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CEPHALOMETRIC CHARACTERISTICS IN INDIVIDUALS WITH DIFFERENT TYPES OF VERTICAL GROWTH

КЕФАЛОМЕТРИСКИ КАРАКТЕРИСТИКИ КАЈ ИНДИВИДУИ СО РАЗЛИЧЕН ТИП НА ВЕРТИКАЛЕН РАСТ

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Abstract

Modern society today considers facial beauty as an important physical attribute. Hence achieving facial harmony and aesthetics referring to orthodontic issues becomes a major imperative. Changes in craniofacial and dentoalveolar structures during growth and development have a major influence on the change of soft tissue structures and periodontal tissues, which significantly changes the external appearance of the patient. The main purpose and task of orthodontic therapy is to correct the imbalance of the craniofacial and dentoalveolar structures and to achieve good occlusion, aesthetics and function. In order to achieve these goals, a series of diagnostic procedures will be required to provide the basic guidelines for orthodontic treatment consisting of phased implementation of certain therapeutic protocols, and often in combination with other dental branches - oral and maxillofacial surgery, periodontology, conservative dentistry. Particularly challenging are the individuals with greater deviation in the vertical dimension due to the need for combined orthodontic-surgical treatment which are the subject of our study. **Key words:** cephalometry, craniomandibular angle, type of growth-hypodivergent, hyperdivergent.

Апстракт

Модерното општество денес ја смета фацијалната убавина како важен физички атрибут. Оттаму и во ортодонцијата постигнувањето на фацијалната хармонија и естетика станува главен императив . Промените на краниофацијалните и дентоалвеоларните структури во текот на растот и развојот имаат големо влијание и на промената на мекоткивните структури и перироалните ткива, со што значително се менува и надворешниот изглед на пациентот. Основна цел и задача на ортодонтската терапија е корекција на дизбалансот на краниофацијалните и дентоалвеоларни структури и постигнување на добра оклузија, естетика и функција. За реализација на тие цели потребно е спроведување на низа од дијагностички процедури кои ќе ги дадат основните насоки на ортодонтскиот третман кој се состои од етапно спроведување на одредени тераписки протоколи, а често пати, истите се во комбинација и со останатите стоматолошки гранки – орална и максилофацијална хирургија, пародонтологија, конзервативна стоматолгија. Посебен предизвик се индивидуите кај кои постои поголемо отстапување во вертикалната димензија, заради потребата од спроведување на комбиниран ортодонтско-хируршки третман и кои се предмет на нашето испитување. **Клучни зборови:** кефалометрија, краниомандибуларен агол, тип на раст- хиподивергентен, хипрдивергентен.

Introduction

The growth and development of the craniofacial system is an individual and genetic conditional process which is manifested by different variations in the size and the shape of these structures. The morphological and clinical features of these changes are correlated with the growth potential of the individual as well as the intertwining combination of the anteroposterior and vertical dimensions that form individuals with different facial features. Teeth, muscles and bones are interconnected and interrelated throughout the process of growth. Disproportions and malposition often lead to the development of malocclusion and certain facial irregularities.

One of the main and primary tasks of orthodontics is to direct the growth and development of the orofacial system and to establish balance between its parts, thereby providing good occlusion, function and facial aesthetics. There are several diagnostic methods for making the correct diagnosis of skeletal disharmony in the orofacial region. Among the most important are profile teleradiography and cephalometric image analysis which allows us to assess dentofacial development and the type of growth of the individual. This method enables the determination of the dimensions of the facial skeleton, the interconnection of bone and soft tissue structures, as well as the characteristics of the jaw bases and dentoalveolar ratios. That is why in orthodontics the primary

importance is to make a proper diagnosis and to determine the proper plan of orthodontic treatment.

The technique of X-ray originated from Hofrath and Broadbent who have made use of X-rays to estimate the longitudinal growth of individuals. In its beginnings x-ray cephalometry was developed as means of studying craniofacial growth and development, and later its application was expanded to predict growth and development, as well as to plan the diagnosis and treatment and to evaluate the progress. Steiner emphasizes that the analysis is incomplete until individualization and adjustment of each patient is done individually. Most orthodontic clinicians supplement and refine the analysis, Sassoni, Tweed, Steiner, Shwartz, Ricketss, Solow[1-4].

The type of vertical growth of the face plays a vital role in achieving the facial balance[5]. Variations in the vertical growth are common and have certain orthodontic implications. A "long" or "short" person face may be the result of abnormal proportions of soft and bony structures in the craniofacial region. Excessive vertical growth can result in a gingival smile, incompetent lips and a long face[6]. On the contrary, lack of vertical growth can lead to an inappropriate presentation of the incisors, an inward twist of the lips and a short face[7]. Both types of face are considered to be non-aesthetic and are included in the list of orthodontic irregularities and anomalies.

The treatment of these conditions and irregularities is usually performed through functional jaw orthodontics in persons during their growth or by an orthogonal surgery in adult individuals. The success of an orthodontic treatment plan depends not only on understanding where growth occurs, but also when it is completed[8]. As the vertical component of growth is the last in the growing process, failure to control it can lead to a complex treatment, compromised outcomes and relapse after the treatment[9,10]. This explains the need for a thorough assessment and an accurate diagnostic evaluation of such differences in the vertical growth of the face in order to ensure success in the orthodontic treatment.

Lateral cephalometry facilitates the assessment of vertical skeletal discrepancies. Downs[11] used the Frankfurt Horizontal (FH) as a reference line of lateral cephalograms to estimate mandibular growth, using the Y axis and the mandibular angle of the Frankfurt horizontal (FMA). Steiner[12] uses the anterior cranial base as the reference plane - Sella-Nasion in relation to mandibular plane, the so-called cranio-mandibular angle (SN / MP) to estimate the vertical growth model. Schwarz[13], proposed the angle of the maxillary / mandibular plane (MMA) to evaluate the intermaxillary connection in vertical direction. Later, however, certain linear parameters are used, including the Jarabak's ratio and the ratio of a lower anterior face height to a total anterior face height (LAFH / TAFH), to estimate the vertical facial growth[14].

The mandibular plane as a reference plane and its relation to the surrounding structures is used in many cephalometric analyzes. Namely, it is related to the lower jaw motility, the correlation with TMZ and occlusal relations and the type of growth in horizontal or vertical direction. The craniomandibular angle - SN / MP - a parameter that is independent of the change in sagittal dimension of the mandible is used to define individuals with different types of vertical growth, i.e. individuals with vertical i.e. a hyper divergent type of growth where the values of this angle are greater than 32°, and a hypodivergent type of growth - where the SN / MP angle is less than 32°.

The size of the gonial angle has a significant influence on the degree of expression of the mandibular rotation. A smaller gonial angle results in a greater rotation forward and a shift of the chin and pogonion in the same direction. The blunt angular angle can in turn compensate for the short length of the mandibular body. In fact, the gonial angle provides compensation for the disharmony of facial ratios. The gonial angle is significantly increased in persons with hyperdivergent - a vertical type of growth compared to persons with normal and horizontal growth. The findings reached by many scientists Jensen[15], Schendel[23], Opdebeeck[18], Sassouni et al.[19], Decoster[15], Swinehat EW[15], Hapak[15], Subtelny[20], Nahor[21, 22], Trouten[23], Cangialosi[24] et al.[5] Siriwat[16] also indicate that a blunt gonial angle is associated with a skeletal open bite, while a relatively small gonial angle (a sharp angle) is associated with the presence of a deep bite. According to Sassouni[19], decreased growth in the posterior facial area height and increased anterior lower facial height result in a mandibular rotation downwards and backward with an increasing craniomandibular angle and a gonial angle.

