selecting the respondents taking part in realizing the set goal was based on the following criteria: individuals that had not previously undergone orthodontic treatment, with no great craniofacial disorders and with complete dentition.

In relation to the characteristics of the vertical incisal rate, the respondents were divided in three groups and classified as:

- The first group consisted of respondents with open bite, where the vertical incisal rate was lower or equal to -1 mm,
- The second consisted of respondents with deep bite, where the vertical incisal rate was over +4 mm, and
- The third group consisted of respondents with normal incisal overlap, where the vertical incisal rate was more than +1 mm, but lower or equal to +4 mm. This group was also the control group.

Every group consisted of 30 respondents, 15 female and 15 male that came in the period from 2009 to 2015.

For the respondents from the research groups standardized clinical and diagnostic procedures were conducted with x-ray cranial imaging in a standardized way in Norma lateralis.

The linear parameters we used in the research are:

1. **Maxillary anterior alveolar basal height (MxAABH mm)** - the distance from the middle

point of the alveolar meatus on the maxillary central incisor and the cross section point from the palatal plane and the longitude axis of the maxillary central incisor.

2. **Maxillary anterior depth (MxAD mm)** - The distance between points A-A`.
3. **Maxillary posterior alveolar basal height (MxPABH mm)** - The vertical distance between the middle point of the alveolar meatus on the maxillary first permanent molar and the palatal plane.
4. **Mandibular anterior alveolar basal height (MxAABH mm)** - The distance between the middle point of the alveolar meatus on the mandibular central incisor and the cross section point from the palatal plane and the longitude axis of the mandibular central incisor.
5. **Mandibular posterior alveolar basal height (MxPABH mm)** - The vertical distance between the middle point of the alveolar meatus on the mandibular first permanent molar and the palatal plane.

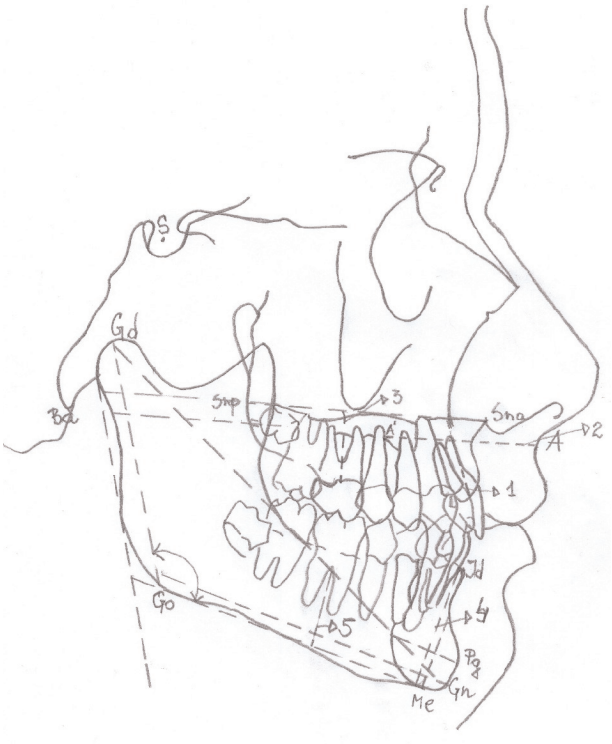

Figure 1. *Cephalometric parameters used in this study*

The statistical data analysis was conducted in SPSS for Windows 17.0 program.

- For data testing we used the Shapiro-Wilk`s W test.
- For data depiction descriptive statistics was used.
- For comparison of the analyzed parameters between the three analyzed groups, we used One way Anova, and for the inter-group differences we used the Tukey test.
- For comparison of the analyzed parameters in relation to gender, the Student "t" test was used.
- The levels of probability for achieving null hypothesis, concordant with international standards for bio-medical sciences were 0.05 and 0.01.

Results

Table 1. Maxillary anterior alveolar basal height in groups with open, deep and normal bite

Group	Maxillary anterior alveolar basal height MxAABH		
	mean±SD	min-max	median
Open bite	23.6±3.7	17-34	24
Deep bite	15.6±3.0	10-21	15.5
Normal bite	18.3±2.3	15-21	18
tested differences	F=34.9 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

Respondents with open, deep and normal bite have significantly different average lengths for the parameter MxAABH (F=34.9, p<0.01). Respondents with open bite have a significantly greater average depth for the parameter MxAABH compared to respondents with deep bite (23.6±3.7 mm vs 15.6±3.0 mm) and with normal bite (23.6±3.7 mm vs 18.3±2.3 mm). Analysis results for gender influence on the average depth on MxAABH show that it significantly depends on gender in the deep bite group. Male respondents with deep bite have a significantly shorter average length of MxAABH compared to female respondents with deep bite (14.15±2.9 mm vs 17.1±2.5 mm).

Table 2. Maxillary anterior depth in groups with open, deep and normal bite

Group	Maxillary anterior depth MxAD		
	mean±SD	min-max	median
Open bite	12.2±1.4	10-15	12
Deep bite	17.1±1.5	14-19.5	17.75
Normal bite	14.05±2.2	11-20	14
tested differences	F=40.8 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

The average length of the maxillary anterior depth MxAD in the open, deep and normal bite is 12.2±1.4 mm, 17.1±1.5 mm and 14.05±2.2 mm respectively.

Post hoc analysis for testing the intergroup differences shows that the respondents with open bite have significantly shorter MxAD average length compared to the respondents with deep and normal bites (F=40.8 ; p<0.01). In all three analyzed groups, the gender has no significant influence over the average length of the MxAD parameter.

Table 3. Maxillary posterior alveolar basal height in groups with open, deep and normal bite

Group	Maxillary posterior alveolar basal height MxPABH		
	mean±SD	min-max	median
Open bite	19±3.0	13-24	19
Deep bite	13.0±2.5	8-17.5	13
Normal bite	15.3±2.3	12-20	15
tested differences	F=25.9 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

Respondents with open bite have a significantly greater average depth for the parameter MxPABH compared to respondents with deep bite (19±3.0 mm vs 13.0±2.5 mm) compared to the control group (19.3±3.0 mm vs 15.3±2.3 mm). In the deep bite group a shorter MxPABH average length was measured, compared to the control group (19.3±3.0 mm vs 15.3±2.3 mm). Analysis results for gender influence over the average length of MxPABH showed that the MxPABH average length does not significantly rely on gender in both respondent groups.

Table 4. Mandibular anterior alveolar basal height in groups with open, deep and normal bite

Group	Mandibular anterior alveolar basal height MdAABH		
	mean±SD	min-max	median
Open bite	32.35±3.7	24-40	32.5
Deep bite	22.95±2.6	19-27	23.5
Normal bite	26.8±2.1	22-30	27
tested differences	F=53.7 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

For the value of F=53.7 and p<0.01, significant difference is confirmed in the average length of the MdAABH parameter between the three analyzed groups. The significant difference is due to the significantly shorter average length of this parameter in the deep bite group, relating to the open bite group (22.95±2.6 mm vs 32.35±3.7 mm) and relating to the control group (22.95±2.6 mm vs 26.8±2.1 mm), as well as significantly shorter average length of this parameter in the normal bite group, relating to the open bite group (26.8±2.1 mm vs 32.35±3.7 mm). The MdAABH parameter length significantly relies on the gender in the open bite group (t=2.92 p<0.01), and does not significantly rely on gender in the deep bite group (t=0.502 p>0.05) as well as the normal bite group (t=1.073 p>0.05).

The average length of the linear dimension MdPABH in the three analyzed groups (open, deep and normal bite) is 25±3.3 mm; 22±2.0 mm and 22.35±1.8 mm, respectively. The MdPABH parameter tested difference

Table 5. Mandibular posterior alveolar basal height in groups with open, deep and normal bite

Group	Mandibular posterior alveolar basal height MdPABH		
	mean±SD	min-max	median
Open bite	25±3.3	17-31	25
Deep bite	22±2.0	18-27	22
Normal bite	22.35±1.8	19-26	22
tested differences	F=8.99 p<0.01 post hoc open vs. deep p<0.01 open vs. normal p<0.01 deep vs. normal p<0.01		

between the three groups is statistically significant (F=8.99, p<0.01). The intergroup difference with post hoc analysis shows that this significance is due to significantly longer average length of MdPABH in the open bite group relating to the deep and normal bite groups. Gender function analysis shows that males and females have insignificantly different average depth of this parameter in the open bite group (t=0.673 p>0.05), and significant differences in the deep bite group (t=4.103 p<0.01) as well as the normal bite group (t=2.702 p<0.05).

Discussion

For the MdAABH parameter, a statistically highly significant difference between the average values in the three groups exists (P<0.01). Our results are nearly equal to Ceylan's results for the open bite group, and for the deep bite group as well as for the control group in which they were identical[6].

For the MxAD parameter, we confirm a significant difference between the average values in the three analyzed groups. The intergroup difference shows that the respondents with open bite have significantly shorter average MxAD length. The obtained data does not correspond to Ceylan's results where the average lengths in the respondent groups are completely identical[6].

In the open bite group, a longer average MxPABH length was measured. Our results for the three groups are completely concordant with the Beckmann[2,3], Fields[8] and Ceylan[6] findings, and in relation to gender there is no statistically significant difference.

For the value of F=53.7 and p<0.01, a significant difference is confirmed in the average length of the MdAABH parameter between the three analyzed groups. The significant difference is due to the significantly shorter average of this parameter in the deep bite group in relation to the open bite group. Our results are concordant with the Beckmann[2,3] and Ceylan[6] results, according to which the skeletal differences in children with long and short face originate from mandibular morphology, meaning the length of the mandible and ramus in children with long and short face do not differ from the same values in children with normal face length, however the gonial angle is significantly greater or smaller depending on the anomaly.

The intergroup difference for the MdPABH parameter shows that this significance is due to significantly longer average length in the open bite group relating to the deep and normal bite groups.

Conclusion

The height of the MxAABH parameter was highest in the open bite group, and shortest in the deep bite group, compared to the control group. In the deep and normal bite groups the MxAABH length is longer in female respondents as opposed to male respondents.

MxAD length is longest in the deep bite group, and shortest in the open bite group compared to the control group.

MxPABH height is longest in the open bite group, and shortest in the deep bite group compared to the control group.

Significant differences in gender function in MxAD and MxPABH parameters were not noticed.

The height of the MdAABH and MdPABH parameters is highest in respondents with open bite, and shortest in respondents with deep bite. In male respondents, from the open bite groups the height of the MdAABH parameter is higher than in female respondents, however the values for MdPABH in male respondents from the deep and normal bite groups are greater than those for female respondents.

Radiological and craniofacial results contribute to better understanding of the vertical abnormalities and can assist in determining a correct and precise diagnosis and adequate planning of the orthodontic treatment.

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TELE-ROENTGEN ANALYSIS OF CHANGES IN SKELETAL AND SOFT TISSUE IN PATIENTS WITH CLASS II DIVISION 1 MALOCCLUSION AND NORMAL OCCLUSION

ТЕЛЕРЕТГЕН АНАЛИЗА НА ПРОМЕНИ НА СКЕЛТЕТОТ И МЕКИТЕ ТКИВА КАЈ ПАЦИЕНТИ МАЛОКЛУЗИЈА II КЛАСА 1 ОДДЕЛЕНИЕ И НОРМАЛНА ОКЛУЗИЈА

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Abstract

Malocclusions that are usually present in patients often give changes to the skeleton of the face and changes on the soft tissue structures.The **purpose** of this study is to determine the changes that occur in the skeleton and soft facial structures, in tele-roentgen pictures, in patients with Class II Division 1 Malocclusion and subjects with normal occlusion, to determine the bone support (apical and basal) on maxilla and mandible, as a basis for supporting the movement of the teeth and todetermine the position of the upper and lower lip in relation to the "Aesthetic" line by Ricketts.For that purpose, 60 patients with Class II Division 1 Malocclusion and 30 patients with normal occlusion were examined. From the **results** obtained, we see that the maxilla is in normal position, and the maxillary incisors are proclinated, while the mandible is in a distal position according to the cranial base.The support of the apical bone of the maxilla is thinner in subjects with Class II/1Malocclusion compared to subjects with normal occlusion.Both lips (upper and lower) touch the "Aesthetic" line in patients with Class II/1. In the same investigated group there is also exposure of the incisions of 1.93 mm, which is not presented in the group with normal occlusion. **Key words:** Class II Division 1 Malocclusion, normal occlusion, protrusion of the incisors

Апстракт

Малоклузиите кои се присутни кај пациентите често даваат промени и на скелетот на лицето и промени на меките структури. **Целта** на ова истражување е да се одредат промените кои што се јавуваат на скелетот и на меките структури на лицето, на Tele rtgснимки, кај пациетни со присутна малоклузија II класа 1 одделение и испитаници со нормална оклузија. Да се одреди коскената потпора (апикална и базална) и на максилата и на мандибулата, како основа за поддршка при придвижување на забите. Да се одреди поставеноста на горната и долната усна во однос на "Естетската" линија по Ricketts. За таа цел испитани се 60 пациенти со малоклузија II/1 и 30 пациенти со нормална оклузија. Од добиените **резултати** гледаме дека максилата е во нормопозиција и максиларните инцизиви се проинклинирани, додека мандибулата се наоѓа во дистална позиција. Апикалната коскена основа на максилата е потесна кај испитаници со II/1,во однос на испитаници со нормална оклузија. И двете усни ја добираат "Естетската" линија, кај пациенти со малоклузија II/1. Кај истата испитувана група има и експонираност на инцизивите од 1.93мм, што не е случај кај групата со нормална оклузија. **Клучни зборови:** малоклузија II класа 1 одделение, нормална оклузија, протрузија на инцизиви

Introduction

Normal occlusion and articulation allow for the proper functioning of the entire dento-alveolar complex.Any deviation from the normal occlusion in this region gives its repercussions of inter-cuspidation, which can be manifested not only in the dento-alveolar fetuses but in the soft tissue structures, too.Class II Division 1 malocclusion is manifested by changes in the anteroposterior direction, with a distal placement of the mandible in relation to the maxilla, perceived through the ratio of the canines and the first permanent molars.In this malocclusion where the protrusion of themaxillary incisors is present is defined as a Class II Division 1 malocclusion. [1,2]

In the malocclusion of II/1, the maxillary dental arch is marked with a pointed shape and often is in the form of the letter "V". Mandibular incisions most commonly touch palatal mucosa[(1,2)]

The position of the maxilla and mandible in relation to the front cranial base may be different, so we can find the cause of this malocclusion right here.There are various combinations of the position of the maxilla and mandible, but as the most difficult degree for this malocclusion is considered when the maxilla is proclined and the mandible is in the retrograde position[1,2,3]

The extra-oral appearance of patients may suggest a present orthodontic anomaly. Thus, in class II/1 malocclusions due to the protrusion of the maxillary incisors, the upper lip only partially covers them, so here we are talking about incompetent lips.Most often in these patients there is hypotonia of the muscles of the lips. Due to hypotension, we often encounter gum exposure during smile known as the "gingival smile."[4,5]. There are changes in orofacial muscles, such as the persistence of infantile swallowing. The profile in these patients is convex and most often the upper and lower lips touch or pass the aesthetic line[6].

Orthodontists determine the positioning of the jaws, their interaction and the position of the teeth, using profiled tele-roentgen images and gnathometric analyzes.

Many studies have shown that minor changes in the dento-alveolar complex can lead to significant changes in the ultimate appearance after orthodontic treatment[7,8,9,10].

The tele-roentgenanalysis provides data on the growth and development of the maxilla, mandible, anterior cranial base and whole facial complex[11,12]. The growth and development of the facial skeletonand plan for orthodontic therapy for each patient individuallycan be estimated with measurements of dento-alveolar, skeletal and soft tissue changes. Accordingly, a proper diagnosis is made and appropriate therapy is planned, which will be suitable for the given malocclusion, depending on the growth and development of the jaws[12,13].