In the study of Guo at all[25], the first group of subjects had a horizontal type of growth, while the second group had a vertical type of growth. Thus, maxillary premolar extraction was indicated only in patients with horizontal growth, whereas bimaxillary premolar extraction was appropriate in patients with moderate or vertical growth. Benett at all[28] studies have shown that persons with a hyperdivergent type of facial growth are more likely to receive dental extraction treatment, while those with a meso-divergent type of growth are more likely to undergo treatment without reduction in the teeth number. According to Shudy[29], tooth extraction contributes to "bite closure" and applies to people with a vertical type of growth.

Kim[30-33] in turn applies a specific model of determining extraction index by applying several parameters ODI - an

indicator of vertical maxillomandibular ratio which is indicative of the size of a vertical incisor relation (a sum of angles AB / MPl and SpPl / FH); APDI – an indicator of anteroposterior dysplasia of maxillary mandibular relation (a sum of angles FH / NPg, NPg / AB and SpPl / FH); CF - a balance indicator of horizontal and vertical orofacial skeletal components -∑ (ODI + APDI) and EI -an extraction index- which determines whether extraction is needed or not (∑ CF + IIA + value for protrusion or retraction of the lips) - and it is correlated with the horizontal and vertical components, the interincisal angle and the position of the lips which directly affect the appearance of the person and his aesthetic.

Lin and Gu[42] in their study conclude that more severe forms of Class III malocclusion in permanent dentition can be successfully treated by extraction of the mandibular second molar, especially in persons with a vertical growth type. This allows for greater inclination and movement of the teeth distally, as well as noticeable changes in the soft profile.

Concerning the treatment of Class III malocclusion, Beltrao[43] proceeding from Kim's cephalometric analysis and estimation of the need for extraction concludes that in these subjects good and stable results are obtained by applying camouflage orthodontic treatment that satisfies the aesthetic and the functional aspect. This is especially true for individuals with an open bite and a hyperdivergent type of growth and it is a good alternative to the surgical approach of this malocclusion.

Aims

Establishing a diagnosis thus establishing an orthodontic treatment plan is the basis and a starting point in orthodontics. It does not often indicate the need to reduce the number of teeth, so we often come across the question of how the extraction will affect the individual's external appearance, as well as the functions occurring in the oral cavity (masticatory, phonetic or nutritional function), such as the influence on the general psychosocial health of the person.

The purpose of this study is to predict and determine the orthodontic treatment plan with the help of the examined cephalometric parameters - whether it will be carried out with or without extraction of teeth in the subjects, as well as:

- to evaluate the morphological characteristics in patients with different types of vertical growth,
- to define the relation between Bjork polygon and the craniomandibular angle at different sagittal irregularities in comparison with the craniomandibular angle,
- to estimate the Jarabak ratio at different types of growth in subjects with malocclusion Class II and III and subjects with normocclusion.

Material and method

The study was performed on profile cephalograms of 60 individuals with Class II malocclusion division 1 (distocclusion), 60 individuals with class III malocclusion (mesiocclusion) and 30 individuals with normal occlusion (neutro-occlusion) (Fig.1), aged 12-16 years.

In each study group, cephalograms were divided by the type of growth determined according to the values of the craniomandibular angle (Fig.2) of the persons:

- a hyper divergent i.e. a vertical type of growth where the value of SN / MP angle is greater than 32˚ and
- a hypo divergent i.e. a horizontal type of growth, where the value of this angle is less than 32˚.

Different linear and angular parameters were included for the evaluation of the jaw relationship and the cranial base ratios from the analysis by Steiner, Jarabak and

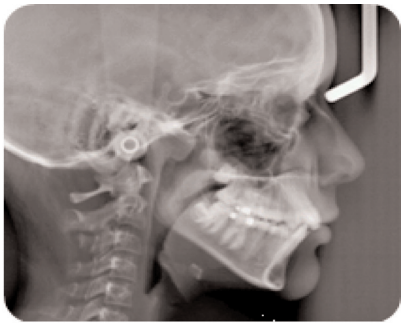


Fig.1. *Neutroocclusion* *Class II division 1 malocclusion* *Class III maloclussion*

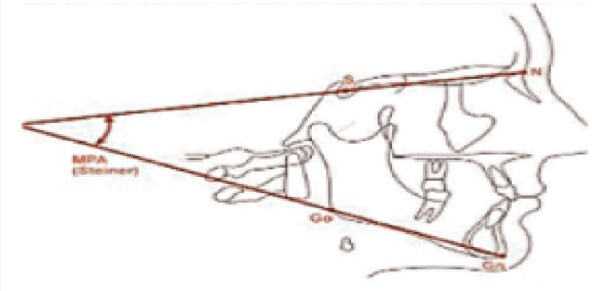


Fig 2. Craniomandibular angle SN/MPL

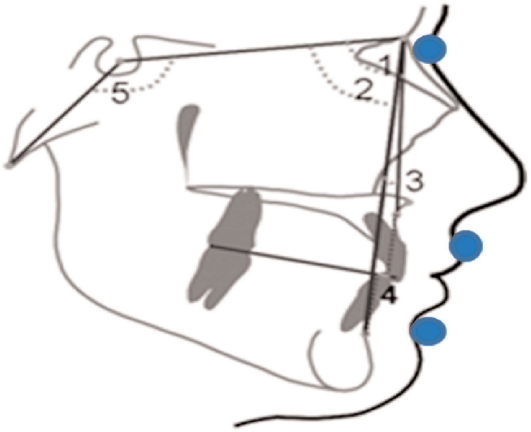


Fig 3. 1-SNA;2-SNB, 3- ANB, 4-OccPl, 5-NSBa

Tweed: SNA, SNB, ANB, NSBa (Fig. 3) as well parameters for vertical growth of Bjork and Jarabak's craniofacial structures (Fig 4.)

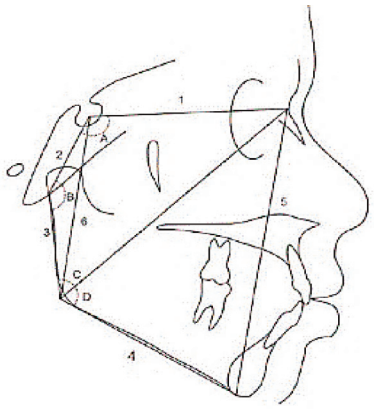


Fig. 4. A - NSAr; B – SArGo; C + D = ArGoMe
C - ArGoN (upper gonial angle):
D - NGoMe (lower gonial angle)
A+B+C+D= Bjork polygon

Results

The results of our measurements were analyzed with Statistical 7.o and are presented in the following tables.

Table 1 shows the distribution of a type of growth among the subjects with different malocclusion in the class II malocclusion division 1, we have 51.6% of subjects with a horizontal type of growth and 48.4% with a vertical type of growth. In class III malocclusion 48.4% of the subjects are with a horizontal type of growth and 51.6% with a vertical type of growth.