The size of the alveolar and basal bone has been examined by Bajracharya[14] in patients with Class II/1 malocclusion whocame to the conclusion that male and female subjects with a high angle had a smaller maxillary alveolar bone compared to those with a low and average angle. In relation to mandibular alveolar basal bone, it was found to be greater in male examinees with a smaller angle.These trials can determine the borders of the "orthodontic wall" whose frames will enable the movements of the anterior teeth[4]. Normally, if these borders give bigger results with more free teeth movements and increased stability in the retention period. If during tele-roentgen analysis appears that there is insufficient bone in the apical and basal part of the maxilla and mandible, this fact indicates that a successful orthodontic therapy should be done by extraction of the teeth.

The **purpose** of this study is to define and demonstrate the dento-alveolar and skeletal changes that have repercussion onthe extra-oral appearance of patients with Class II Division 1 malocclusion and in patients with normal occlusion.

- To determine the position of the maxillary incisors according to the maxillary plane (Sp) - according to Schwarz
- To determine the placement of mandibular incisors according to the mandible plane (Mp) - according to Tweed
- To determine the size of the apical and basal bone of the maxilla and mandible in patients with Class II /1 and in patients with normal occlusion
- To define the upper and lower lip position relative to the Ricketts aesthetic line

Material and method

Tele-roentgen images of 60 patients with Class II Division 1 malocclusion and 30 subjects with normal occlusion were analyzed. All respondents were from 12 to 18 years of age.

Criteria for selection:

- for class II division 1 malocclusion, the ANB angle is> 4º
- for normal occlusion, the ANB angle is between 2º and 4º

Tele-roentgen images were drawn on a pause paper and measurements were made of the following parameters:

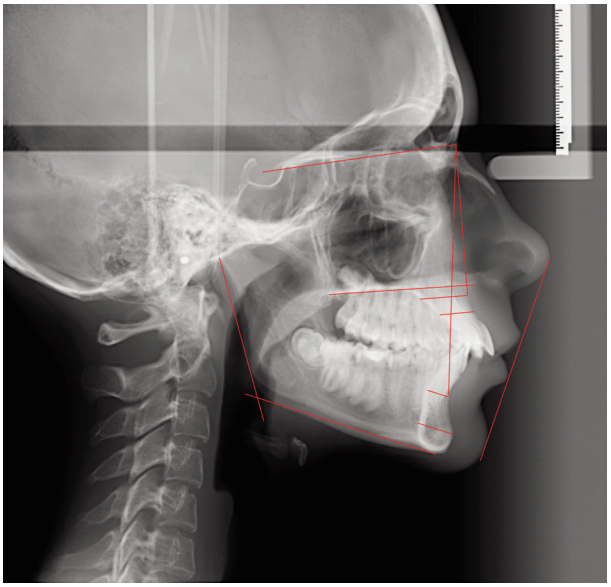
- SNA - position of the maxilla in relation to the anterior cranial base
- SNB - mandibular position relative to the anterior cranial base
- ANB - mutual relation of maxilla and mandible
- Sna-Snp - the length of the body of the maxilla
- G0-Gn - length of the mandible body
- 11/Sp - incline of the maxillary incisions by Schwarz
- 31/Mp - incidence of mandibular incisions by Tweed
- Is/Ii - inter-incisors angle by Downs
- MxAD - maxillary alveolar depth (from A to A')
- MxBaD - maxillary basal depth
- MxIAH – maxillary alveolar height, from an incisal edge of maxillary incisor
- MxAH – maxillary alveolar root height
- MdAD - mandibular alveolar depth (from B to B')

- MdBaD - mandibular basal depth
- MdIAH - mandibular alveolar height, of an incisal edge of mandibular incise
- MdAH - mandibular alveolar root height

Tele-roentgen measurement on the soft tissue profile:

- UL-EL - from the most prominent part of the upper lip to EL
- LL-EL - from the most prominent part of the lower lip to the EL
- Ul - length of the upper lip (from Sn to Ls)
- UlT- thickness of the upper lip (from maxillary incisor to Ls)
- Ll - length of the lower lip (from Li to sulcus mentolabialis)
- LlT - thickness of the lower lip (from mandible incisor to Li)
- Exposure of the maxillary incisors - from stomion to the incisal edge of the maxillary incisors

Statistical processing of results



Picture 1. *Tele-roentgen measurements*

The obtained results from both examined groups, the normal occlusion group and the group with malocclusion II/1 were computerized with the following statistical parameters:

- Arithmetic environment
- Standard deviation
- Default error
- Minimum
- Maximum
- Students "t" test for the significance of differences

$p > 0.05$ (-) has no significance
$0.05 > p > 0.01$ (*) has significance
$0.01 > p > 0.001$ (**) high significance
$p < 0.001$ (***) expressed significance

Results

We obtained the results which show the position of the incisors in relation to their reference plains, the size of the alveolar and basal bone of the maxilla and mandible in patients with normal occlusion and in

Table 1. Tele-roentgen values in patients with Class II Division 1 Malocclusion

II/1 n=60	x	SD	SE	Min.	Max.
SNA	82.85	3.60	0.47	75.00	91.00
SNB	76.73	3.48	0.45	70.00	86.00
ANB	6.08	1.17	0.15	5.00	9.00
Sna-Snp	54.37	3.78	0.49	47.00	65.00
Go-Gn	71.75	4.79	0.62	61.00	82.00
11/Sp	117.33	5.52	0.71	102.00	130.00
31/Mp	87.73	14.39	1.86	9.00	119.00
Is/Ii	122.08	7.01	0.91	108.00	143.00
MxAD	12.13	1.74	0.22	9.00	17.00
MxBaD	15.60	2.24	0.29	10.00	21.00
MxIAH	33.12	3.35	0.43	23.00	40.00
MxAH	21.00	3.19	0.41	10.00	29.00
MdAD	8.72	1.33	0.17	5.00	11.00
MdBaD	15.20	1.80	0.23	9.00	19.00
MdIAH	42.75	4.47	0.58	16.00	50.00
MdAH	34.00	3.06	0.39	26.00	41.00
UL-Rickets	-1.52	2.49	0.32	-8.00	4.00
LL-Rickets	-0.08	3.42	0.44	-8.00	7.00
UL length	20.68	2.53	0.33	15.00	29.00
Ul thickness	12.72	2.62	0.34	6.00	19.00
LL length	15.62	3.19	0.41	10.00	29.00
LL thickness	16.72	1.89	0.24	13.00	21.00
Ekspoz 11	1.93	2.43	0.31	0.00	8.00

patients with Class II division 1 malocclusion, the position of the lips in relation to the aesthetic plane and their length and thickness.

From the values in the first table we can see that the ANB angle is increased (6°) which indicates the existence of a skeletal class II, combined with normo-position of the maxilla (SNA = 82.85°) and retrusion of the mandible (SNB = 76.73°). There is an enlarged length of the body of the maxilla Sna-Snp = 54.37 mm, and the normal length of the mandible body Go-Gn = 71.75 mm. The mean value of the angle of the maxillary incision (11) with Spina planum is 117.33°, and the normal value of this angle is 104°. Mandibular incisors are placed in mild retraction (31/Mp = 87.73 °).The inter-incisors angle is reduced (Is/Ii=122.08°). The maxillary alveolar depth (MxAD) is 12.13 mm, and the maxillary basal depth (MxBAD) in patients with II/1 is 15.60 mm. MxIAH - the maxillary alveolar height is 33.12mm, and the alveolar root height (MxAH) is 21 mm. The mandibular alveolar depth is (MdAD) is 8.72 mm, while the mandibular basal depth (MdBaD) is 15.20 mm. The mandibular alveolar height (MdIAH) is 42.75 mm, and the mandibular height of the root is 34.00 mm.

Regarding the Rickett Aesthetic Line, the upper lip is - 1.52 mm backwards, and the lower lip almost touches the line. It is - 0.08 mm behind it. The thickness of the upper lip is 12.72 mm, and its length is 20.68 mm. The lower lip has a thickness of 16.72 mm and a length of 15.62 mm. The upper lip still fails to cover the incisors and they are visible at 1.93mm.

From the values in this table we can see that the ANB angle is 2.73°, indicating the existence of skeletal class I, combined with normo-position of the maxilla (SNA = 81.27 °) and normo-position of the mandible (SNB = 78.53°). There is an increase in the length of the body of the maxilla Sna-Snp = 54.63 mm, and an insignificant increase in the length of the mandibular body, Go-Gn = 74.40 mm.The mean value of the angle of the maxillary incision (11) with the Spina planum is 105.50° and is in the range of normal values. Mandibular incisors are placed in the normal position (31/Mp = 92.00°). The inter-incisors angle is increased (Is/ Ii = 137.97°).The maxillary alveolar depth (MxAD) is 12.83 mm, and the maxillary basal depth (MxBAD) in patients with Class II/1 is 16.33 mm. MxIAH - the maxillary alveolar height is 31.83 mm, and the alveolar root height (MxAH) is 21.13 mm. The mandibular alveolar depth is (MdAD) is 8.80 mm, while the mandibular basal depth (MdBaD) is 15.43 mm. The mandibular alveolar height (MdIAH) is 43.53 mm, and the mandibular height of the root is 35.13 mm.

Regarding the Ricketts Aesthetic Line, the upper lip is - 4.60 mm behind the Aesthetic line and the lower lip is almost in the normal position, i.e. - 2.73 mm behind this line. The thickness of the upper lip is 16.37 mm, and its length is 20.20 mm. The lower lip has a thickness of 15.77 mm and a length of 16.37 mm. The incisors are not exposed during the rest position of the lips, only 0.87 mm.

Table 2. Tele-roentgen values in patients with normal occlusion

II/1 n=60	x	SD	SE	Min.	Max.
SNA	81.27	2.78	0.51	76.00	89.00
SNB	78.53	2.67	0.49	74.00	85.00
ANB	2.73	1.06	0.19	1.00	4.00
Sna-Snp	54.63	2.82	0.52	47.00	63.00
Go-Gn	74.40	3.76	0.69	68.00	84.00
11/Sp	105.50	6.40	1.17	90.00	114.00
31/Mp	92.00	4.82	0.88	84.00	104.00
Is/Ii	137.97	4.48	0.82	130.00	148.00
MxAD	12.83	1.42	0.26	11.00	15.00
MxBaD	16.33	2.37	0.43	12.00	23.00
MxIAH	31.83	2.44	0.44	26.00	37.00
MxAH	21.13	2.81	0.51	14.00	28.00
MdAD	8.80	1.14	0.21	6.00	12.00
MdBaD	15.43	1.98	0.36	10.00	20.00
MdIAH	43.53	3.26	0.60	36.00	52.00
MdAH	35.13	4.29	0.78	28.00	53.00
UL-Rickets	-4.60	1.87	0.34	-7.00	0.00
LL-Rickets	-2.73	2.11	0.39	-7.00	1.00
UL length	20.20	2.82	0.52	14.00	25.00
Ul thickness	14.60	2.46	0.45	10.00	19.00
LL length	16.37	1.94	0.35	13.00	22.00
LL thickness	15.77	2.22	0.40	13.00	20.00
Ekspoz 11	0.87	1.56	0.29	0.00	5.00

From the values in this table we can see that the parameters ANB, 11/Sp, Is/Ii, UL-Rickets, LL-Rickets have substantialsignificance in the level of $p < 0.001$ (***). The significance of $0.05 > p > 0.01$ (*) wasfor the following parameters: SNA, SNB, Go-Gn, 31/Mp, MxAD, MxIAH, LL thickness and exposure at 11.

For the other parameters, no significant differences were found between the examined groups.

Table 3. Values of t-test in patients with Class II Division 1 Malocclusion compared with subjects with normal occlusion

	II-1		Normal occlusion			
	x	SD	x	SD	t-test	p
SNA	82.85	3.60	81.27	2.78	0.03	0.05 > p > 0.01 (*)
SNB	76.73	3.48	78.53	2.67	0.01	0.05 > p > 0.01 (*)
ANB	6.08	1.17	2.73	1.06	0.00	p < 0.001 (***)
Sna-Snp	54.37	3.78	54.63	2.82	0.71	p> 0.05 (-)
Go-Gn	71.75	4.79	74.40	3.76	0.01	0.05 > p > 0.01 (*)
11/Sp	117.33	5.52	105.50	6.40	0.00	p < 0.001 (***)
31/Mp (IMPA)	87.73	14.39	92.00	4.82	0.04	0.05 > p > 0.01 (*)
Is/Ii	122.08	7.01	137.97	4.48	0.00	p < 0.001 (***)
MxAD	12.13	1.74	12.83	1.42	0.05	0.05 > p > 0.01 (*)
MxBaD	15.60	2.24	16.33	2.37	0.17	p> 0.05 (-)
MxIAH	33.12	3.35	31.83	2.44	0.04	0.05 > p > 0.01 (*)
MxAH	21.00	3.19	21.13	2.81	0.84	p> 0.05 (-)
MdAD	8.72	1.33	8.80	1.14	0.76	p> 0.05 (-)
MdBaD	15.20	1.80	15.43	1.98	0.59	p> 0.05 (-)
MdIAH	42.75	4.47	43.53	3.26	0.35	p> 0.05 (-)
MdAH	34.00	3.06	35.13	4.29	0.21	p> 0.05 (-)
UL-Rickets	-1.52	2.49	-4.60	1.87	0.00	p < 0.001 (***)
LL-Rickets	-0.08	3.42	-2.73	2.11	0.00	p < 0.001 (***)
UL length	20.68	2.53	20.20	2.82	0.44	p> 0.05 (-)
UI thickness	12.72	2.62	14.60	2.46	0.00	p < 0.001 (***)

Discussion

Orthodontics is a branch of dentistry that aims not only to care for the proper arrangement of teeth in dental arches, which will improve the function of chewing, but to participate in the creation and improvement of facial aesthetics.

For this purpose, the growth and development of each patient should be evaluated to calculate dental, bone and soft tissue parameters and changes that occurred as a result of the presence of an orthodontic anomaly. It will be a guide for establishing a proper diagnosis and conducting appropriate orthodontic therapy.

The assessment of the growth and development of the maxilla and mandible have a major influence on the development of the entire cranial system and the skeletal and soft tissue structures of the face.

Enlow[15,16] in his study describes the development of the maxilla as a passive displacement upward and downward, as a result of the growth of the cranial base, the growth of the maxillary structures and the growth of the nose.

The mandible grows so that the beard moves forward and down. The main centers of growth and development of the mandible are the posterior surface of the ramus, the condylar and the coronary process and the partially anterior part of mandible Enlow[15, 16].

Disharmony between the degree ofposition of the maxilla and mandible is most often expressed through the ANB angle. In patients with normal occlusion, its value is from 2-4°[16], while in patients with distal position of the mandible it is enlarged. In our examined group with Class II Division 1 malocclusion there is an increase in the ANB angle of 6° indicating that the skeletal Class IIis present.

The reason for the present class II malocclusion can be the protrusion of the maxilla in relation to the front cranial base.

But according to the findings of Zuzelova[17],Class II Malocclusion is not exclusively due to the distal position

of the mandible. There are various combinations of components in the oro-facial region that participate in the formation of malocclusions. Our examined values have shown that the present Class II Division 1 Malocclusion is the result of a distal placement of the mandible (SNB =76.83°), and the maxilla is set almost in the normal position relative to the front cranial base.

The placement of the upper and lower incisors among each other and their dependence on the bone tissue of the maxilla and mandible, play an important role when making a tele-roentgen analysis. Achieving good facial harmony and balance of the face profile will depend of their position, which will affect the stability during the period of retention[14,18,19,20].

The bone support in the alveolar and basal part of the maxilla and mandible is an important component because the roots of the teeth are located there. The width and height of this section shows how much we are able to retrude or intrude teeth in the frontal region. If in this section we do not have enough bone support then before the start of the therapy we will have to do extraction of teeth in the side region. The values we received for these parameters (MxAD, MxBaD, MdAD, MdBaD) in both examined groups are greater than the values obtained by Bajracharya[14] in hisexamination.