Table 2 and Table 3 provide a descriptive overview of the skeletal ratios of maxilla and mandible, between class I and Class II, and retrospectively class I and Class III as

Table 1. Distribution of subjects with malocclusion according to growth pattern of a craniomandibular angle -SN/MPl

Type of growth	I Class		Class II division 1 Malocclusion		Class III malocclusion	
	n	%	n	%	n	%
Normal growth	30	100,0%	0	0,0%	0	0,0%
Horizontal growth	0	0,0%	30	51,6%	30	48,4%
Vertical growth	0	0,0%	30	48,4%	30	51,6%
Total	30	100,0%	60	100,0%	60	100,0%

Table 2. Characteristics of Angular Skeletal Cephalometric Parameters in individuals with Class I -normal growth type and Class II Malocclusion with Horizontal and Vertical Growth Type

Angular Skeletal Cephalometric Parameters	Class I Normal growth			Class II division 1 Horizontal growth			t	p
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
SNA – position of maxilla relative to cranial base	80,65	2,51	0,45	82,66	3,06	0,54	-2,844	0,006 **
SNB –position of mandible relative to cranial base	77,35	2,63	0,47	76,94	2,98	0,53	0,589	0,558
ANB – angle of intermaxillary sagittal relation	3,29	0,90	0,16	5,72	1,11	0,20	-9,493	0,000 ***
SN/MP – craniomandibular angle	32,00	0,00	0,00	27,09	3,48	0,61	7,855	0,000 ***
Angular Skeletal Cephalometric Parameters	**Class I normal growth**			**Class II division 1 Vertical growth**			**t**	**p**
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
SNA – position of maxilla relative to cranial base	80,65	2,51	0,45	80,93	3,26	0,59	-0,388	0,700
SNB –position of mandibula relative to cranial base	77,35	2,63	0,47	73,63	3,31	0,60	4,876	0,000 ***
ANB – angle of intermaxillary sagittal relation	3,29	0,90	0,16	7,30	1,78	0,33	-11,133	0,000 ***
SN/MP – craniomandibular angle	32,00	0,00	0,00	39,70	4,67	0,85	-9,184	0,000 ***

Arithmetic mean - $\bar{X}$
Standard deviation – SD
Default error - SG

p <0, 05 * - low statistical significance
p <0, 01 ** - high statistical significance
p <0, 001 *** - very high statistical significance

well as their relation to malocclusion, in individuals with a horizontal growth type and a vertical type of growth.

The analysis of the angular parameter SNA^0 among the subjects with a class I normal type of growth and a malocclusion class II division 1 with a vertical type of growth, “t" test does not show statistical significance. While the SNB^0 , ANB^0 angle analysis showed very high statistical significance of 0.000 *** among individuals with Class I and Class II division 1 malocclusion with a vertical type of growth, while analysis for the cranio-mandibular angle SN/ MP^0 - "t" test shows very high statistical significance of 0.000 *** for both types of growth.

Maxillary position relative to the cranial base - SNA^0 in subjects with Class I has a mean of 80.65° , with a standard deviation of 2.51, and in subjects with Class III malocclusion with a horizontal type of growth has a mean value of 80.87 ° and a standard deviation of 3.40, the "t" test shows no statistical significance. Whereas, in the analysis of the angular parameter SNA^0, ANB^0 and SN/MP^0 among subjects with Class I with normal growth and Class III malocclusion with a vertical type of growth, the “t” test shows very high statistical significance of 0.000 ***, as a result of morphological and skeletal characteristics of malocclusions.

Compared to subjects with Class I malocclusion with normal growth and Class II Malocclusion with vertical growth there is a very high statistical significance in two parameters- the gonial angle - ArGoMe (0.000 ***) and Bjork's. polygon (0,000 ***), and low stastistical significance for gonial angle at subjects with horizontal growth compared to the normal ones.

Comparison of subjects with Class I and Class III malocclusion with a horizontal type of growth showed low statistical significance for NSAr -a selar angle (0.012 *), ArGoMe-gonial angle (0.036 *), and Bjork polygon (0.014 *). But there is a very high statistical significance

Table 3. Characteristics of Angular Skeletal Cephalometric Parameters in individuals with Class I Malocclusion and Class III Malocclusion with different growth pattern

Angular Skeletal Cephalometric Parameters	I Class normal growth			III Class Horizontal growth			t	p
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
SNA – a position of maxilla relative to cranial base	80,65	2,51	0,45	80,87	3,40	0,62	-0,290	0,773
SNB – a position of mandibula relative to cranial base	77,35	2,63	0,47	83,93	4,00	0,73	-7,617	0,000 ***
ANB – zn angle of intermaxillary sagittal relation	3,29	0,90	0,16	-3,07	2,89	0,53	11,684	0,000 ***
SN/MP – a craniomandibular angle	32,00	0,00	0,00	28,07	3,47	0,63	6,307	0,000 ***
Angular Skeletal Cephalometric Parameters	**Class I normal growth**			**Class II division 1 Vertical growth**			**t**	**p**
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
SNA – a position of maxilla relative to a cranial base	80,65	2,51	0,45	77,84	3,22	0,57	3,840	0,000 ***
SNB –a position of mandibula relative to a cranial base	77,35	2,63	0,47	80,06	3,98	0,70	-3,179	0,002 **
ANB – an angle of intermaxillary sagittal relation	3,29	0,90	0,16	0,09	0,30	0,05	19,028	0,000 ***
SN/MP – a craniomandibular angle	32,00	0,00	0,00	39,66	4,08	0,72	-10,454	0,000 ***

Arithmetic mean - $\bar{X}$
Standard deviation – SD
Default error - SG

p <0, 05 * - low statistical significance
p <0, 01 ** - high statistical significance
p <0, 001 *** - very high statistical significance

Table 4. Bjork polygon and its Angular Cephalometric Parameters at Class I and Class II division 1 with Horizontal and Vertical Growth

Angular Skeletal Cephalometric Parameters	I Class normal growth			Class II division 1 Horizontal growth			t	p
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
NSAr – selar angle	123,87	4,88	0,88	124,75	4,56	0,81	-0,739	0,463
SArGo – articular angle	146,26	7,51	1,35	143,19	7,38	1,30	1,637	0,107
ArGoMe – gonial angle	121,84	6,03	1,08	119,25	4,25	0,75	1,975	0,053 *
Bjork polygon	392,00	2,65	0,48	387,19	7,15	1,26	3,519	0,001 ***
Angular Skeletal Cephalometric Parameters	**I Class normal growth**			**Class II division 1 Vertical growth**			**t**	**p**
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
NSAr – selar angle	123,87	4,88	0,88	124,67	4,98	0,91	-0,631	0,531
SArGo – articular angle	146,26	7,51	1,35	144,27	6,94	1,27	1,075	0,287
ArGoMe – gonial angle	121,84	6,03	1,08	131,23	6,51	1,19	-5,850	0,000 ***
Bjork polygon	392,00	2,65	0,48	400,17	7,11	1,30	-5,983	0,000 ***

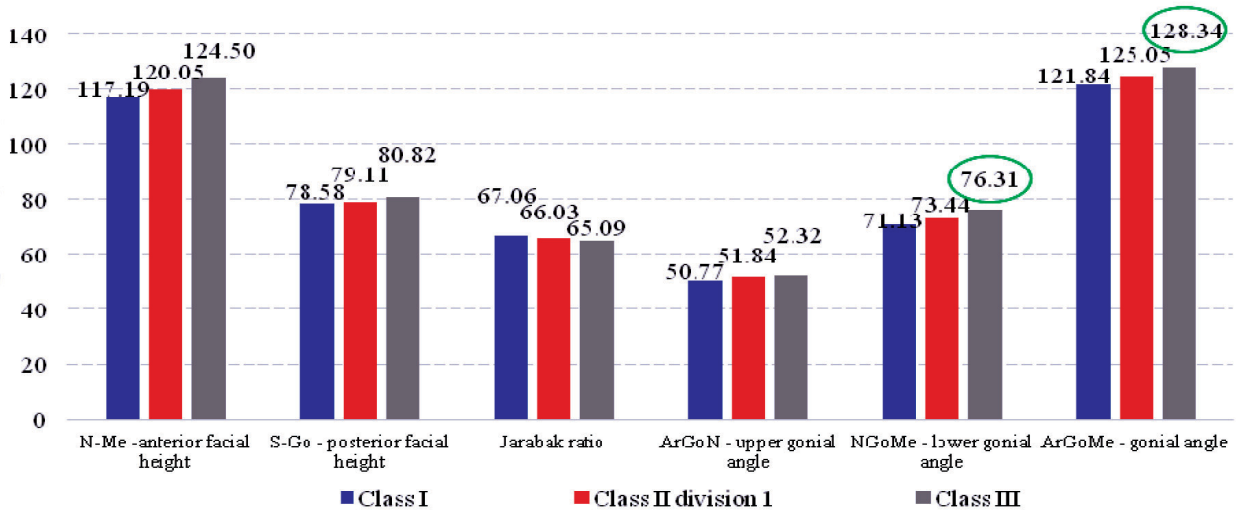
Table 5. Bjork polygon and its Angular Cephalometric Parameters at Class I and Class III with Horizontal and Vertical Growth