The maxillary incisions are the front leading slopes for protrusive mandible movements. The placement and axial inclination of the upper and lower incisors (Is/Ii) are also important factors in determining facial aesthetics.[21,22] In our investigations, the value of this angle has decreased (122.08°) indicating a greater incisors inclination.

The axial incline of the incisors regarding the maxillary plane is determined by the angle Is/Sp and determines the protrusion of the maxillary incisors with theSchwarz analysis, while the placement of the mandibular incisors regarding the mandibular plane gives the IMPA angle (according to the Tweed method). This angle is important to assess whether sufficient space can be provided in the lower dental arch without extraction, or to satisfy the function and the aesthetics there will be a need to extract teeth. Also,this angle points to the stability of the mandible incisions after orthodontic therapy. In his investigation Ceylon[23] finds increased protrusion of mandible incisions, which may result from compensation for reducing o.j. In our study we found that the value of the IMPA angle is 87.73°, indicating a mild retrusion of mandible incisions, in patients with Class II Division 1 Malocclusion, which emphasizes class II.

Janson and Hasund,[24] in their study of the placement of lower incisors in orthodontic-treated patients found that lower incisors tend to become unstable and because of their position, they become an important factor in the analysis of the plan for the therapy of malocclusions.

The aesthetic line along the Ricketts is a tangent that connects the tip of the nose (Prn‘) and the tip of the chin, the soft tissue Pg’ (Ozerovic B[11]). There is normal placement if the upper lip is -3mm and the lower lip is -2mm behind this line. In our examined groups, in the group with Class II Division 1 Malocclusion, the upper lip is -1.52 mm behind the Aesthetic Line, and the lower lip is -0.08 mm behind it. This suggests a protraction of both the upper and lower lip, so the changes in bone tissue are accompanied by changes in soft tissues. These findings coincide with the findings of Gjorgova[25], Nanda and all[26,27] and Forsberg[28].

The length of the upper lip is almost the same in subjects with Class II/1 and subjects with normal occlusion, while the thickness of the lower lip differs. Patients with Class II/1 have a thinner lower lip, its value is 12.72 mm, compared to subjects with normal occlusion (14.60 mm) Oliver MB[29].

The length and thickness of the lower lip do not differ in subjects with normal occlusion and subjects with Class II Division 1 Malocclusion.

Conclusion

Based on the analysis of the results obtained with the measurements of tele-roentgen images in patients with Class II Division 1 Malocclusion and subjects with normal occlusion, we can conclude that in subjects with Class II/1, except that we have the presence of skeletal class II with more pronounced distal placement of themandible, there is also inclination of the maxillary incisors with a marked retraction of the mandibular. Therefore, when planning the therapy, a suitable orthodontic device should be planned, which will lead to the set mandible in more mesial position, in order to achieve the correct occlusion.

The width and height of the maxillary and mandibular alveolar and basal bone play a major role as bone support for teeth movements. These parameters will influencethe fact whether we will be able to retrude or intrude teeth in the frontal region, or to perform orthodontic therapy without tooth extinction in the side segment. This will be an indicator of a properly implemented orthodontic treatment which will result in bigger stability in the retention period.

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BIOCOMPATIBILITY OF TWO DIFFERENT RESTORATIVE MATERIALS USED IN PAEDIATRIC DENTISTRY

КОМПАРАТИВНА ХИСТОЛОШКА АНАЛИЗА НА БИОКОМПАТИБИЛНОСТА НА ДВА РЕСТАВРАТИВНИ МАТЕРИЈАЛИ

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Abstract

The purpose of our investigation was to make a comparative histopathological analysis of two different restorative materials used in paediatric dentistry. Eighteen male albino rats (Wistar) weighing 200-250 mg were used in this study. Tested material was freshly prepared as advised by the manufacturer and placed in a polyethylene tube. For material implantation, the dorsal skins of the animals were shaved under ketamine (25 mg/kg) anesthesia and disinfected with 5% iodine solution. Three incisions were made on the back of each animal, on the dorsal surface of the front limbs and on the dorsal pelvic area. Each animal received one tube filled by glass ionomer cement and a compomer. For control purposes, empty polyethylene tubes closed from both sides by heat were implanted on the dorsal surface of the left back limb. The histopathological evaluations were performed 1 week, 3 weeks and 45days post implantation. At each period, the rats were sacrificed by anesthetic overdose; the tubes and surrounding tissues were removed by tissue dissection technique and fixed in 10% buffered formalin at pH 7.0. Comparative histopathological analysis were made. One week post implantation at the control and experimental group, microscopic examination revealed the strongest inflammatory reaction despite another three examining periods. All materials in current use are considered acceptable, in terms of their biocompatibility with local tissues, when properly handled and placed.

Апстракт

Цел на нашето истражување беше да ја споредиме хистокомпатибилноста на гласјономерните и компомерните реставративни материјали. Во студијата беа вклучени 18 машки стаорци од видот Wistar со тежина од 200-250g (±20 g) стари 20-24 недели. На грбниот дел од стаорците (субскапуларно) билатерално се обележани 3 оперативни полиња, лево и десно од медијалната линија. Во едното оперативно поле, по соодветната препарација, беше поставен гласјоноер цемент, по соодветната подготовка (според упатството од производителот) и внесен во полиетиленски тубички со должина од 5мм и дијаметар од 3 мм. Во другото оперативно поле се поставува компомерен реставративен материјал и во третото оперативно поле се поставуваат празни полиетиленски тубички со истите димензии, како контролната група. Стаорците се делат во 3 групи, по 6 примероци. Истите се жртвувани по 7, 21 и 45 дена, соодветно по група и е земен примерок од ткивото од местото на имплантацијата. Од земените примероци се изготвуваат хистопатолошки анализи. Резултатите се статистички обработени во статистичката програма STATISTICA 7.1 for Windows. **Резултатите** добиени во нашата студија говорат за појава на ткивна реакција и кај двете групи, поголема кај експерименталната во однос на контролната група. Најбурна ткивна реакција се забележува во првите 7 дена по имплантацијата. Во однос на биокомпатибилноста на гласјономер цементите и компомерите како реставративни средства, применети во нашето истражување, можеме да укажеме на потребата од правилна манипулација од страна на стоматолозите и строго придржување до упатствата за употреба од производителите.

Introduction

Biocompatibility refers to how well the material coexists with the biological equilibrium of the tooth and body systems. Since fillings are in close contact with mucosa, tooth and pulp, biocompatibility is very important, especially in paediatric dentistry. Common problems with some of the current dental materials include chemical leakage from the material, pulpal irritation and less commonly allergy.

To accommodate the bioactive dimension of materials we can use The Williams Dictionary of Biomaterials

which updates the original definition of biocompatibility: "ability of a biomaterial to perform its desired function with respect to a medical therapy, without eliciting any undesirable local or systemic effects in the recipient or beneficiary of that therapy, but generating the most appropriate beneficial cellular or tissue response to that specific situation, and optimizing the clinically relevant performance of that therapy"[1].

Restorative dental biomaterials are designed to recover the shape and the function of the teeth, to protect the pulp tissue and to create adhesion between the tooth surface and the restorative material. Dental materials should not be toxic, irritating or corrosive, and should be easy to use[2].

GJC are "bioactive" materials due to ion exchange with the host, depending on the tissue which reacts, causing a positive response of the host. The term "glass-ionomer" has traditionally been applied to that group of materials which undergo setting through an acid-base reaction between an ion-leachable glass powder and a water-soluble polymeric acid such as the poly-acrylic acid. The traditional (conventional) glass-ionomers are characterized by properties such as brittleness, adhesion and fluoride release[3,4]. Resin-modified glass-ionomers are dental restorative materials of the glass-ionomer family. In addition to the aforementioned components, they contain organic monomers, typically 2-hydroxyethyl methacrylate (HEMA) and an associated initiator system[5,6].

Biocompatibility of GJC is monitored in terms of their cytotoxicity against the cells of the pulp, as assessed by the MTT test. Studies have shown that the concentration of ions and the Sr^{2+}, Al^{3+} and F- are too low to cause any cytotoxic effect. However, it comes from the release of HEMA, which is thought to compromise the biocompatibility of GJC modified resin. Negative biological effects of HEMA include cytotoxicity, induction of apoptosis, persistent inflammation, respiratory problems, allergies and contact dermatitis. It is clear that these kinds of negative effects are possible, although dental literature found very little information about this kind of negative effects in their clinical application[7].

Glass ionomer cements are, in general, cytotoxic shortly after mixing (low pH, between 0.9 to 1.6) with decreasing toxicity as setting occurred. The presence of dentin between filling material and cells (pulp) significantly reduces the toxicity of glass ionomer cements. Conventional glass ionomer cements were not cytotoxic in a dentin barrier test using three-dimensional cultures (Fig. 6.9). Obviously, dentin may act as an acid buffer and as an absorption medium for fluorides[8].

Compomers or polyacid-modified resin-based composites are chemically closely related to resin-based composites and GJC, consisting of filler particles and an organic matrix. The filler (a radiopaque, fluoride-containing silicate glass) comprises approximately of 72 wt.% and contains about 13 wt.% fluoride. UDMA (urethandimethacrylate) is used as base monomer together with a special (acidic) monomer with polymerizable acrylate residues and carboxyl groups (trichlorobenzene). Polymerization is initiated by light irradiation. Additions of cetylamine hydrofluoride are intended to increase fluoride release. The material is applied in combination with an adhesive. Compomers are also used for luting inlays, crowns, and bridges. These materials are autopolymerizing[9,10].

Setting of compomers is primarily caused by a polymerization, whereas the acid-base reaction of the carboxyl group, including components of the glass fillers, is of only secondary importance. Thus, the contribution of this acid-base reaction to the entire setting is considered minor (no setting of compomers in the dark!)[11].

The aim of our investigation was to examine histopathologically the biocompatibility of two different restorative materials used in children: Dyract® eXtra and GC Fuji VIII GP.

Material and methods

Materials and manufacture of specimens

For the evaluation of the histological response of the rats'' tissue, two different restorative dental materials were used: compomer Dyract® eXtra and resin-modified GIC, GC Fuji VIII GP (Table 1.).

Experimental animals and implantation procedure

Eighteen male albino rats (Wistar) weighting 200-250 mg were used in this study. Tested material was freshly prepared as advised by the manufacturer and placed in a polyethylene tube (5mm long/3 mm internal diameter). For material implantation, the dorsal skins of the animals were shaved under ketamine (25 mg/kg) anesthesia and disinfected with 5% iodine solution. Three incisions were made on the back of each animal, on the dorsal surface of the front limbs and on the dorsal pelvic area. Each animal received one tube filled by glass ionomer cement and a compomer. For control purposes, empty polyethylene tubes closed from both sides by heat were implanted on the dorsal surface of the left back limb. The histological evaluations were performed 1 week, 3 weeks and 45 days post implantation.

At each period, the rats were sacrificed by anesthetic overdose; the tubes and surrounding tissues were removed by tissue dissection technique and fixed in 10% buffered formalin at pH 7.0. Comparative histological analysis were made.

Table 1. Examined restorative dental materials

Dental material	Name of the material	Manufacturer	Ingredients (compositions)
Compomer	Dyract® eXtra The caries preventive restorative	DENTSPLAY De Trey GmbH Konstanz, Germany	• Urethane dimethacrilate (UDMA) • Carboxylic acid modified dimethacrilate (TCB resin) • Triethylenglicol dimethacrylate (TEGDMA) • Trimethharylate resin • Camphorquinone • Ethyl-4-dimethylaminobenzoate • Butylated hydroxy toluene (BHT) • UV stabiliser • Strontium-Alumino-sodium-fluoro-phosphor-silicate glass • Highly dispersed silicon dioxide • Strontium fluoride • Iron oxide and titanium dioxide pigments
Glass ionomer cement	GC Fuji VIII GP	GC DENTAL PRODUCT CORP. Torimatisu-Cho, Kasugai, Aichi, Japan	Powder • Alumino-silicate glass Liquid • 2-hydroxyethyl methacrylate (HEMA) • Polyacrylic acid • Urethane Dimethacrylate (UDMA) • Distilled water
Control group (empty polyethylene tube)			

Specimen preparation and criteria of histological response evaluation

Following formalin fixation, specimens were routinely processed and embedded in paraffin wax, serially sectioned at a setting of 5 μm, and stained with hematoxylineosin. From each tissue sample, 5 sections presenting the greatest inflammatory reaction were examined with a light microscope. The materials were sign like:

1. Compomer
2. Glass ionomer cement
3. Control

The preparations were analysed by the tissue inflammatory reaction, degree of blood vessels dilatation, fibrosis and presence or absence of giant cells by pathological criteria: 1 (no response), 2 (mild reaction), 3 (moderate reaction), 4 (strong reaction).

The areas of inflammatory reaction, fibrosis and presence or absence of giant cells were evaluated quantitatively and the number of inflammatory cells was scored as:

- 1 (no response),
- 2 (mild reaction),
- 3 (moderate reaction),
- 4 (strong reaction).

The type of inflammatory cells (neutrophils, lymphocytes, macrophages, mast cells and giant cells) was determined.

Fibrous capsule, necrosis and formation of calcification were recorded as present or absent.

Statistical analysis

Statistical evaluation of tissue response to different dental materials, the compomer Dyract® eXtra and the resin-modified GIC, GC Fuji VIII GP, were performed by the statistical software SPSS for Windows. Results were statistically analyzed using ANOVA by ranks analysis (Kruskal-Wallis-test). Differences between groups were statistically analyzed using the Tukey NSD test.

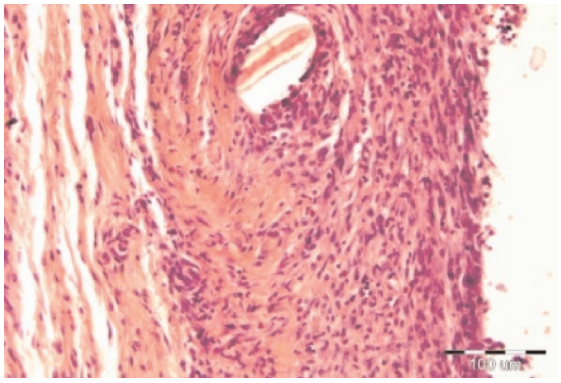
Results

The results obtained in our study show the occurrence of tissue response in all groups, higher in the experimental compared to the control group (Table 2). The strongest tissue reaction was observed in the first seven days after implementation.

Dyract® eXtra

One week post implantation of the compomer (Dyract® eXtra, DENTSPLAY De Trey GmbH Konstanz, Germany), microscopic examination revealed moderate inflammatory reaction (mixed type), the presence of lymphocytes, polymorphs and observed eosinophils, which suggest the possible allergic reaction (Fig. 1 and 2). There is a weak vasodilation, low and moderate fibrosis and occurrence of giant cells.

Exactly 21 days after implantation, a decrease of inflammatory reaction was observed with mild fibrosis (Fig. 3).



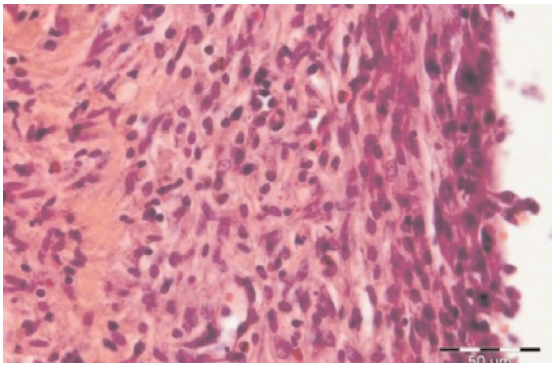


Figure 1./ Figure 2. *Tissue inflammatory reaction one week post implantation of the compomer*

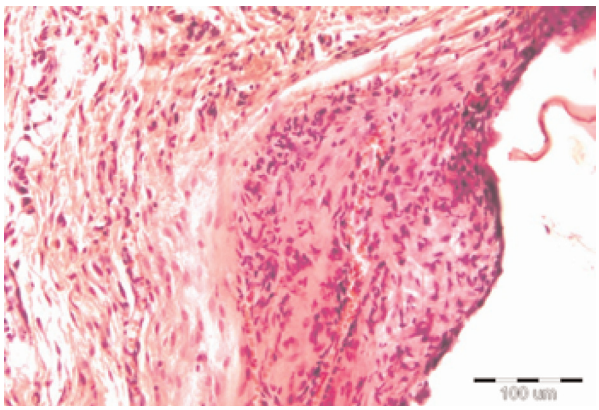


Figure 3. *Tissue inflammatory reaction 21 days after implantation of the compomer*

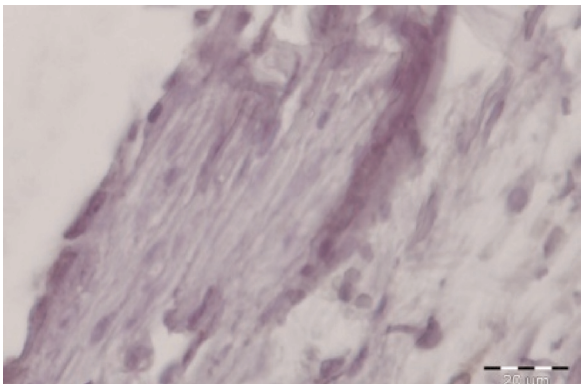
After 45 days of the implantation of the compomer, microscopic examination revealed that there are no serious changes, except moderate to strong fibrosis with calcification and ossification (Fig 4 and 5).

GC Fuji VIII GP

Microscopic examination of the tissue reaction to GC Fuji VIII GP, after one week, revealed a strong neovascularization with occurrence of mild fibrosis, moderate to strong inflammatory cell infiltration, mainly lympho-

Table 2. Tissue inflammatory reaction, degree of blood vessels dilatation, fibrosis and presence or absence of giant cells, necrosis and formation of calcification in the control and experimental groups

Parametar	Blood vesels dilatation			Inflamation			Fibrosis			Giant cells		
Time	7 days	21 days	45 days	7 days	21 days	45 days	7 days	21 days	45 days	7 days	21 days	45 days
1. COMPOMER	2	1	1	3	1	1	2	3	3	1	1	1
2. GJC	3	1	1	4	3	1	2	2	1	1	1	1
3. CONTROL	2	1	1	2	1	2	2	1	1	4	3	1



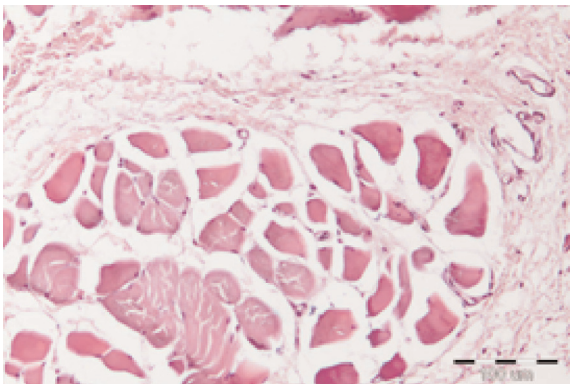


Figure 4./ Figure 5. *Tissue inflammatory reaction 45 days after implantation of the compomer*

cytes (Fig. 6). This is consistent with the results of Souza et al. who think that tissue reaction is caused by the presence of HEMA in the dental material.

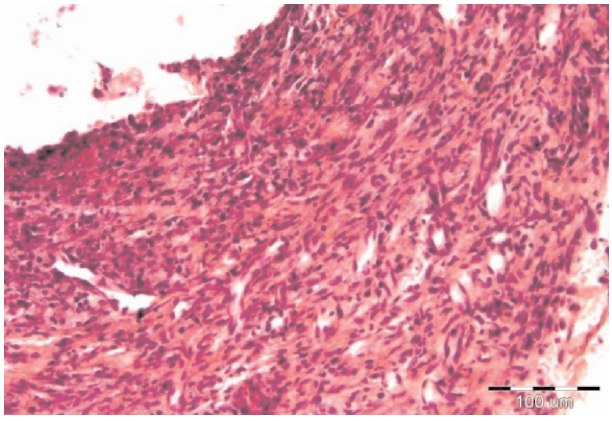


Figure 6. *Tissue inflammatory reaction one week post implantation of glass ionomer cement*

Precisely 21 days after material implantation (GIC), the inflammatory reaction became moderate (decrease), with the presence of calcifications (Fig. 7).

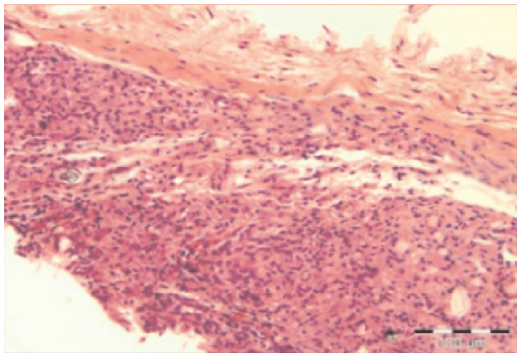


Figure 7. *Tissue inflammatory reaction 21 days post implantation of glass ionomer cement*

At the 45th day of the observation period, inflammatory cells were almost absent with presence of stromal edema (Fig. 8).

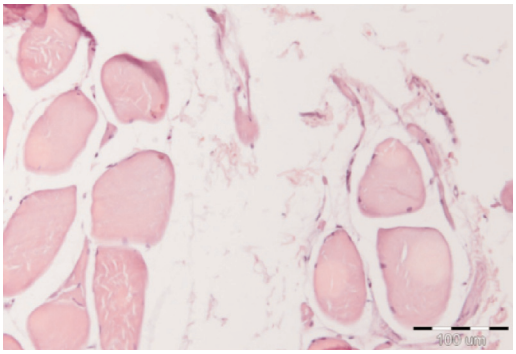


Figure 8. *Tissue inflammatory reaction 45 days post implantation of glass ionomer cement*

Control group (empty polyethylene tube)

One week post implantation of an empty polyethylene tube, microscopic examination revealed a small initial concentration of inflammatory cells in the subcutaneous tissue adjacent to the control, mild vasodilation, quite discreet fibrosis and plenty of giant cells (reaction type foreign body)(Fig. 9).

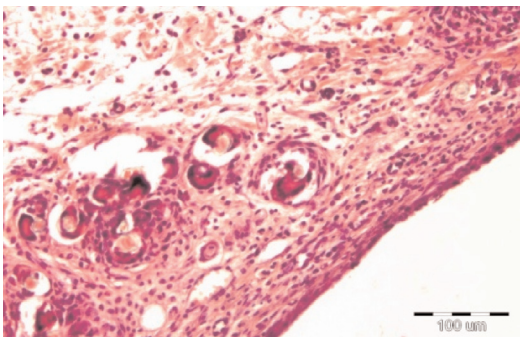


Figure 9. *Tissue inflammatory reaction in the control group one week post implantation*

This reaction quickly calmed down at the 21st day of material implantation, with presence of a thin fibrous capsule that surrounds the tube with a moderate colony of giant cells (Fig. 10).

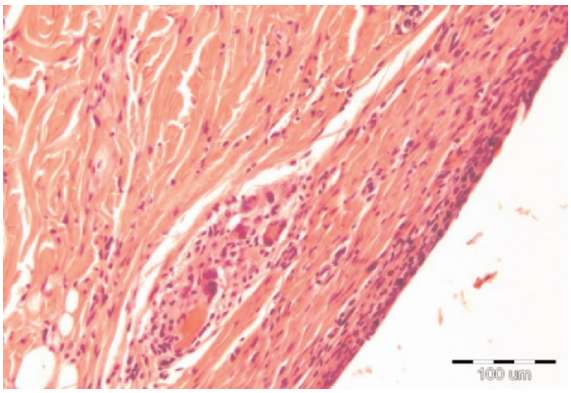
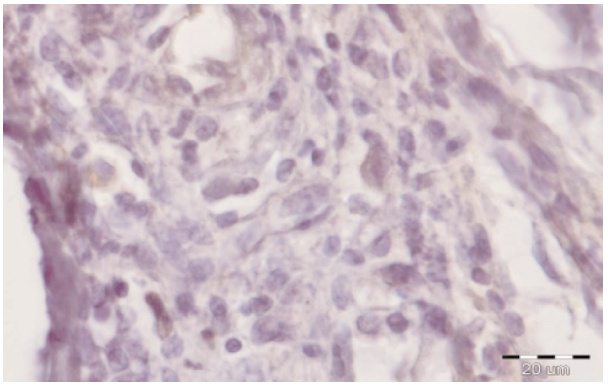


Figure 10. *Tissue inflammatory reaction in control group at the 21st day post implantation*

On the 45th day of the observation period there were no serious changes; all parameters were with response 1 (no response). (Fig. 11 and 12)



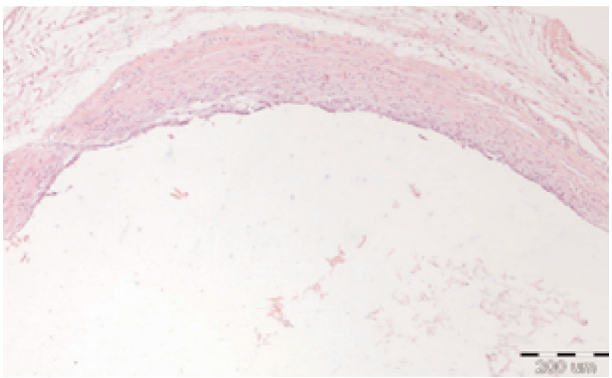


Figure 11. / ***Figure 12.*** *Tissue inflammatory reaction in the control group on the 45st day post implantation*

ANOVA by ranks (Kruskal-Wallis-test) indicate a statistically significant ($p<0.05$) relationship between the degree of inflammation, after 7 days of implementation, and type of the material, which means that there is a statically significant difference between the type of material and thedegree of inflammation in the first 7 days (Table 3.).

Table 3. Results of the Kruskal-Wallis-test for inflammation reaction after 7 days post implantation of the materials

Depend: Inflammation	Kruskal-Wallis ANOVA by Ranks; Inflammation (7 days) Independent (grouping) variable: Material Kruskal-Wallis-test: H(2,N=18)=10,60354 p=0,0050			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	59,50000	9,91667
2	2	6	84,00000	14,00000
3	3	6	27,50000	4,58333

The Tukey HSD test accurately defined the differences between the groups and showed a statistically significant difference only in the 3rd group (control group) compared to the other two groups of materials, compomer and GIC. There was no statistically significant difference between the compomer and GIC (Fig. 13).

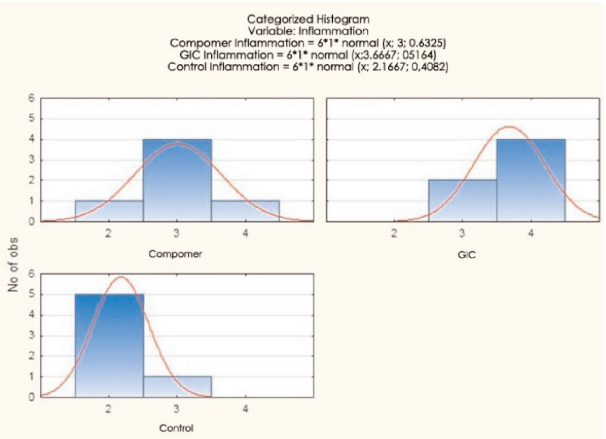


Figure 13. *Categorized histogram for inflammation 7 days post implantation period of the materials*

The inflammatory reaction, at the control group, in the first seven days, was around 2 (mild inflammation)

Table 4. Results of the Tukey HSD test for inflammation 7 days post implantation period of the materials

Material		Unequal N HSD; Variable: inflammation (7 days) Marked differences are significant at p<0,05000		
		{1} M=3,0000	{2} M=3,6667	{3} M=2,1667
1	{1}		0,105398	*0,038318*
2	{2}	0,105398		*0,000637*
3	{3}	*0,038318*	*0,000637*	

while at the other two groups of materials it iwas between 3 and 4 (moderate to severe inflammation) (Tab.4, Fig. 14).

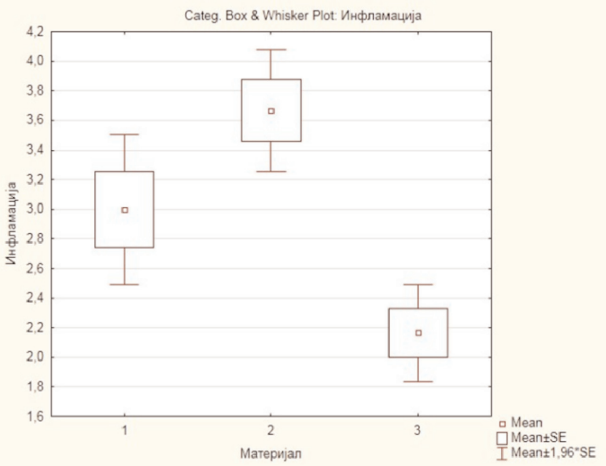


Figure 14. *Results of the Tukey HSD test for inflammation 7 days post implantation period of the materials*

Inflammation 21 days

ANOVA by ranks (Kruskal-Wallis-test) was used to exam the relationship between tissue inflammation and the type of material after 21 days of the implementation. The results indicate that there is a statistically significant ($p<0.05$) difference between the degree of inflammation in different types of materials after 21 days of implantation (Tab.5).

Table 5. Results of the Kruskal-Wallis-test for inflammation reaction after 21 days post implantation of the materials

Depend: Inflammation	Kruskal-Wallis ANOVA by Ranks; Inflammation (21 days) Independent (grouping) variable: Material Kruskal-Wallis-test: H(2,N=18)=10,64074 p=0,0049			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	44,00000	7,33333
2	2	6	89,50000	14,91667
3	3	6	37,50000	6,25000

Tukey HSD test shows a statistically significant difference only in the 2nd group (GIC) in relation to the other two groups of materials. Between the control material and the compomer there is no statistically significant difference (Table 6).

On the 21st day post implantation period, inflammation reaction around the GIC is moderate (3) while in the other two groups it varies between no response (1) and mild reaction (2) (Fig. 15).

Table 6. Results of the Tukey HSD test for inflammation 21 days post implantation period of the materials

Material		Tukry HSD test; Variable: inflammation (21 days) Marked differences are significant at p<0,05000		
		{1} M=1,6667	{2} M=3,0000	{3} M=1,5000
1	{1}		0,002846	0,868421
2	{2}	0,002846		0,001120
3	{3}	0,868421	0,001120	

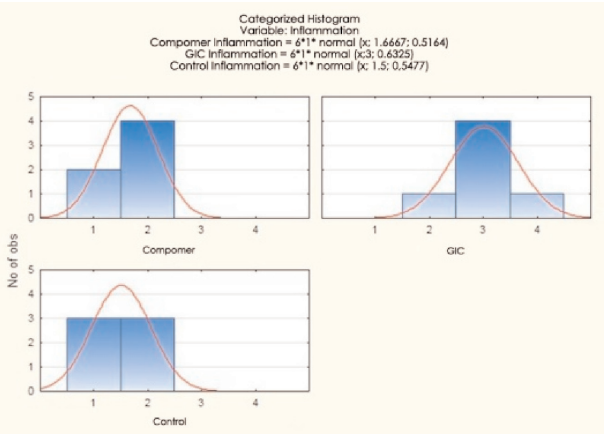


Figure 15. *Categorized histogram for inflammation 21 days post implantation period of the materials*

According to the Kruskal-Wallis-test there is a statistically significant relationship between the degree of vascular dilatation, depending on the type of material in the first 7 days after implantation (Table 7).