Angular Skeletal Cephalometric Parameters	I Class normal growth			Class III Horizontal growth			t	p
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
NSAr – selar angle	123,87	4,88	0,88	120,30	5,80	1,06	2,607	0,012 *
SArGo – articular angle	146,26	7,51	1,35	144,07	8,31	1,52	1,081	0,284
ArGoMe – gonial angle	121,84	6,03	1,08	125,00	5,47	1,00	-2,143	0,036 *
Bjork polygon	392,00	2,65	0,48	389,37	5,12	0,94	2,535	0,014 *
Angular Skeletal Cephalometric Parameters	**I Class normal growth**			**Class III Vertical growth**			**t**	**p**
	$\bar{X}$	SD	SG	$\bar{X}$	SD	SG		
NSAr – selar angle	123,87	4,88	0,88	121,78	4,88	0,86	1,700	0,094
SArGo – an articular angle	146,26	7,51	1,35	147,38	6,43	1,14	-0,635	0,528
ArGoMe – a gonial angle	121,84	6,03	1,08	131,47	6,11	1,08	-6,297	0,000 ***
Bjork polygon	392,00	2,65	0,48	400,63	3,93	0,70	-10,180	0,000 ***

for the gonial angle - ArGoMe (0.000 ***) and Bjork polygon (0.000 ***) at subjects with vertical growth Compared to subjects with Class I malocclusion with a combined growth type and Class II malocclusion with a vertical type of growth.

That is in corespondence with the findings made by Jensen, Schendel, Opdebeeck, Sassouni et al. , Decoster, Subtelny, Siriwat, -who indicate that an obtuse gonial angle is associated with a skeletal open bite, a long face, a vertical type of growth, while a relatively small gonial angle (a sharp angle) is associated with the presence of a deep bite.

When comparing the subjects with Class I malocclusion with normal growth and Class II malocclusion with a horizontal type of growth we have statistical significance in the following parameters: posterior facial



Graph 1. A presentation of anterior and posterior face height in subjects with malocclusion Class I, Class II division 1 and Class III malocclusion

height - S-Go, Jarabak ratio and a lower gonial angle - NGoMe. Regarding the ratio of Class I and Class II malocclusion with a vertical type of growth, statistically significant differences were found in almost all anterior and posterior parameters, except for posterior facial height - S-Go. "T" test showed very high statistical significance 0.001 *** in anterior face height - N-Me. The lower gonial angle showed high statistical significance for subjects with class II and III with vertical growth in comparison to Class I.

Discussion

For establishing orthodontic diagnosis and planning of orthodontic treatment, it is essential to perform an individual assessment of the craniofacial and dentoalveolar structures in all three dimensions, i.e. in the transverse, vertical and sagittal directions. The vertical facial component is an important aspect of orthodontics during the process of diagnosis and treatment planning by defining variability in treatment planning, mechanics, and facial proportions[44]. Tweed[45] links the stability of the mandibular position to the mandibular position treatment based on vertical growth. As the vertical growth of the person finishes last, the assessment of the face mismatch in the vertical dimension is not only important for accurate diagnosis and effective treatment planning, but also plays a major role and importance in preventing the relapse of the correct malocclusion.

In the past, much attention has been paid to the diagnosis and treatment of anteroposterior ratios of dental arches. However, cases that have been the most difficult to treat and have the lowest success rates and the most unfavorable prognosis are often those with vertical discrepancy. This data is often corroborated by the fact that relapse of the vertical dimension occurs in this group of treated patients.

Predicting the type of growth according to the morphology of the lower jaw of an individual has clinical implications in the planning of the patient's treatment. Namely, the decision to extract individual teeth, the type of anchorage, the mechanics and type of tooth movement, as well as the retention period are greatly influenced by the type of growth of each individual.

Morphological differences between patients with a vertical and a horizontal type of growth also result in a significant difference in mechanical activity and characteristics of the jaw muscles. The gonial angle is increased in patients with a long face or vertical type of growth, thereby reducing the muscle activity of the adductors and vice versa. As the height of the ramus increases, the muscle activity of the masseter increases. Accordingly, patients with a horizontal growth type and so-called "short face" have a significantly greater mechanical advantage over muscle activity than the long face group and the vertical type growth. Some surgical procedures that are used to correct facial dysmorphia can have a significant impact on the mechanical properties of the jaw muscles. Namely, pulling the mandible forward, that is, mesializing it, reduces the strength of the musculature.

This has a great impact on orthodontic tooth movement and must be considered when planning orthodontic treatment with mastectomy since vertical forces are often produced in the process of treating malocclusions, such as when using Class 2 intermaxillary traction or tip back. Sometimes it is also desirable - chewing forces to neutralize the action of these orthodontic forces. In addition, the significance of the effect of the masseteric force on the vertical stability of the outcome of orthodontic treatment is enormous. The new position of the teeth should be compatible with the dynamics of muscle and occlusal forces in all directions and planes. There is a serious risk of extreme migration after tooth extraction in people with vertical growth, so good anchoring is required. Providing and preserving that support zone is a critical factor in managing space in people with vertical growth, as opposed to individuals with horizontal growth or a "short face".

Larger extrusive forces are also needed to overcome increased muscle activity in persons with a hypodivergent growth type (i.e., "short" face), whereas in individuals with a hyperdivergent growth type or in vertical facial types due to leaner muscles, these forces are controlled along with the control of sagittal changes in terms of overcoming mesial migration forces of the teeth.

In individuals with a hyperdivergent growth type, a long face and a skeletal bite, mandibular and ramus surgery must be combined with maxillary intrusion. Otherwise there will be elongation of the ramus, stretching of the pterygoid muscles, and thus the tendency for relapse will be greater.

Conclusion

Our findings indicate that in persons with a hyperdivergent growth type, the maxilla and the mandible are in a retrograde position in individuals with malocclusion class I and II, whereas in subjects with malocclusion class III the maxilla is in a normal relation with other craniofacial structures.

In persons with a hypodivergent growth type there is maxillary prognathism in all sagittal irregularities examined, while the mandible is in relative normognatism, with the exception of malocclusion class III where it has a pronounced ratio in relation to other craniofacial structures.

Mandibular retrognathism is present more in subjects with Class I and II malocclusion, while prognathism - at subjects with Class III malocclusion. The maxillary position varies from normognatism at subjects with Class III, retrognathism at class I, and prognathism at individuals with class II.Facial height is in relation to the craniomandibular angle, especially anterior facial height at subjects with vertical growth and distooclusion. The lower gonial angle is also in relation to a type of growth in hyperdivergent individuals with Class II and Class III malocclusion.

All of these findings lead us to plan determination of the orthodontic treatment which at horizontal growth is mostly without extraction and at individuals with vertical growth there is a need for reduction in the number of teeth so we could establish proper occlusion, function and esthetics.

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CORRELATION BETWEEN PARENTAL KNOWLEDGE AND PARENTS' ATTITUDE TOWARDS DENTAL HEALTH OF THEIR CHILDREN

КОРЕЛАЦИЈА МЕЃУ ИНФОРМИРАНОСТА НА РОДИТЕЛИТЕ И НИВНИОТ СТАВ КОН ДЕНТАЛНОТО ЗДРАВЈЕ НА НИВНИТЕ ДЕЦА

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Abstract

This study aims to determine the relationship of parental knowledge and parents' attitude on one side, comparable to the oral habits and dental status of their children on the other, as well as to evaluate whether educational status of parents and the level of motivation of parents play a significant role for children's regular dental check-ups.The present study is a descriptive survey which was carried out at the University Dental Clinical Centre "Ss. Pantelejmon" in Skopje, at the Clinic for paediatric and preventive dentistry. The representative subjects were selected by convenience sampling and included parents of preschool children. A total of 57 subjects participated in the study. An informed consent was obtained prior to data collection. The questionnaire assessed the parental knowledge and awareness of primary teeth, their location, number, functions, shedding and effects on permanent teeth. Further assessments of parents' attitude toward treatment of decayed, traumatized or infected primary teeth were made as well as assessment of their opinion and willingness to treat and extract such teeth. Most of the children attending the Pediatric and Preventive Dentistry Clinic have dental caries. Parents show more superficial or partial knowledge of the meaning of milk teeth, which in turn imposes the need to improve their awareness related to this issue. **Keywords:** information, attitude, meaning, parents, primary teeth.

Апстракт

Оваа студија има цел да ја детерминира врската меѓу информираноста на родителите и нивниот став, наспроти оралните навики и денталниот статус на нивните деца како и да евалуира дали степенот на образование на родителите и степенот на мотивираноста имаат сигнификантна врска со регуларните дентални прегледи на нивните деца. Студијата е описна и истражувачка и беше изведена на Универзитетскиот стоматолошки клинички центар „Св.Пантелејмон" во Скопје на клиниката за Детска и превентивна стоматологија. Во студијата беа вклучени родителите на предучилишни деца. Вкупниот број на испитаници беше 57, а прашалникот беше насочен кон познавањата на родителите за забите од млечната дентиција во однос на нивната локација, број, функција и нивното влијание врз трајната дентиција. Беше проследен и ставот на родителите околу третманот на кариозните, фрактурираните или инфицираните млечни заби и нивната мотивираност и став за нивно санирање или екстрахирање. Најголем број од децата кои ја посетуваат Клиниката на детска и превентивна стоматологија имаат голема застапеност на денталниот кариес. Родителите покажуваат повеќе површно или делумно познавање за значењето на млечните заби, што, од своја страна ја наметнува потребата за подобрување на оваа свест. **Клучни зборови:** информираност, значење, родители, млечни заби.

Introduction

Appropriate infant oral health attitudes and practices are of fundamental importance for preventing chronic oral diseases[1]. Oral health patterns are consolidated during childhood, and some attitudes may increase the child's risk of caries development[2, 3]. Morbidities due to dental caries are particularly harboured in children from families of low socio-economic level[4], whose nutrition[5, 6] and quality of life may be consequently impaired[3, 7–9]. Potential risk factors of dental caries include biological and behavioural factors, all of which may be modulated by environmental factors[10, 11]. Parents play an important role in promoting positive attitudes and strategies toward oral health behaviours[12, 13]. Mothers are the immediate and reliable caregivers of children in many countries, and they have a central role in providing effective guidance and positive attitudes toward oral health[14, 15]. Despite improvements in oral health measures in high-income countries, the literature notes the persistence of

an imbalance in caries prevalence in certain countries[16, 17]. Moreover, most surveys concentrate on parents from high-income countries, and less is known from countries with high prevalence of dental caries.

Aim

This study aims to determine the relationship of parental knowledge and attitude towards oral habits and dental status of their children, and evaluate whether the educational status of parents and the level of their motivation play a significant role for children's regular dental checkups.

Material and method

The present study was a descriptive, cross sectional survey which was carried out at the University for Dental Clinical Centre "Ss. Pantelejmon" in Skopje, at the Clinic for paediatric and preventive dentistry. The representative subjects were selected by convenience sampling and included parents of preschool children and primary school children categorized up to 12 years of age. A total of 60 subjects participated in the study. An informed consent was obtained prior to data collection.

A self-designed closed end type of questionnaire was provided. Assistance was offered to those who desired help in understanding the questions. The demographic details were collected from the parents, such as age, sex, educational qualification, monthly income, child's age and the reason for their visits to the dental clinic. The responders were then asked to indicate the most appropriate correct answer from the given list of options in order to assess their knowledge, awareness and perception regarding the significance of primary teeth. The questionnaire assessed the parental knowledge and awareness of primary teeth, their location, number, functions, shedding and effects on permanent teeth. Further assessments of parents' attitude toward treatment of decayed, traumatized or infected primary teeth were made as well as assessment of their opinion and willingness to treat and extract such teeth.

Results

The survey included 57 parents. It was observed that mothers (57,9%) accompanied their children more than fathers (42,1%) for dental treatment (Table 1). of which 33 (57.9%) were mothers and 24 (42.1%) fathers.

As a proxy for the socioeconomic status of the parents, we use the parents' employment status, so we rank them as parents with high, middle and low socioeconomic status, if both, one or none of the parents were employed, respectively. Figure 1 shows that 30 % of the families had one employed parent, 43 % were with both employed parents and 27 % were with two unemployed parents.

Table 1. Distribution of respondents by sex

Parent	Number of respondents	Percent
Mother	33	57,9
Father	24	42,1
Total	57	100

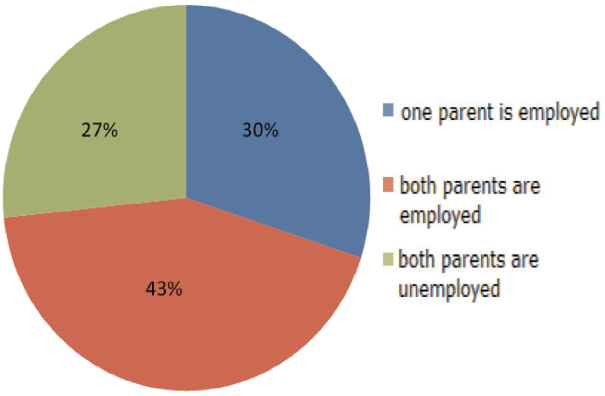

Figure 1. *Distribution of parents by employment*

Figure 2 describes the level of parents' education in our survey. 12 % of the parents were with primary education, 50 % with secondary, 2 % higher education and 37 % with high education.

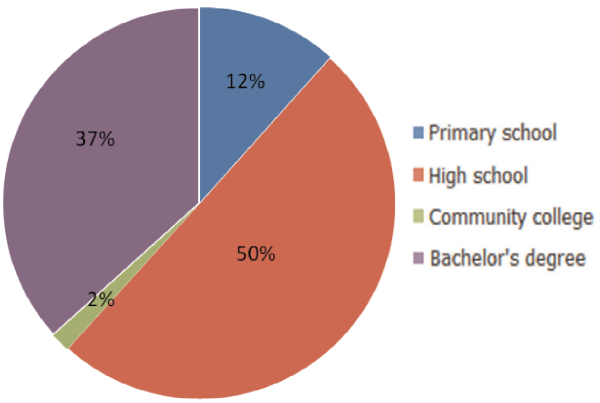

Figure 2. *Distribution of parents by level of education*

Table 2. Distribution of parental responses in percentages

		Answers in numbers	Percentage
1	**What was the reason for your child's first dental visit?**		
	Pain/swelling	21	36.84
	Visible change in the teeth colour	7	12.28
	Regular check-up	29	50.88
2	**How frequently do you take your child to the dentist?**		
	Every 3-6 months	18	31.58
	Every 6-12 months	8	14.04
	When needed (when there's a problem)	31	54.39
3	**Who is your child's dentist?**		
	My dentist	22	38.60
	A specialist in pediatric and preventive dentistry	35	61.40
4	**What are primary (milk) teeth?**		
	Teeth which only children that drink milk have	5	8.77
	Teeth which all children have	10	17.54
	The first set of teeth that will be replaced with permanent teeth	42	73.68
	None of the above	0	0.00
5	**What is the total number of milk teeth?**		
	All the front teeth	9	15.79
	All the teeth in the mouth, when the children are 4 years old	43	75.44
	All the upper teeth		0.00
	I don't know	5	8.77
6	**How many teeth in a 3-years old child's mouth are milk teeth?**		
	0.5	14	24.56
	0.25	2	3.51
	There're no milk teeth when a child is 3-years old		0.00
	All the teeth are milk teeth	41	71.93
7	**What's the total number of milk teeth?**		
	8	4	7.02
	12	11	19.30
	18	11	19.30
	20	31	54.39
	4	0	0.00
8	**Do you think that all the milk teeth will be replaced?**		
	Yes	49	85.96
	No	4	7.02
	Only the front teeth	4	7.02
	Only the back teeth	0	0.00