Table 7. Results of the Kruskal-Wallis-test for vascular dilatation reaction after 7 days post implantation of the materials

Depend: Dilatation KC	Kruskal-Wallis ANOVA by Ranks; Dilatation KC (7 days) Independent (grouping) variable: Material Kruskal-Wallis-test: H(2,N=18)=7,990408 p=0,0184			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	43,00000	7,16667
2	2	6	85,00000	14,16667
3	3	6	43,00000	7,16667

The Tukey HSD test accurately defines between which groups the difference in dilatation exist. It is evident, from Table 8 that no significant difference in dilatation exists between the first and the third group of materials, compomer and control group, in the first 7

days. Statistically significant dilation differs in GJC versus the other two materials.

Table 8. Results of the Tukey HSD test for vascular dilatation reaction 7 days post implantation period of the materials

Material		Tukry HSD test; Variable: Dilatation KC (7 days) Marked differences are significant at p<0,05000		
		{1} M=2,0000	{2} M=3,3333	{3} M=2,0000
1	{1}		*0,012739*	1,000000
2	{2}	*0,012739*		*0,012739*
3	{3}	1,000000	*0,012739*	

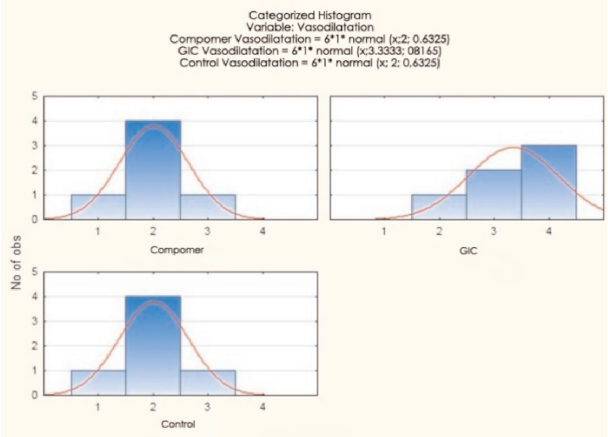


Figure 16. *Categorized histogram for vascular dilatation reaction 7 days post implantation period of the materials*

Results of the Kruskal-Wallis-test for the dilatation of blood vessels and the type of material, after 21 days of implantation of the materials, shows that there is no statistically significant relationship (Table 9).

Table 9. Results of the Kruskal-Wallis-test for vascular dilatation reaction after 21 days post implantation of the materials

Depend: Inflammation	Kruskal-Wallis ANOVA by Ranks; Dilatation KC (21 days) Independent (grouping) variable: Material Kruskal-Wallis test: H(2,N=18)=1,416667 p=0,4925			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	57,00000	9,50000
2	2	6	66,00000	11,00000
3	3	6	48,00000	8,00000

On the 21st day post implantation period of the materials the inflammatory response of the tissue calms down which indicates the decrease of the vascular response of the tissue (Fig. 17).

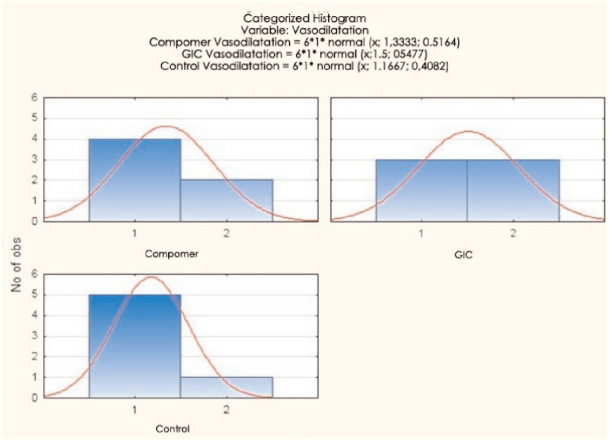


Figure 17. *Categorized histogram for vascular dilatation reaction 21 days post implantation period of the materials*

After seven days observation period, results of the Kruskal-Wallis-test indicated that there was no relationship between fibrosis and the implanted materials in the first 7 days (Table 10).

Table 10. Results of the Kruskal-Wallis-test of tissue fibrosis after 7 days post implantation period of the materials

Depend: Fibrosis	Kruskal-Wallis ANOVA by Ranks; Fibrosis (7 days) Independent (grouping) variable: Material Kruskal-Wallis test: H(2,N=18)=5,059524 p=0,0797			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	67,00000	11,16667
2	2	6	67,00000	11,16667
3	3	6	37,00000	6,16667

Wavy collagen fiber deposits were noted and everywhere there was mild fibrosis present (2) (Fig. 18).

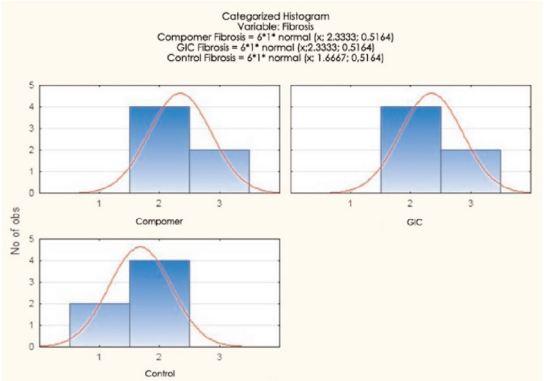


Figure 18. *Categorized histogram of tissue fibrosis after 7 days post implantation period of the materials*

There is a statistical relationship between the degree of fibrosis and the type of implemented material. This signifies that there is a statistically significant difference ($p<0.05$) in the extent of tissue fibrosis in different types of materials after 21 days of implantation (Table 11).

Table 11. Results of the Kruskal-Wallis-test of tissue fibrosis after 21 days post implantation period of the materials

Depend: Fibrosis	Kruskal-Wallis ANOVA by Ranks; Fibrosis (21 days) Independent (grouping) variable: Material Kruskal-Wallis test: H(2,N=18)=7,870370 p=0,0195			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	82,00000	13,66667
2	2	6	54,50000	9,08333
3	3	6	34,50000	5,75000

According to the Tukey HSD test, which accurately defines between which groups the difference exists, statistically significant was the difference in tissue fibrosis between the compomer and the control group (Table 12).

Table 12. Results of the Tukey HSD test for tissue fibrosis reaction after 21 days post implantation of the materials

Material		Tukey HSD test; Variable: Fibrosis (21 days) Marked differences are significant at p<0,05000		
		{1} M=2,6667	{2} M=2,0000	{3} M=1,5000
1	{1}		0,138272	*0,007666*
2	{2}	0,138272		0,307518
3	{3}	*0,007666*	0,307518	

The tissue fibrosis reaction at the compomer ranges between mild to moderate (2-3), at the control, empty polyethylene tube, it varies between no response and mild response and at the GIC the degree is that of mild reaction (Fig. 19).

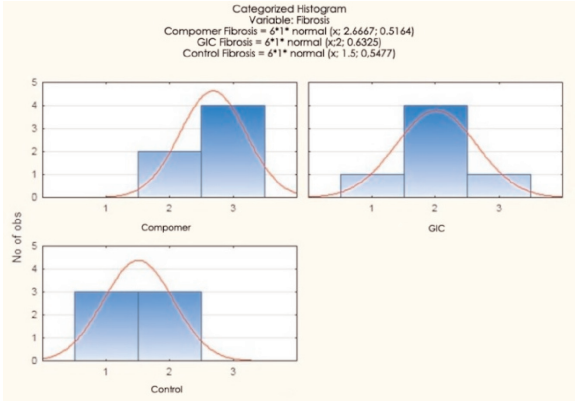


Figure 19. *Categorized histogram of tissue fibrosis after 21 days post implantation period of the materials*

Analysis of variance ranking (ANOVA by ranks), Kruskal-Wallis test, shows the dependence between the amount of giant cells and the type of material, after 7 days observation period. There is a relationship between the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material, statistically significant difference ($p<0.05$).

Table 13. Results of the Kruskal-Wallis for the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 7 days post implantation period of the materials

Depend: Giant cells	Kruskal-Wallis ANOVA by Ranks; Giant cells (7 days) Independent (grouping) variable: Material Kruskal-Wallis-test: H(2,N=18)=13,18038 p=0,0014			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	39,50000	6,58333
2	2	6	39,50000	6,58333
3	3	6	92,00000	15,33333

Tukey HSD shows that there is a statistically significant difference between the amount of giant cells only around the 3rd material (control, empty polyethylene tube) compared to the other two materials (Table 14).

Table 14. Results of the Tukey HSD test for the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 7 days post implantation period of the materials

Material		Tukey HSD test; Variable: Giant cells (7 days) Marked differences are significant at p<0,05000		
		{1} M=1,1667	{2} M=1,1667	{3} M=3,5000
1	{1}		1,000000	*0,000186*
2	{2}	1,000000		*0,000186*
3	{3}	*0,000186*	*0,000186*	

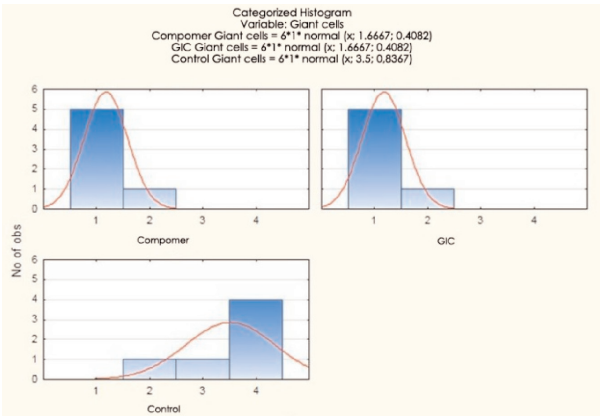


Figure 20. *Categorized histogram of the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 7 days post implantation period of the materials*

According to the Kruskal-Wallis test, there is a relationship between the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 21 days with statistically significant difference ($p < 0.05$).

Table 15. Results of the Kruskal-Wallis for the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 21 days post implantation period of the materials

Depend: Giant cells	Kruskal-Wallis ANOVA by Ranks; Giant cells (21 days) Independent (grouping) variable: Material Kruskal-Wallis-test: H(2,N=18)=11,47171 p=0,0032			
	Code	Valid N	Sum of Ranks	Mean Rank
1	1	6	37,00000	6,16667
2	2	6	44,00000	7,33333
3	3	6	90,00000	15,00000

Tukey HSD indicates that there is a statistically significant difference between the amount of giant cells present in the tissue around the implemented dental materials only in the 3rd material (control) compared to the other two materials (Table 16).

Table 16. Results of the Tukey HSD test for the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 21 days post implantation period of the materials

Material		Tukey HSD test; Variable: Giant cells (21 days) Marked differences are significant at p<0,05000		
		{1} M=1,1667	{2} M=1,3333	{3} M=2,6667
1	{1}		0,823575	*0,000361*
2	{2}	0,823575		*0,000799*
3	{3}	*0,000361*	*0,000799*	

Around the compomer and GIC, after 21 days of implementation of the materials, the giants cells are almost gone, while the control still gives moderate response (Fig. 21).

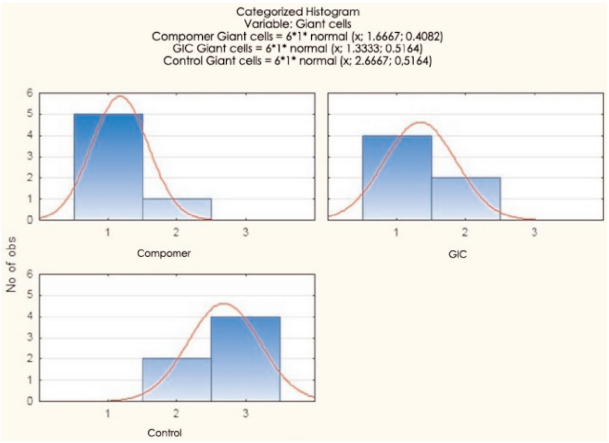


Figure 21. *Categorized histogram of the amount of giant cells in the tissue around the implemented dental materials and the type of the dental material after 21 days post implantation period of the materials*

Discussion

Dental restorative materials can affect oral health in several ways: by components that are soluble in water and reach saliva and oral media in general, and through direct interaction with pulp, gingiva or periodontal bridle[12].

Therefore, selection and evaluation of any material or device intended for use on humans requires structural assessment in four stages: toxicity (cell culture), local tissue irritation (implantation in animals), preclinical (animal tests) and clinical evaluation (testing on patients)[13].

There is no proof that glass ionomer cements cause systemic toxicity. Only Mjor reported an outbreak of generalized urticaria after application of glass ionomer cements. The main reason for this reaction is thought to be HEMA (known allergen)[14].

Microscopic examination of the tissue reaction to GC Fuji VIII GP, after one week, revealed a strong neovascularization with occurrence of mild fibrosis, moderate to strong inflammatory cell infiltration, mainly lymphocytes (Fig. 6). This is consistent with the results of Souza

et al. who think that tissue reaction is caused by the presence of HEMA in the dental material[15].

Nicholson and Czarnecka, 2006 considered that resin-modified glass-ionomers can't be biocompatible as conventional glass ionomer cements because of the presence of 2-hydroxyethyl methacrylate (HEMA) which has harmful biological properties and is known to be part of these restorative materials[9].

Exactly 21 days after material implantation (GIC), the inflammatory reaction, in our study, became moderate (decrease), with the presence of calcifications (Fig. 7) and at the 45th day of the observation period, inflammatory cells were almost absent with presence of stromal edema (Fig. 8).

Several studies have revealed various adverse biological effects caused by the HEMA ingredient in dental materials. The study of Buoillaguet et al. (2000) clearly shows that extremely small amounts of HEMA are capable of causing disorder of cells function, inhibiting growth and reducing mitochondrial activity by 60-80%[16].

Experiments of Becher et al, 2006 showed that HEMA causes apoptotic death in peripheral blood mononuclear cells. Moreover, Schweikl et al, 2006 show that micronuclei develop in cells affected by HEMA and TEGDMA, and that HEMA causes damage to chromosomes and errors in DNA molecules[17].

One week post implantation of an empty polyethylene tube, microscopic examination revealed a small initial concentration of inflammatory cells in the subcutaneous tissue adjacent to the control, mild vasodilation, quite discreet fibrosis and plenty of giant cells (reaction type foreign body) (Fig. 9). This reaction quickly calmed down on the 21st day of material implantation, with presence of a thin fibrous capsule that surrounded the tube with a moderate colony of giant cells (Fig. 10). On the 45th day of the observation period there were no serious changes; all parameters were with 1 response (Fig. 11 and 12).

Yaltirik et al, 200418 and Zmener 200419 reported initial low concentration of inflammatory cells in the subcutaneous tissue adjacent to the control. This reaction quickly appeased and over time, a delicate fibrous capsule surrounded the tissue reaction. This reaction was probably the result of surgical trauma of implantation. However, microscopic analysis made by Batista et al, 200720 showed that the empty polyethylene tubes do not cause an inflammatory reaction.

No evidence of necrosis could be detected in all groups throughout the experiment except at the group of GJC were we found presence of calcifications.

The reactions observed in our study represent a preliminary stage in evaluating the potential of irritating abilities of restorative materials investigated. They cause different inflammatory reactions depending on the time of implantation. However, better tolerated by the tissue itself is GJC despite the stormy reaction in the one week period after inoculation of the material and the presence of calcifications associated with pulp tissue proper defense response.

Conclusions:

- The results obtained in our study show occurrence of tissue reaction in both, control and experimental group, depending on the time of implantation of the restorative material. The strongest tissue reaction was observed in the first week after implantation, which was gradually reduced until the 21st and the 45th day.
- The reactions observed in our study represent a preliminary stage in evaluating the potential of irritating abilities of restorative materials. They cause different inflammatory reactions depending on the time of implantation.
- However, GIC are better tolerated by the tissue despite the strong reaction on the 21st day of the period after implantation and the presence of calcifications.
- After 45 days of observation, every parameter was with value 1- no response, only mild inflammatory reaction at the control, and moderate to strong fibrosis with calcification after compomer implantation.
- We advise dentists to perform proper manipulation and usage of dental restorative materials guided by the strict manufacturers recommendations.