9	**At what age do milk teeth start being replaced by permanent teeth?**		
	4 years	9	15.79
	6 years	47	82.46
	12 years	1	1.75
	18 years		0.00
10	**Do all the permanent teeth erupt with the replacement of milk teeth?**		
	Yes	32	56.14
	No	7	12.28
	Some of them	18	31.58
11	**Milk teeth are important for:**		
	Chewing	6	10.53
	The child's physical appearance	3	5.26
	Speaking	2	3.51
	The eruption and maintaining space for the permanent teeth	8	14.04
	All the above is correct	38	66.67
	None of the above is correct	0	0.00
12	**Do you think that a milk tooth decay should be treated?**		
	Yes	53	92.98
	No	4	7.02
13	**If a milk toot is infected**		
	It's important that is preserved, if possible	39	68.42
	It's not necessary to be preserved, since it will eventually fall off	18	31.58
14	**If your child has a milk tooth that is infected and needs a longer therapy which will be provided over several dental visits and will incur additional costs, you will:**		
	Accept the therapy	53	92.98
	Reject the therapy	4	7.02
14a	**Reasons:**		
	Time	3	5.26
	Financial challenges	1	1.75
	You don't feel the need to waste time and resources for curing a tooth which will eventually be replaced with a permanent one		
15	**If your child has an infected tooth for which the only solution is tooth extraction, you will:**		
	Accept	47	82.46
	Reject	10	17.54
15a	**Reasons:**		
	You're afraid that the infection will spread to the eyes	1	1.75
	You're afraid that the infection will spread to the brain		
	You don't think that extraction will be needed, since the tooth will be replaced by another tooth	3	5.26
	It will cause trauma or pain for the child	6	10.53
	It costs		

The $\chi 2$ independence test is used to test the dependence between two categorical variables. Each of the selected variables can have two or more categories. The basic assumption, in order to obtain valid results using the $\chi 2$ test is at least 80% of the data to have an expected frequency of 5 or more. The SPSS 21 statistical software was used to calculate the $\chi 2$ test statistic. This software, when calculating the $\chi 2$ test, shows Pearson Chi-Square and Likelihood Ratio values, with corresponding p-values. When the basic assumption is not disturbed, we use the Pearson Chi-Square value, and if it is, then the Likelihood Ratio is used. In the following table, both are shown, but both show the same (in) significance. In order to determine if there is a statistically significant correlation, we compare the p-values of $\chi 2$ test with the selected level of significance (5%). If the p-values of the $\chi 2$ test are less than 5%, then the relationship is statistically significant.

In our research, the $\chi 2$ test was used to show whether there was a statistically significant relationship between the level of education of the parent and the answer to the questions in the survey. Finally, the $\chi 2$ value is given for examining the significance of the level of education on the dmf index, which will be discussed later on.

Thus, at the significance level of 5%, the results show that statistically significant correlations are present in questions 2, 4, 5 and 14. Namely, how often parents take their children to the dentist depends on the level of education of the parent, i.e. parents with lower education (primary) visit the dentist only when a problem occurs, unlike those with higher education (secondary and higher) who visit their dentist on a more regular basis. Similarly, knowledge of primary teeth, what they are and what their number is, is relatively lower among parents with primary education compared to parents with secondary and higher education. Also, their willingness to accept longer treatment, which would mean more visits to the primary dentist and additional costs, is related to the level of education of the parents. Since the $\chi 2$ test only shows whether there is a certain statistical relationship between the two variables but does not indicate how strong the relationship is, we also calculate the Cramer's V - effect size measure where a statistically significant correlation is evident. According to Cramer's V obtained values for questions where there is a significant association, we can conclude that the effect of educational level on the corresponding answers is moderate (Table 3).

Next, we look at the dmf index, which measures the average number of cavities, extracted and sealed teeth in each child as a truly measurable indicator and standard set by the WHO (World Health Organization).

In our study, the dmf index was 5.21 which is also considered high compared to WHO's recommendations for oral health. In order to determine whether there is any relationship between this index and the level of parent's education, we applied the $\chi 2$ independence test, with the results indicating that there was no statistically significant relationship between them (Table 3).

Table 3. Correlation between parents' level of education and children's dmf index with parents' knowledge

Question	Pearson Chi-Square	p-value	Likelihood Ratio	p-value	Significance of association 0=insignificant 1=significant	Strength of the effect of education Cramer's V
1	8.95	0.062	9.436	0.051	0	
2	**10.313**	**0.035**	**13.149**	**0.011**	**1**	**0.301**
3	0.409	0.815	0.409	0.815	0	
4	**15.924**	**0.003**	**17.254**	**0.002**	**1**	**0.374**
5	**16.918**	**0.002**	**15.082**	**0.005**	**1**	**0.385**
6	7.977	0.092	7.36	0.118	0	
7	10.582	0.102	12.066	0.061	0	
8	6.089	0.196	5.145	0.273	0	
9	6.604	0.158	4.406	0.354	0	
10	8.909	0.063	10.252	0.086	0	
11	8.084	0.425	10.057	0.261	0	
12	0.688	0.727	0.61	0.737	0	
13	3.969	0.137			0	
14	**9.789**	**0.007**			**1**	**0.414**
14A	2.278	0.685	3.001	0.558	0	
15	2.471	0.291	3.227	0.199	0	
15A	7.192	0.303	9.812	0.133	0	
KEP	18.21	0.868	22.136	0.681	0	

Table 4. Correlation between socioeconomic status of parents and children's dmf index with parents' knowledge

Question	Pearson Chi-Square	p-value	Likelihood Ratio	p-value	Significance of association 0=insignificant 1=significant	Strength of the effect of education Cramer's V
1	8.95	0.062	9.486	0.051	0	
2	10.313	0.035	13.149	0.011	1	0.301
3	0.409	0.815	0.409	0.815	0	
4	15.924	0.003	17.254	0.002	1	0.374
5	16.918	0.002	15.082	0.005	1	0.385
6	7.977	0.092	7.36	0.118	0	
7	10.582	0.102	12.066	0.061	0	
8	6.089	0.196	5.145	0.273	0	
9	6.604	0.158	4.406	0.354	0	
10	8.909	0.063	10.252	0.036	0	
11	8.084	0.425	10.057	0.261	0	
12	0.638	0.727	0.61	0.737	0	
13	3.969	0.137			0	
14	9.789	0.007			1	0.414
14A	2.278	0.685	3.001	0.558	0	
15	2.471	0.291	3.227	0.199	0	
15A	7.192	0.308	9.812	0.133	0	
KEP	18.21	0.868	22.136	0.681	0	

In addition to testing the relationship between the level of education of the parent and the answer to the questions in the survey, we also decided to test the relationship between the socioeconomic status of the parents and the questions' answers. As a proxy for the socioeconomic status of the parents we use the parents' employment status, so we rank them as parents with high, middle and low socioeconomic status, if both, one or none of the parents are employed, respectively. Thus, at the significance level of 5%, the results show that statistically significant correlations are present in questions 1, 4, 8 and 14A. The results in the present study suggest that half of the parents visited their dentist for the first time only after their child had complaints or they have noticed a change of color of the teeth themselves, while the other half actually visited the dentist for a regular check-up. In fact, the socioeconomic status does have an effect on the reason parents visited their child's dentist for the first time, so those parents with high and middle socioeconomic status are more likely to head to the dentist just for a check-up, rather than waiting for the toothache. Moreover, the knowledge of primary teeth, what they are and whether they will all be replaced, was relatively less among low socioeconomic group of parents, as compared with middle and high socioeconomic groups. Finally, their willingness for a longer treatment of an infected primary tooth was more of a time problem between high and middle socioeconomic groups, whereas it was more of a money issue for parents with low socioeconomic status.

According to the calculated Cramer's V, a statistically significant correlation is evident, we come to the conclusion that the effect of socioeconomic status on the corresponding answers is moderate.

Discussion

Maintaining healthy primary teeth is essential to a child's overall oral and general development[18]. Family members are considered the primary source for knowledge about children's health habits[19]. They are considered the key persons in achieving the best oral health outcomes and assuring well-being for children. Frequently in pediatric dental practice we find parents ignorant about the primary tooth, its function and importance. They often question the necessity of treatment to save and maintain the milk tooth in function. There is no good reason for leaving primary teeth decayed and untreated in a child's mouth. No other branch of medicine would willingly leave disease untreated[20]. Untreated carious primary tooth can give rise to different complications, such as pain, oral infection, problems in eating and sleeping, malnutrition and alterations in growth and development[21-24] and probably early loss of teeth, which

might lead to short-term effects like problems in eating and speaking and long term effects like malalignment of permanent teeth and increased risk of malocclusion later on[25].

In the present study, 36,84%of parents visited the dental clinic only after their child had complaints of untreated carious teeth; 66,67% of parents were aware of all the functions of primary teeth. How often parents take their children to the dentist depends on the level of education of the parent, i.e. parents with lower education (primary) visits the dentist only when a problem occurs, unlike those with higher education (secondary and higher) who visit their dentist on a more regular basis. Similarly, knowledge of primary teeth, what they are and what their number is, is relatively lower among parents with primary education compared to parents with secondary and higher education. Also, their willingness to accept longer treatment, which would mean more visits to the primary dentist and additional costs, is related to the level of education of parents. The reason for poor knowledge among parents and low value about primary teeth might be due to cultural-based opinions or the fact that these are temporary teeth and they will shed and be replaced by a new set of secondary teeth.

Some authors have reported that certain cultures place little value on primary teeth and that caries and early loss of the primary dentition is an accepted occurrence[26]. A qualitative study of caregivers in Saipan found that the low value attributed to baby teeth was an obstacle to developing effective preventive program[27]. In another qualitative study, Finnish caregivers of preschool children gave less importance to primary teeth when compared with general health[28]. Conversely a Canadian study indicated that parents who believed baby teeth were important had children with significantly lower caries rates than those who believed otherwise[29]. Thus, parental knowledge of primary teeth appears to have a direct effect on the oral health of the child.

In this study, the socioeconomic status does have an effect on the reason parents visited their child's dentist for the first time, so those parents with high and middle socioeconomic status are more likely to head to the dentist just for a check-up, rather than waiting for the toothache. Moreover, the knowledge of primary teeth, what they are and whether they will all be replaced, was relatively less among low socioeconomic group of parents, as compared with middle and high socioeconomic groups. Finally, their willingness for a longer treatment of an infected primary tooth was more of a time problem between high and middle socioeconomic groups, whereas it was more of a money issue for parents with low socioeconomic status.

Conclusion

The results of our study indicate that the parents involved in the research are relatively well informed, regardless of their educational and socioeconomic status, yet the impression is that children are practicing habits that adversely affect their oral dental health.

It is of particular importance to raise dental awareness of parents through programs designed for children with active parent involvement, with particular emphasis not only on their education, but also on developing personal skills, both for parents and young children.

There is an urgent need to motivate and strengthen the parents' positive attitude towards milk dental health, their function, primary preventive care for these teeth, as well as informing the parents about the first visit and the importance of regular visits to the dentist.

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PENETRATION ABILITY AND MICROLEAKAGE ASSESSMENT OF TWO DIFFERENT MATERIALS USED AS FISSURE SEALANTS

ОЦЕНУВАЊЕ НА СПОСОБНОСТА ЗА ПЕНЕТРАЦИЈА И МИКРОПРОПУСТЛИВОСТА НА ДВА РАЗЛИЧНИ МАТЕРИЈАЛИ УПОТРЕБЕНИ КАКО ЗАЛЕВАЧИ

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Abstract

Pit and fissure sealant placement is considered to be an effective modality for prevention of caries on occlusal surfaces. Penetration, retention and marginal adaptation are the key factors in success of pit and fissure sealant restorations. The failure of marginal adaptation leads to marginal leakage, which means passage of bacteria, fluids, molecules or ions between the enamel and the sealant, creating a possibility for development of dental caries below the sealant. **Aim:** The aim of this study is to assess and compare microleakage and penetration ability of a resin based sealant and a glass-ionomer cement sealant. **Materials and Methods:** In order to achieve this objective, an in vitro study will be conducted containing 30 premolars and molars extracted for orthodontic purposes, without any structural anomalies, divided in two groups of 15 samples in each group. Group-I: Fissures sealed with a resin based sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein). Group-II: Fissures sealed with a glass-ionomer cement sealant (Fuji Triage, GC Corporation Tokyo, Japan). **Results**: The first group contains samples, sealed with resin based Helioseal-F. 10 (66, 67%) samples demonstrate level-0 microleakage, 2 (13, 33%) samples demonstrate level-1 microleakage and 3 (20, 00%) samples demonstrate level-3 microleakage; 7 (46,67%) samples demonstrate level-0 penetration ability and 8 (53,33%) samples demonstrate level-1 penetration ability. The second group contains samples sealed with glass-ionomer based Fuji Triage. 3 (20%) samples demonstrate level-0 microleakage, 1 (6,67%) sample demonstrate level-1 microleakage, 3 (20%) samples demonstrate level-2 microleakage, 8 (53,33%) samples demonstrate level-3 microleakage; 10 (66,67%) samples demonstrate level-0 penetration ability and 5 (33,33%) samples demonstrate level-1 penetration ability. **Conclusion:** By observing the penetration ability and the marginal leakage score of a resin based sealant and a glass-ionomer sealant we can conclude that both materials could be recommended as a primary sealant material in the action plan strategies for prevention of dental caries. **Key words:** Prevention, microleakage, penetration ability, pit and fissure sealant.