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UDC: 611.314:616.314.16]:616.314.6

EVALUATION OF ROOT ANATOMY AND CANAL MORPHOLOGY OF MAXILLARY SECOND PREMOLARS

ЕВАЛУАЦИЈА НА КОРЕНСКАТА АНАТОМИЈА И КАНАЛНА МОРФОЛОГИЈА НА МАКСИЛАРНИТЕ ВТОРИ ПРЕМОЛАРИ

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Abstract

The **aim** of this study was to evaluate the root anatomy and apical canal morphology in maxillary second premolars. For the set task thirty (30) maxillary second premolars were extracted. After thorough rinse, visual assessment of root anatomy was made. Each root was transversally sectioned six millimeters from apex. The apical amputates were decalcificated in 7.5% trichloroacetic acid, then stored in 10% formalin and dyed with hematoxylin-eosin. Apical canal morphology was evaluated with an optical microscope. Most of the maxillary second premolars had a single root with almost equal occurrence of one, two, as well as variable root canal configuration (70.0%; n=21). Equal occurrence of double separated and fused roots with total value of (27.0%; n=8) was noted, with a single canal and two root canals accordingly. A very rare occurrence of maxillary second premolar with three roots (3.0%; n=1) was detected, two vestibular and one palatal, each containing a single canal configuration. Accessory lateral canals were detected in 17.0% of maxillary second premolars. Transversal communications were detected in maxillary second premolars with one root and double fused roots (46.6%; n=14). Two apical foramina were detected in the majority of maxillary second premolars (46.6%; n=14). A single apical foramen (36.6%; n=11), three (10.0%; n=3), four (3.4%; n=1) and five apical foramina (3.4%; n=1) were detected as well. When surgery of maxillary second premolars is to be considered, it is reasonable to expect difficulties because of variable canal configuration, transversal canal communications and numerous apical foramina, that cannot be detected with clinical and radiology examinations. **Keywords:** maxillary second premolar, root anatomy, canal morphology, decalcification, optical microscope

Апстракт

Цел на оваа студија беше да се процени коренската анатомија и каналната морфологија на максиларните втори премолари. За остварување на поставената цел триесет (30) максиларни втори премолари беа екстрахирани. По темелна промивка се направи визуелна проценка на коренската анатомија. Секој корен беше трансверзално пресечен 6мм од коренскиот апекс. Добиените апикални ампутати беа декалцинирани во 7,5% трихлороцетна киселина, фиксирани во 10% формалин и обоени со хематоксилин и еозин. Апикалната канална морфологија беше проследена со оптички микроскоп. Најголем број на вторите премолари имаа еден корен, со скоро еднаква застапеност на една, два и променлива канална стуктура (70.0%; n=21). Еднаков број на двокорени примероци со фузионирани и сепарирани корени беше забележан (27.0%; n=8) со соодветна застапеност на едноканална и двоканална конфигурација. Во оваа студија беше забележена и многу ретка појава на максиларни втори премолари со три корени (3.0%; n=1), два вестибуларни и еден палатинален, секој со по еден канал. Акцесорни канали беа детектирани кај 17,0% од примероците. Трансверзални комуникации беа детектирани кај премоларите со еден корен и со фузионирани корени (46,6%;n=14). Два апикални форамени беа детектирани кај повеќето примероци (46,6%;n=14). Покрај тоа, беа забележани еден форамен (36.6%; n=11), три (10,0%; n=3), четири (3.4%; n=1) и пет форамени. Врз основа на добиените сознанија од оваа студија кога е во прашање хируршка терапија на максиларните втори премолари може да се очекува комплексност поради варијабилната канална конфигурација, трансверзални конекции и мултипни апикални форамени кои клинички и рентгенолошки не можат да се детектираат. **Клучни зборови:** максиларен втор премолар, коренска анатомија, апикална канална морфологија, декалцификација, оптички микроскоп.

Introduction

A thorough knowledge and understanding of root anatomy and canal morphology is a key prerequisite for successful surgical and endodontic treatment.

Apical surgery of maxillary premolars is a delicate surgical procedure that incorporates removal of apical pathology, identification of roots number and location, root resection, examination, identification, instrumentation of the complex apical canal anatomy and placement of hermetic apical seal.

Intraoral and extra oral radiography is an important preoperative diagnostic tool that proffers a two dimensional image of a three dimensional entity. Therefore the

number of roots, their shape, position and complex inner canal morphology remain questionable, even guessable.

Clinical examination and exploration, adjacent to radiographic evaluation, using various probes and canal files enables the surgeon additional information concerning the root canal morphology.

Nevertheless, the apical canal morphology remains uncertain and dubious.

Hence, surgeons and endodontists are forced ad nauseam to follow their own tactile sensitivity rather than trail required preoperative anatomical landmarks with clear accuracy.

It is of paramount importance to be able to identify and verify existing root and apical canal morphology preceding any surgical and endodontic procedure.

There are several published data on the root and canal morphology of maxillary second premolars.

Frequent variation in the number of root canals, the configuration of pulp cavity and insufficient knowledge of the morphology of maxillary first and second premolars can affect the outcome of the endodontic treatment. The upper premolars can have canals that are difficult for treatment because of the proximity of the maxillary sinus and variations of the apical delta[1,2]. The relative simplicity and uniformity of the external surfaces of roots often mask internal complexity[3].

The maxillary premolars are among the most difficult teeth to treat due to their variation in number of roots, canal configuration, the direction and longitudinal depressions of the roots, and various pulp cavity configurations[4,5].

The roots of these teeth are very problematic, especially in the apical third. Thus, the treatment of the canal in the apical portion has to be performed with great caution[6].

The aim of the present study was to evaluate the root anatomy and apical canal morphology of maxillary second premolars.

Material and methods

For the set task thirty (30) maxillary second premolars were extracted. After thorough rinse, visual evaluation of root anatomy was made. Each root was transversally sectioned six millimeters from the apex with a straight hand piece. The apical samples were decalcificated in 7.5% trichloroacetic acid (Merck, UK), exposed in a series of transversal sections starting and numerated from I to VI. The transversal apical sections were stored in 10% formalin and dyed in hematoxylin and eosin {H&E}. Apical canal morphology was evaluated with a Leica DM 2500 optical microscope (Leica Microsystems, Germany).

Results

The majority of second premolars were single rooted (70.0**%**; n=21). Double separated and fused roots with equal occurrence was noted with a total value of27.0%; n=8. Three roots were found **in** 3.0%; n =1. The root anatomy distribution of maxillary second premolars is presented in figure 1.

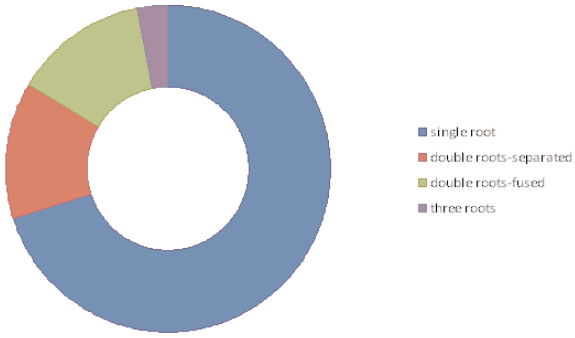

Figure1. *Root anatomy distribution, n=30 (100%)*

Maxillary second premolars with single root (70.0%; n=21) had a single and two apical canal configuration (Fig. 2). Equal occurrence of double separated and fused roots was noted, with a total value of 27.0%; n=8, with a single and two root canal configuration accordingly. A very rare three rooted type of premolar with a single apical canal configuration per root was detected in3.0%; n=1. The distribution of apical canal morphology is presented in Table 1.

Accessory lateral canals were detected in 17.0% of maxillary second premolars.

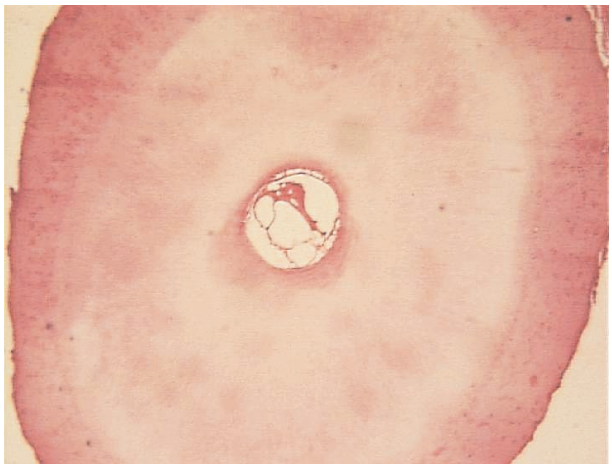

Figure 2. *Single canal (optical microscope, x40 magnification, H&E)*

Table 1. Distribution of apical canal morphology

Apical canal morphology	Single root	Double roots vestibular/palatal		Double roots fused	Three roots vestibular (2) / palatal		
one canal	10	2	2	2	1	1	1
two canals	9	2	2	2	0	0	0
variable canals	2	0	0	0	0	0	0
N=30	21	4		4	1		

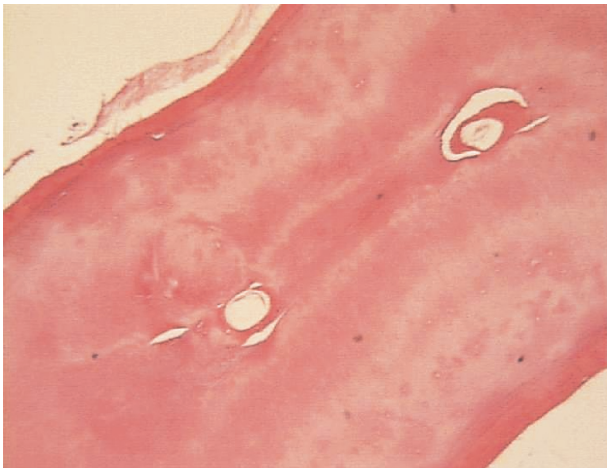

Figura 3. *Two canals (optical microscope, x 40 magnification, H&E)*

Figura 5. *Apical sample with irregular shaped apical foramen (optical microscope, x40 magnification, H&E).*

Transversal communications were detected in maxillary second premolars with one root and double fused roots (46.6%; n=14).

Two apical foramina were evident in the majority of maxillary second premolars (46.6%; n=14). A single apical foramen (36.6%; n=11), three (10.0%; n=3), four (3.4%; n=1) and five apical foramina (3.4%; n=1) were detected as well. The number and location of apical foramina are presented on Figure 4.

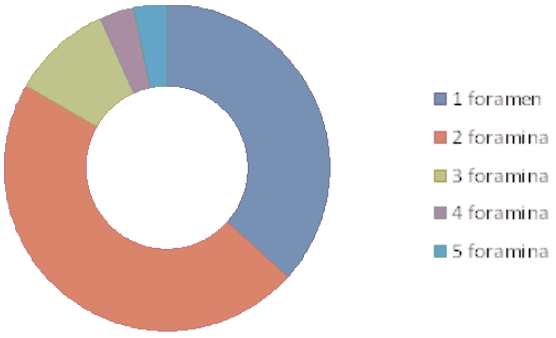

Figura 4. *Incidence of apical foramina*

Discussion

The prime scope of this study was evaluation of the root and apical canal morphology of maxillary second premolars.

In this study, a clear distinction between the root forms was established according to recommendations[7].

The results from our study confirmed a clear predominance of single rooted maxillary second premolars (70%). Far less were double rooted (27%), as demonstrated by other studies. According to Stošić N et al[6] the upper second premolars had one root more often (89.6%). Elkady AM et al.[8] studied the morphology of the root of the second upper premolar using CBCT (cone beam computed tomography). They found that 76.4% of teeth had one root, and the remaining 23.6% of teeth had two roots. A large distribution of one root (in 90% of cases) was also observed in the study conducted on a much larger sample size[2].

Triple rooted maxillary second premolars are a very rare entity. Although the sample size of our study was modest, we encountered three rooted samples, as high as

the reported 0.8-6%[9]. The differences between the results of these morphology studies may be related to variations of examination methods, classification systems, sample sizes, and ethnic background of tooth sources[10].

Morphological canal variations are numerous and are particularly present in the apical root portion.

Unfortunately, the results are difficult to compare, but it's obvious that root canal morphology varies greatly among different populations and even in different individuals within the same population[11].

Because of these differences in the morphology of teeth in patients of different geographic and ethnic groups (on different continents), taking precautions is necessary when relying on the results obtained from studies done in other populations[7].

Numerous studies have been carried out, using different methods such as radiography[12], cleaning and decalcification[13], cutting and microscopic observation[14], and computed tomography for better understanding of the morphology of the canals[15].

It has been reported in the literature that ex vivo demineralization and staining provides the most detailed information, while maintaining the original form and relations of canals[16].

In our study, by implementing the method of decalcification, cutting, staining and microscopic observation, we were able to detect the variation of the apical root canal morphology of the second premolars.

Internal root canal system morphology reflects the external root anatomy. Furthermore, there is correlation between the shape of the outer surface of the root and the shape of the root canal.

Because of unpredictable variations of the apical canal system of maxillary second premolars, the canal evaluation of successive apical transversal sections was performed with stereo microscope and magnification.

The upper second premolars show many variations in the number of canals[17]**.** Predominantly single rooted samples had an equal presence of single and double root canal morphology (70%, n=21). Other study reported upper second premolars with one canal in 79.2% of cases[18] which was much higher than the percentage reported by other authors, despite the fact that even in their research the percentage of one canal was more common[1,2,19]. The frequency of three canals was much lower as only one premolar had three canals (2%), which was also observed in the study of Vertucci F et al[20].

Our results of single canal configuration in maxillary double rooted and three rooted second premolars were in accordance with the published study[21].

Double rooted fused and single rooted samples expressed unpredictable apical canal morphology due to two canal structure as well as a variable one-two–one canal structures.

When two or more canals are present within a single root, chances for transversal communications rise. Literature has reported a high percentage of inter canal communications in teeth with two canals. This communication is of clinical significance as it may be difficult to debride and fill it adequately[22].

The results from our study reported high incidence of transversal communications in maxillary second with two canals (46.6%).

Lower incidence of inter-canal communication or transverse anastomoses/isthmus in 16% of the samples was reported[16].

This was in accordance with the textbook of endodontics, where maximum incidence of intercanal communication was in the middle third of the root[23].

Accessory root canals are predominantly seen in the apical root portion with incidence of 17%[24].

Canal configurations of the maxillary second premolars were categorized at the apex level. Lateral canals were located mainly in the apical region (17%).

The occurrence of lateral canals in our study was consistent with the reported incidence[24].

The number and location of apical foramen is of clinical significance during working length determination, which often depends on the average position of the apical constriction relative to the root apex[22]. The majority of maxillary second premolars in our study had two apical foramina (47.0%). However, the occurrence of a single, three and four foramina with eccentric locations were also detected.

Conclusion

Maxillary second premolars were predominantly single rooted with variable canal morphology, transversal communications and multiple apical foramina. Thus, when surgery is considered it is reasonable to expect complexity.

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EVALUATION OF ORAL HEALTH IN CHILDREN OF SCHOOL AGE FROM THE REPUBLIC OF MACEDONIA

ЕВАЛУАЦИЈА НА ОРАЛНОТО ЗДРАВЈЕ КАЈ ДЕЦА НА ШКОЛСКА ВОЗРАСТ ОД РУРАЛНА ОБЛАСТ НА Р МАКЕДОНИЈА

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Abstract

Dental caries is a widespread disease in our country and even wider in the world, whose prevalence and incidence are a challenge to public health. Caries isthe most common teeth disease in childhood. Despite the significant scientific achievements and the fact that caries can be prevented, the disease continues to be an important public health problem. **Objective:** The aim of this paper was to evaluate the prevalence of the DMFT index in schoolchildren from rural settlements in the Prespa region of the Republic of Macedonia with mixed ethnicity through conducting clinical trials. **Material and method:** In order to achieve the goal set in the survey, 198 respondentswere surveyed, including students aged from 6 to 14 of both sexes, with different national backgrounds. All respondents were divided into two groups: pupils with deciduous dentition from 6 to 10 years of age and students with mixed dentition from 11 to 14 years of age. Prior to the start of the research, approval was requested from the managers and teachers of the schools that were involved in the research. Given the fact that the respondents were juveniles, a written consent from the parentswasrequested, which ensured the permission to use the surveyed information for scientific - research purposes. **Results:** Our results showed that in the group of students from 6 to 10 years, the prevalence of the DMFT index on teeth was 73.53%,whereasin the group of students from 11 to 14 years,the prevalence of the DMFT index on teeth was 93.75%.. **Conclusion:**The analysis of the results of our research indicates the need for taking stronger measures for primary and preventive dental care among children of school age from rural settlements in the Prespa region of the Republic of Macedonia with mixed ethnicity. **Keywords:** oral health, school children, caries, DMFT index

Апстракт

Забниот кариес е распространето заболување кај нас и пошироко во светот чија преваленца и инциденца се предизвик на јавното здравство. Кариесот претставува најчеста болест на забите во детската возраст.И покрај значајните научни достигнувања и фактот дека кариесот може да се превенира,болеста продолжува да биде значаен јавно-здравствен проблем. **Цел на трудот:** Целта на овој труд беше преку спроведување на клинички испитувања да се евалуира преваленцијата на КЕП индексот за состојбата на забалото кај деца на училишна возраст од руралните населени места во Преспанскиот регион на Република Македонија со мешана етничка припадност. **Материјал и метод:** За реализација на поставената цел во испитувањето беа вклучени 198 испитаници, ученици од 6 до 14 годишна возраст од обата пола, со различна национална припадност. Сите испитаници беа поделни во две групи: ученици со млечна дентиција од 6 – 10 годишна возраст и ученици со мешовита дентиција од 11 – 14 годишна возраст. Пред да почнеме со истражувањето беше побарана дозвола од директорите и наставниците на училиштата кои беа вклучени во истражувањето. Имајќи го предвид фактот дека се работи за малолетни лица беше побарана и писмена согласност од родителите, со што ни беше овозможено добиените податоци да ги употребуваме во научно-истражувачки цели. **Резултати:** Нашите резултати покажаа дека во групата на ученици од 6-10 години преваленцата на КЕП индексот за состојбата на забалото е 73,53%, а во групата на ученици од 11-14 години преваленцата на КЕП индексот за состојбата на забалото е 93,75%. **Заклучок:** Анализата на резултатите од нашите истражувања укажува на потребата за превземање на засилени мерки за примарна и превентивна стоматолошка заштита кај децата на школска возраст од руралните населени места во Преспанскиот регион на Република Македонија со мешовите национална припадност. **Клучни зборови:** орално здравје, школски деца,кариес,КЕП индекс

Introduction

Poor oral health has potential and may impair the quality of life, as well as reduce food intake due to oral pain.Also,impaired dental status can cause low growth in children and worsen their nutritional status.Bad dental status in children has a negative effect on the development of speech, and this may have a socially adverse effect in children that will affect their social acceptance[1]. In developed countries, there is a decline in oral diseases, and globally an increase in their prevalence[2,3].

Various occurrences of oral diseases in different countries have been observed in different countries and hence the need for organizing an oral health service that would meet the needs of the local population with global strategic proposals from WHO[4,5,6].

Caries and periodontal disease are the two most common oral pathologies, and the indices that describe their prevalence are often used to roughly describe the oral health status of the population.Oneimportant caries index is new and has been introduced to identify individuals or groups with the highest DMFT values[7]. Early epidemiological studies have proven that the DMFT Index is a relevant indicator of oral health and socioeconomic status[8]. In industrialized Western countries the prevalence of caries has decreased and concentrated among 20% of the population[9]. Quite worrying is the fact that only 66.9% of the total population has functional dentition (21-32 teeth) and in the near future, the goals of the WHO 2020 will be difficult to achieve[10].

Dental caries is a widespread disease in our country and even wider in the world, whose prevalence and incidence are a challenge to public health. The caries is the most common teeth disease in childhood.

Despite the significant scientific achievements and the fact that caries can be prevented, the disease continues to be an important public health problem. In developing countries, changing habits and diet considerably increase the incidence of cavities[11]. According to the World Health Organization, 60-90% of school-age children around the world have dental caries and the disease has the highest prevalence among children from Asian and Latin American countries[2]. The last two decades have seen a significant decline in the appearance of caries in children in industrialized countries[12,13]. This is due to the increased culture and knowledge of maintaining oral hygiene, the use of fluoride, the use of improved tooth brushes, improved access to dental health care, and prevention campaigns and programs aimed at raising awareness among population for oral health. Conversely, an increased frequency of dental caries has been reported in developing countries and especially in countries where preventive dental programs have not yet been established[14,15,16].

In social groups with a lower standard of living the need for teeth treatment is prevailing, while among the population with a higher level of income, the approach to providing dental services is greater.

Objective

The purpose of this paper was to carry out the clinical trials on schoolchildren from rural settlements in the Prespa region of the Republic of Macedonia with mixed ethnicity to determine the following objectives:

1. To examine the prevalence of DMFT, and to determine the differences between the two examined groups: students from 6-10 and students from 11-14 years of age;
2. To examine the relationship between the soft and hard deposits of Greene-Vermillion, the index of gingival inflammation following Sillnes&Loe and DMFT index.

Material and methods

In order to achieve the goal set in the survey, we surveyed 198 respondents, including students aged from 6 to 14 of both sexes, with different national backgrounds. All respondents were divided into two groups: pupils with primary dentition from 6 to 10 years of age and students with mixed dentition from 11 to 14 years of age. Respondents involved in the research were students of three primary schools located in rural areas, as follows: Primary School “Slavejko Arsov” village Podmochani, Primary School “Dimitar Vlahov” village Ljubojno, and Primary School “Brakja Miladinovci” village Carev Dvor, in the Prespa region of the Republic of Macedonia.

Prior to the start of the research,permission was obtained from the managers and teachers inthe schools-mentioned above. Given the fact that juveniles were involved a written consent from the parents was requested, which enabled us to use the obtained data for scientific and research purposes.

Within the scope of the clinical trials, the degree of maintenance of teeth (DMFT index) was noted.All data obtained from clinical trials were noted in a pre-prepared questionnaire for each patient separately.

For determining the condition of the teeth, we used the DMFT indexin the permanent dentition in the elderly group of pupils from 11-14 years of age, and this assessment was done foreach tooth (caries, extraction and flame), whereasin the primary dentition,we used thedmftindex of the teeth in the group of pupils from 6-10 years of age, and this assessment was done only for sealed and carious teeth, because here, the extraction is considered to be normal resorption and the removal of the primary teeth into permanent teeth.

All clinical trials of this study were performed in the Private Health Institution “DENT-S”, village Krani, Resen, as part of a pre-scheduled systematic dental examination of all students (examinees) from the primary schools mentioned above.

Statistical analysis

The data analysis was performed with the statistical program Statistica 7.1 for Windows.

Results

Description and Differences Between the Groups

Descriptive statistics of the DMFT index of students from the two groups is shown in Table 1.

In the 6-10 years group, the value of the DMFT index varies in the range of 2.4 ± 1.89; ± 95.00% CI: 2.04-2.78; the minimum value is 0 and the maximum value is 8.00.

In the 11-14 age group, the value of the DMFT index varies in the interval of 7.03 ± 4.09; ± 95.00% CI: 6.20-7.86; the minimum value is 0 and the maximum value is 19.00.

The value of the DMFT index is higher for 11-14 years students, but the difference compared to pupils from 6-10 years for Z=-8.50 and p<0.001 (p=0.000) is significant (Table 1 .1).

In Table 1.2, the data presented refer to the presence of DMFT on teeth in the students of both groups.

In the group of 6-10 years out of a total of 102 students, 75 (73.53%) had dmfton the teeth, and 27 (26.47%) did not have dmfton their teeth.

In the group of 11-14 years out of 96 students, 90 (93.75%) had DMFT on the teeth and 6 (6.25%) did not have DMFT on the teeth.

In the distribution of data related to the presence of DMFT on teeth, students of both groups for Pearson Chi – square = 14.56 and p<0.001 (p = 0.000) have significant difference.

In the group of students from 6-10 years, the prevalence of dmft is 73.53%.

In the group of students aged 11-14, the prevalence of DMFT is 93.75%.

Descriptive statistics of the index of students from the 6-10 years group is shown in Table 2.

Table 1. DMFT Index/Status of permanent dentition

Group	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
6 - 10 years	102	2.41	2.04	2.78	0.00	8.00	1.89
11 - 14 years	96	7.03	6.20	7.86	0.00	19.00	4.09

Table 1.1. DMFT Index/Status of permanent dentition

Difference between groups

Parameter	Rank Sum 6-10 years	Rank Sum 11-14 years	U	Z	p-level	Valid N 6-10 years	Valid N 11-14 years
DMFT index	6723.00	12978.00	1470.00	-8.50	0.000	102	96

Table 1.2. Presence of DMFT

	Group	Presence of dmft/DMFT		Total
		Present	None	
Number	6-10 years	75	27	102
%		73.53%	26.47%	
Number	11-14 years	90	6	96
%		93.75%	6.25%	
Number	Total	165	33	198

Table 2. Index/Status of primary dentition

Group	Number	Average	Confidence -95.00%	Confidence + 95.00%	Minimum	Maximum	Standard deviation
6 - 10 years	102	6.98	6.20	7.76	0.00	18.00	3.97

Table 2.1. Index/Sex of the respondents

Parameter	Mean Boys	Mean Girls	t-value	df	p	Valid N Boys	Valid N Girls	Std.dev. Boys	Std.Dev. Girls
index	8.08	6.00	2.73	100	0.008	48	54	3.89	3.81

In the 6-10 years group, the value ofthe index varies in the range of 6.98±3.97; ±95.00% CI: 6.20-7.76; the minimum value is 0 and the maximum value is 18.00.

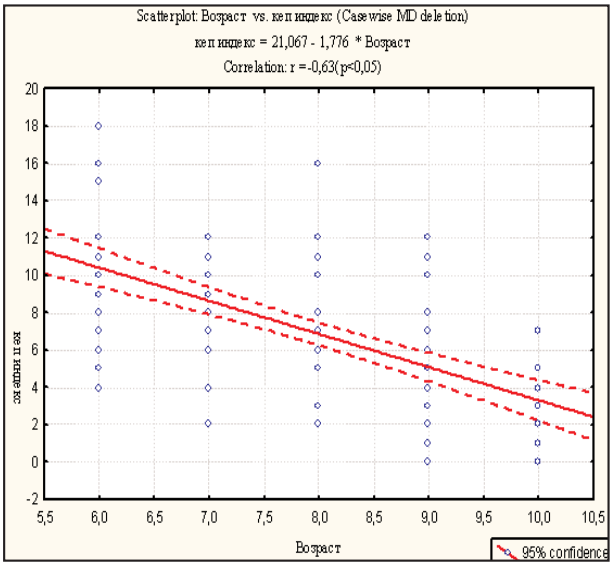
For t=2.73 and p<0.01 (p=0.008) the value of the index inthe male students was significantly higher in terms of value rather than that of the female students. (Table 2.1)

Graph 1 shows the relationship between the age of students of 6-10 years and the value of the index's index.

For r = - 0.63 (p<0.05), a very significant negative correlation was found in the examined relationship. Namely, with the increase in the age of students in a year, the value of the index was significantly lower by 1.78.

The differences between the values of the KP index in relation to the ethnicity of the students are shown in Table 2.2 and Table 2.2.1.

For F = 1.87 and p> 0.05 (p = 0.14) there is no significant difference between the values of the cap index



Graph 1

Table 2.2. Index/Sex of the respondents

Parameter	SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	p
DMFT index	86.38	3.00	28.79	1505.58	98	15.36	1.87	0.14

Table 2.2.1. index/Ethnic affiliation of the respondents/Post hoc

Ethnicity	{1} M=6.82	{2} M=6.42	{3} M=8.91	{4} M=11.00
Macedonians {1}		0.63	0.11	0.14
Albanians {2}	0.63		0.07	0.11
Turks {3}	0.11	0.07		0.49
Roma {4}	0.14	0.11	0.49	

compared to the ethnicity of the students from 6-10 years.

In the Post hoc analysis between the average values of the cap population index of the Macedonians (x=6.82), the Albanians (x = 6.42), the Turks (x = 8.91) and the Roma (x = 11.00) for p> 0.05 no significant difference was observed (Table 2.2.1).

Group 1: Students from 6 to 10 years of age

1. Soft and hard dental plaques according to the reene-Vermillion and IGI after Silness&Loe/DMFT index

The results shown in Table 3 refer to the investigated relationship between the DMFT index as a dependent variable and the soft and hard dental plaques according to Greene-Vermillion index and the index of gingival inflammation following Silness&Loe as independent variables.

For R = 0.30 and p< 0.05 (p = 0.03), a moderately strong significant correlation was found in the examined relation.

The DMFT indexhas the strongest impact on the IGI after Silness&Loe (Beta=0.24), the soft plaque on teeth in the Greene-Vermillion index (Beta=0.14), andthe weakest is the impact of hard dental plaque according to Greene-Vermillion index (Beta=- 0.04).

With each increase in the single value of the Silness&Loe gingival inflammation, the DMFT index increases by 1.87 units (B=1.87), significant for p<0.05 (p=0.02), with unchanged values of soft plaque on teeth in the Greene-Vermillion index and ofhard tooth deposits according to the Greene-Vermillion index.

With each increase in the single value of the soft plaque on teeth in the Greene-Vermillion index, the DMFT indexincreases by 0.52 units (B = 0.52),insignificantly for p>0.05 (p=0.17), with unchanged values of the Silness&Loe gingival inflammation and of the hard tooth deposits according to the Greene-Vermillion index.

With each increase in the single value of the hard teeth in the Greene-Vermillion index, the DMFT indexdecreases by 0.25 units (B = -0.25), insignificantly for p>0.05 (p=0.68), with unchanged values of the Silness&Loe index of gingival inflammation and of the soft plaque on teeth according to the Greene-Vermillion index.

Group 2: Students aged11 -1 4

2. Soft and hard dental plaques according to the Greene-Vermillion and IGI fter Silness&Loe/DMFT index

The results shown in Table 4 refer to the investigated relationship between the DMFT index as a dependent variable and the soft and hard dental plaques according to Greene-Vermillion index and the index of gingival inflammation following Silness&Loe as independent variables.

For R = 0.22 and p>0.05 (p=0.21), a moderately weak insignificant correlation was found in the examined relation.

The DMFT indexhas the strongest impact on the IGI after Silness&Loe (Beta=-0.19), the soft plaque on teeth in the Greene-Vermillion index (Beta = 0.13), andthe weakest is the impact of hard dental plaque according to Greene-Vermillion index (Beta = -0.11).

With each increase in the single value of the Silness&Loe gingival inflammation, the DMFT index decreases by 2.15 units (B = -2.15), insignificantly for p>0.05 (p=0.08), with unchanged values of the soft plaque on teeth in the Greene-Vermillion index and of hard tooth deposits according to the Greene-Vermillion index.

With each increase in the single value of the soft plaque on teeth in the Greene-Vermillion index, the DMFT index increases by 1.15 units (B = 1.15), insignificantly for p>0.05(p=0.25), with unchanged values of the Silness&Loe gingival inflammation and of the hard tooth deposits according to the Greene-Vermillion index.

With each increase in the single value of hard teeth in the Greene-Vermillion index, the DMFT indexdecreasesby 1.22 units (B=-1.22), insignificantly for p>0.05 (p = 0.32), with unchanged values of the Silness&Loe index of gingival inflammation and of the soft plaque on teeth according to the Greene-Vermillion index.

Table 3. Soft and hard dental plaques according to the Greene-Vermillion &IGI after Silness&Loe/DMFT index

Regression Summary for Dependent Variable: DMFT index R = 0.30; F (3.98) = 3.19 p <0.03

	Beta	Std. Errorof Beta	B	Std. Error B	t (99)	p-level
Intercept			-0.25	0.89	-0.28	0.78
Soft deposits according to Greene-Vermillion index	0.14	0.10	0.52	0.37	1.39	0.17
Hard deposits according to Greene-Vermillion index	-0.04	0.10	-0.25	0.62	-0.41	0.68
Silness&Loe index of gingival inflammation	0.24	0.10	1.87	0.79	2.37	0.02

Table 4. Soft and hard dental plaques according to the Greene-Vermillion &IGI after Silness&Loe/DMFT index

Regression Summary for Dependent Variable: DMFT index R = 0.22; F (3.928) = 1.529 p <0.21

	Beta	Std. Errorof Beta	B	Std. Error B	t (99)	p-level
Intercept			8.41	1.54	5.48	0.000
Soft deposits according to Greene-Vermillion index	0.13	0.11	1.15	0.99	1.17	0.25
Hard deposits according to Greene-Vermillion index	-0.11	0.11	-0.22	0.22	-1.00	0.32
Silness&Loe index of gingival inflammation	-0.19	0.11	-2.15	1.22	-1.76	0.08

Discussion

The determination of the condition of the teeth was conducted and compared with the DMFT Index, which records the presence of carious, extracted and sealed teeth, between the two groups of examinees: students with primary dentition 6-10 years of age and students with permanent dentition of 11 -14 years.

The results of this study are presented in Tables 1, 1.1, and 1.2, from which it can be concluded that the value ($p<0.001$) and the presence of DMFT index ($p <001$) in pupils from 11-14 years is greater than the 6- 10 years and the difference is statistically significant. This difference is considered to be due to the fact that this group has a mixed dentition, i.e. the presence of lactic dentition and the emergence of permanent teeth.

We found that the value of the DMFT index increases with increasing age. Our results do not coincide with those of Dhar et al.[17], Gao et al.[18] and Nalweyiso et al.[19], but are correlated with the results of Mahesh et al.[20], Retnakumari et al.[21], Prasai et al.[22], Motohashi et al.[23], Shourie et al.[24], Holm AK[25], Bego et al.[26], Rajic et al.[27] and Juric et al.[28] which confirm that the DMFT index increases with age.

In the group of students from 6-10 years, the prevalence of the dmft index is 73.53%. In the group of students from 11-14 years, the prevalence of the DMFT index is 93.75%.

The high prevalence of the DMFT Index is considered to be a consequence of poor and inadequate oral hygiene, hygiene-dietary rhyme, eating habits and health education, as well as the health culture for taking measures for preventive health care.

The descriptive statistics of the DMFT index among students from 6-10 years of age in terms of gender in Table 2.1 found that the value is significantly higher in males than in females. Our results coincide with those of Mahesh Kumar et al.[20], Gauba et al.[29] and Jose et al.[30] which indicate that boys have worse oral hygiene compared to girls, and are contradictory to those of Saha and Sarkar[31] and Retnakumari[21] who concluded that there was no statistically significant difference between the DMFT index in boys and girls of both groups. Graph 1 shows the relationship between the age of students of 6-10 years and the value of the DMFT index: namely, by increasing the age of the students in a year, the value of the DMFT index decreases. With increasing age, milk teeth are replaced and this contributes to the reduction of the DMFT index. The differences between the values of the DMFT index in terms of ethnicity of students Table 2.2 and 2.2.1 do not have statistical significance $p>0.05$ ($p = 0.14$).

The results shown in Table 4 relate to the examined relationship between the DMFT Index as the dependent variable and the index of soft and hard deposits and the index of gingival inflammation as independent variables. For the examined relationship, a mean - strong significant correlation was established $p <0.005$. The index of gingival inflammation, soft plaques is the most influential on the DMFT index, and the weakest is the influence of hard deposits.

These results confirm the harmful effects of microorganisms from dental plaque, not only on gingival health, but also on the condition of the dentition, that is, on the overall oral health.

Conclusion

The analysis of the obtained results from our clinical trials in the two groups of respondents, students from 6

to 10 years and from 11 to 14 years of different ethnic background from the Prespa region of the Republic of Macedonia, point to the following conclusions:

1. The prevalence of the DMFT index among all respondents showed high values. In the group of students from 6 to 10 years, the prevalence of the DMFT Index was 73.53%, and in the 11-14 age group, 93.75%, and the difference between them is statistically significant. The lower DMFT index in students from 6-10 years old is considered to be due to the process of replacing the primary with permanent teeth;
2. The presence of soft deposits and gingival inflammation have an impact on the DMFT index or, more precisely, on the condition of the dentition;
3. The analysis of the results of our research indicates the need for taking stronger measures for primary and preventive dental care among children of school age from rural settlements in the Prespa region of the Republic of Macedonia with mixed national affiliation.

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ORAL AND PERIODONTAL CHANGES IN CANNABIS USERS

ОРАЛНИ И ПАРОДОНТАЛНИ ПРОМЕНИ КАЈ КОРИСНИЦИ НА КАНАБИС

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Abstract

Background: Non-medical abuse of Cannabis may cause adverse effects on general as well as on oral health. Oral health issues related to cannabis use have been addressed concerning oral soft tissue changes and prevalence of oral cancer yet, data on periodontal involvement are still poorly documented.Aim of the study. was to determine the effects on oral and periodontal health, mouth dryness and infection with Candida albicans in patients who regularly use cannabis in comparison to tobacco smokers. **Materials and methods**. Clinical examination of the oral mucosa and periodontal examination regarding the attachment lost on all four surfaces on lower premolars (if missing lower molars) was performed in a total of 90 patients (40 marijuana users and 50 only tobacco users). Gingival bleeding upon probing and inflammation was noted according to Sillnes and Loe. Mouth dryness, Candida albicans presence and lesions of oral mucosa were also notated. **Results.** In our study we found significantly higher gum inflammation, bleeding upon probing, higher attachment lost, presence of candida and mouth dryness, leukoplakia and gingival enlargement in the cannabis users group. **Conclusion.** There is an increased presence of Candida albicans, mouth dryness, increased attachment lost as well as bleeding on probing and inflammation of the gums in cannabis users compared to the smokers. **Key words:** cannabis, smoking, gingival and periodontal changes, salivary flow rate, candida infection

Апстракт

Бројот на корисници на канабис постојано расте во светски рамки, па се смета дека 2,5% од светското население користи некоја форма на канабис. Со оглед на се поголемиот број на корисници спроведовме испитување со цел да ги согледаме ефектите врз оралната слузница како и врз пародонталното здравје кај корисниците на марихуана. За реализација на поставената цел оформивме група од 90 испитаници од кои 40 пушачи и корисници на марихуана повеќе од 5 години и контролна група составена од 50 пушачи. Испитаниците беа селектирани така да имаат приближно ист плак индекс. Беа одредени гингивални и пародонтални индекси како и преглед на оралната слузница кај двете групи. Од добиените резултати може да се заклучи дека кај групата корисници на марихуана беа најдени сигнификантно повисоки индекси на гингивална инфламација крварење и губиток на припој како и присуство на сувост на устата и Candida albicans само кај еден испитаник беше најдена гингивална хиперплазија и леукоедема.

Introduction

The use of cannabis started with the beginning of the civilization, especially for clothes, food and medication. Cannabis preparations derive from a plant called Canabbis sativa, which contains a unique group of chemicals with more than 60 types of cannabinoides. The main psychoactive constituent is 9 - tetrahydrocannabinol (THC)[1].

There are three forms of cannabis: marijuana, hashish and hash oil. After tobacco, marijuana is the second most commonly used smoking product. Among illegal drugs, it is also the most commonly used product. It has been reported that 2.5 % of the world population consumes cannabis on regular basis. With the rising likelihood of cannabis use in youth culture and lifestyle arises an even bigger concern such as the noted decline in the age of first-time users of cannabis compared to other drugs, as well as the fact that marijuana is considered to be the least risk providing drug among the youth[1].

However, the discovery of beneficial health effects of these components prompted research in the medical use of cannabis or even legalization of cannabis use in some countries. Although cannabis has such beneficial effects, non-medical abuse of this product may cause adverse effects on general as well as on oral health. Oral health issues related to cannabis use have been addressed concerning oral soft tissue changes and preva-

lence of oral cancer yet; data on periodontal involvement are still poorly documented.

Aim of the study

The aim of this study was to determine the effect on oral and periodontal health, mouth dryness and candida infection in patients who regularly use cannabis in comparison to tobacco smokers.

Material and methods

Participant selection

Exactly 90 participants, mainly men aged between 16-35 years, took part in the examination.

Group 1/ Control group: tobacco smokers

Group 2/ Examined group: tobacco and cannabis smokers

Participants of the examined group had to meet the following criteria:

- To have used cannabis in the last 5 years
- They claimed not to have any other addictions
- They use cannabis at least once a week.

In order to exclude tobacco effects, a control group was formed of regular tobacco smokers who claimed to:

- have smoked cigarettes in the last 5 years
- have never used cannabis
- have smoked at least 20 cigarettes a day

The average age for both groups was 25±2. In terms of gender representation in the examined group, only 3 women participated and in the control group 9. Participant selection was also conducted according to plaque index. All participants had average plaque score between 1 and 2 according to the Green-Vermilion index.

When we interviewed the participants we found out that they all use marijuana in the same way. Namely, they mix marijuana with tobacco, to enhance burning and afterwards it is rolled up and smoked. All of the subjects were smokers. The subjects were aware of the nicotine effects on periodontal and oral health so we decided to form a control group of smokers who had never used cannabis in order to distinguish the effects of nicotine from cannabis. In the formation of the control group we were faced with another problem, periodontal involvement is largely caused by plaque accumulation, so it was necessary to select a group with an approximately equal plaque index.

Clinical examination of the oral mucosa and periodontal examination regarding the attachment loss on all four surfaces on the lower premolars (and if missing, on lower molars) was performed. Gingival bleeding upon probing and inflammation was noted according to Sillnes and Loe. Special attention was paid to mouth dryness, loss of taste, paresthesia, microbiological findings of candida albicans, white changes of the buccal mucosa and gingival enlargement.

The measurement of the dental plaque was done according to Green-Vermilion index on teeth no. 16, 11, 26 and 31 on the vestibular side and oral surfaces of teeth no. 36 and 46.

The detection of presence of Candida albicans was done by Buchwald and lingual swab. The samples were analyzed by light microscopy on native preparation. Mouth dryness was self-reported by the patient and a test of dental mirror stickiness was performed.

Periodontal examination was conducted and an assessment of attachment lost on all four surfaces on lower premolars if missing lower molars.

Data were processed using the Computer program Statistika 6.0

Results

The results of the gingival inflammation and bleeding upon probing are given in Table 1. Gingival inflammation showed a higher rate in the examined group – 2.46 versus 1.40 in the control group, with a t value of 6.71.

The values of bleeding on probing in the examined versus the controlled group were 2.76 and 1.56 respectively with a t value of 11.30 showing that the bleeding on probing was much higher in the examined group versus the control group.

Table 1. Gingival index values for the controlled and the examined group

	Gingival inflammation	Bleeding upon probing
Control group	1.40	1.56
Examined group	2.46	2.76
t	6.71	11.30
p	<0.001	<0.001

Table 2. shows attachment lost on different surfaces, all measured on lower premolar teeth, and if missing, on lower molars. The attachment lost was much higher in the cannabis group with the highest rates of significance on distal, lingual, buccal and the least on mesial surface of the teeth.

Table 2. Mean values for attachment lost on different surfaces of lower premolar teeth of the controlled and the examined group

	Mesial (mm)	Distal (mm)	Buccal (mm)	Lingual (mm)
Group 1	1.7±0.63	2.33±0.96	3.o5±0.23	2.02±0.05
Group2	3.11±1.79	4.03±0.25	5.02±1.92	3.06±0.12
t	5.12	10.20	5.16	6.81
p	<0.001	<0.001	<0.001	<0.001

Table 3. Oral changes in both groups

	Mouth dryness	Candida albicans	White changes	Gingival enlargement
Group 1 tobacco	23.30%	3.45%		
Group 2 cannabis	52.50%	43.25%	2.2%	2.2%

Oral changes are shown in Table 3.

Mouth dryness and candida albicans were found to be higher in the cannabis group as well. White changes and gingival enlargement were absent in the tobacco group while 2.2 % of the cannabis group had both white changes and gingival enlargement.

Discussion

Since cannabis use has an increasing trend among the world population, the negative effects of the drug on the general physical health is a major concern. Almost all of the body systems are affected from the use of cannabis (the effect is mainly associated with its administration route and dosage in addition to the present general health condition of the user)[2].

However, our study was focused mainly on oral changes and periodontal involvement in long term regular marijuana users. We did expect to find higher scores of periodontal destruction since cannabis and its analogues are modulators of immune cell functions because of the high numbers of CB2 receptors distributed in the immune cells[3,4]. Those receptors exhibit their immunosuppressive effects by suppressing lymphocyte proliferation and antibody production that emerges subsequent cytotoxic activity[5]. During these events, antibacterial effector molecules and nitric oxide are released and the activities of several other critical cytokines affecting macrophages function[6]. Macrophages play a key role in host defense during both gingival inflammation and periodontal destruction. The obtained higher values for gingival inflammation, bleeding on probing and attachment loss in marijuana users compared to tobacco smokers confirmed our presumption of the destructive effects of marijuana on periodontal health.

Marijuana is the most commonly used drug for smoking mainly because it is easy to prepare it and its effects are rapidly received. Marijuana is inhaled with one – third greater volume and the subjects hold their breath four times longer compared to other tobacco products[7]. The smoke of marijuana includes similar carcinogens as the tobacco. Phenols and polycyclic aromatic hydrocarbons such as benzo[α]pyrene are some of the carcinogens present with higher concentrations in cannabis than in tobacco[8]. Therefore, it is safe to conclude that the exposition of oral mucosa to these compounds is greater than in tobacco users.

When compared with non-users, cannabis abusers have generally low oral health level involving higher amount of decayed, missed or filled teeth and increased plaque amounts with accompanying gingival or periodontal diseases[9].

One of the important negative effects of cannabis is Xerostomia[10,11]. Accordingly, its use may contribute to the risk of occurrence of several problems such as caries, periodontal problems and oral wounds[11]. “Cannabis stomatitis” is one of the examples representing the findings of leukoedema of the buccal mucosa and hyperkeratosis caused by cannabis smoking. In our study, the presence of 2.2 % leukoedema and gingival enlargement was detected. The occurrence of Xerostomia was more frequent in cannabis users than in tobacco smokers (Table 3).

While the acute signs and symptoms of the effects of cannabis use are mainly irritation and feeling of superfi-

cial anaesthesia in the oral epithelium, sialostasia and xerostomia may also accompany these findings[10].

According to the relevant literature, there is an increased prevalence of oral candidiasis and density of candida species in cannabis smokers[12], probably due to the residing hydrocarbons in marijuana that may provide energy for candida species[1]. Craving for food, sugars are particularly well known marijuana effects used in anorexia treatments. Mouth dryness, poor oral hygiene and sugar consumption explain the prevalence of candida albicans in oral swabs taken from marijuana users (Table 3).

Conclusion

Taken together, our results lead us to a conclusion that:

- There is an increased presence of Candida albicans, mouth dryness in cannabis users compared to smokers.
- There is greater attachment lost and bleeding on probing as well as inflammation of the gums in cannabis users compared to the tobacco users.
- Marijuana users are more prone to oral and periodontal diseases.

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