Апстракт

Залевањето на јамичките и фисурите се смета како ефективен модалитет во превенцијата на денталниот кариес во оклузалните површини. Способноста за пенетрација, ретенција и маргинална адаптација се клучни фактори во успехот на залевачите. Неуспехот на маргиналната адаптација води кон маргинална пропустливост, што значи премин на бактерии, течности, молекули или јони меѓу глеѓта и залевачот, овозможувајќи развој на дентален кариес под залевачот. **Цел:** Цел на нашата студија е оценувањето и споредбата на микропропустливоста и способноста за пенетрација на смолестиот(композитниот) и гласјономерниот залевач. **Материјал и Метод:** За реализација на поставената цел, се спроведе in vitro истражување во кое беа употребени 30 екстрахирани премолари и трети молари,без структурни аномалии, поделени на две групи по 15 заби. Првата група ја сочинуваа заби кои беа залеани со композитен залевач (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein), втората група ја сочинуваа заби кои беа залеани со гласјономерен залевач (Fuji Triage, GC Corporation Tokyo, Japan). **Резултати:** Првата група ја сочинуваат заби кои беа залеани со Helioseal-F. Кај 10 (66,67%) заби нема пенетрација на боја (скор 0), кај 2 (13,33%) заби утврдена е пенетрација на боја до половината на должината на залевачот (скор 1), додека кај 3 (20,00%) заби е утврдена пенетрација на боја во базата на фисурата (скор 3); Кај 7 (46,67%) заби утврдивме комплетна пенетрација на залевачот (скор 0) и кај 8 (53,33%) заби е утврдена некомплетна пенетрација на залевачот (скор 1). Втората група на заби ја сочинуваат заби кои беа залеани со Fuji Triage . Кај 3 (20%) заби нема пенетрација на боја (скор 0), кај 1 (6,67%) заб утврдена е пенетрација на боја до половина на должина на залевачот (скор 1), кај 3 (20%) заби утврдена е пенетрација на боја поголема од половината на должина на залевачот (скор 2), и кај 8 (53.33%) заби утврдивме пенетрација на боја во базата на фисурата (скор 3); Кај 10 (66,67%) заби утврдивме комплетна пенетрација на залевачот (скор 0) и кај 5 (33,33%) заби е утврдена некомплетна пенетрација на залевачот (скор 1). **Заклучок:** Обсервирајќи го резултатот од способноста за пенетрација и маргиналната пропустливост на композитниот и гласјономерниот залевач, двете материјали може да бидат препорачани како примарен материјал во стратегиите за превенција на денталниот кариес. **Клучни зборови:** Превенција, микропропустливост, способност за пенетрација, фисурен залевач.

Introduction

Occlusal surface accounts for 12.5% of the total tooth area of teeth.1 From a primary prevention perspective, anatomic grooves or pits and fissures on occlusal surfaces of permanent molars trap food debris and promote the presence of bacterial biofilm, thereby increasing the risk of carious lesions development. Effectively penetrating and sealing these surfaces with a dental material, for example, pit-and-fissure sealants, can prevent lesions and are part of a comprehensive caries management approach.2 A Fissure sealant application is one of the most reliable and effective method for preventing occlusal caries. The advantage of the sealant application is significant caries risk reduction compared to non-sealed controls as well as lower cost compared to restoration placement.3 Retention rates vary according to the proper isolation of the working field, viscosity of the sealant material, preparation of enamel surfaces, and the use of an adhesive system.4

Many methods have been defined for applying fissure sealant and many materials used as a sealant have been developed. However, there is no clear consensus regarding which application technique is superior or which type of a sealant material is the most durable under oral conditions.5 Glass ionomer, resin, recently giomer-based fissure sealants, and flowable composites are the main material groups that can be used as fissure sealants. In vivo or in vitro performance of most of these materials has been investigated intensively, however, there is no material suggested as an ideal pit and a fissure sealant.6 Generally, resin-based materials are recommended having the advantage of better retention and glass-ionomer-based materials are recommended due to the advantages of fluoride release and lower moisture sensitivity.7

The preventive effect of the pit and fissure sealing is mainly based on the ability of sealant materials to flow through pits and fissures and completely fill them without any gaps or air entrapments. As long as the sealant material remains bonded to the enamel, the effective protection will continue. Microleakage is the most affecting factor on adhesion failure between the sealant and the tooth structure and can be determined by many in vitro techniques . With the advantages of reliability, simplicity, and ease of application, the dye penetration test is a well-established and commonly used method for the determination of in vitro microleakage .8

Retention and good adaption of the sealants with the occlusal surface of the enamel is essential for their success. Therefore the aim of the study is to evaluate microleakage and penetration depth of different materials used as fissure sealants.

This study will assess and compare marginal leakage and penetration ability of a resin based sealant as well as a glass-ionomer based sealant.

Materials and methods

In order to achieve this objective, we have conducted an in vitro study in which we used 30 extracted premolars and molars devoid of any caries, structural anomalies, without restorations and with orthodontic indication for extraction, distributed equally in two groups (15 in each). After the extraction the samples were held in a saline solution.

Distribution in two groups:

- Group-I: Fissures sealed with composite based fissure sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein).
- Group-II: Fissures sealed with glass-ionomer cement sealant (Fuji Triage, GC Corporation Tokyo, Japan)

For conducting microleakage and penetration ability assessment, the samples were cleaned with periodontal curettes and pumice prophylaxis, undergone for washing, application of 3% peroxide toilet and were dried with an oil free air syringe.

1. According to the manufacturer instructions, the samples from the first group were etched with a 37% phosphoric acid gel in duration of 30 seconds, rinsed with water, dried with an oil free air syringe and sealed with a resin based sealant Helioseal-F. The sealant was photopolymerized for 20 seconds with a halogen lamp Bonart art-L2 with a wavelength around 400 nm.
2. As the manufacturer instruction suggests, the samples of the second group were treated with dentin conditioner in a period of 20 seconds. The occlusal enamel was dried smoothly, in order to gain a wet occlusal surface. With a plastic dental spatula we mix the powder and the liquid in a proportion of 1.8/1 and apply it directly on a dental occlusal surface.

The root apices were sealed with red wax. All the samples were then covered with two layers of nail varnish, except for the 1-mm window around the sealant margins, and then immersed in 2% methylene blue solution for 24 h.

After the dye exposure, the teeth were thoroughly cleaned under running tap water for 5 minutes so that the superficial dye could be removed. On the other hand, the nail varnish was removed with a scalpel. Longitudinal sections were prepared with a diamond disk, in bucco-lin-

gual direction. Approximately 1.5 mm thick sections were made to assess the level of penetration depth and the degree of dye penetration in the occlusal cavity walls separately under a binocular microscope at 40X magnification, and the same were photographed with a digital camera. We determinate the penetration ability at 2 levels as Navin H.K9 stated and marginal dye penetration in 4 levels as did the authors: Overbo R.C and Raddal M.10

PENETRATION ABILITY

0 – Penetration of the sealant into the underlying fissure

1 – Incomplete penetration of the sealant

MARGINAL LEAKAGE

0 - No dye penetration

1 - Dye penetration up to one half the sealant's length

2 - Dye penetration greater than one half, not including the underlying fissure

3 - Dye penetration into the underlying fissure

Microleakage and penetration ability data for each group was compared using the Kruskal-Wallis test (H). Significant differences were evaluated using the Mann–Whitney U test (Z), t- test - independent samples (t) and the difference between the two proportions (p).

Results

1. Penetration ability score

First group contains samples, sealed with resin based material: Helioseal F; 7 (46,67%) samples demonstrate level-0 penetration ability and 8 (53,33%) samples demonstrate level-1 penetration ability. Second group contains samples, sealed with glass-ionomer based material: Fuji Triage; 10 (66,67%) samples demonstrate level-0 penetration ability and 5 (33,33%) samples demonstrate level-1 penetration ability (Table 1).

p>0,05 (p=0,40) indicates that there is no statistically significant difference between the penetration of the sealant into the underlying fissure and the incomplete penetration **of the first group** samples (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein), although incomplete penetration is more presented compared to the complete one.

p>0,05(p=0,12) indicates that there is no statistically significant difference between the penetration of the sealant into the underlying fissure and the incomplete penetration of **the second group samples** (Fuji Triage, GC Corporation Tokyo, Japan), although complete penetration is more presented compared to the incomplete one.

2. Marginal leakage score

The First group contains samples, sealed with resin based Helioseal-F. 10 (66, 67%) samples demonstrate

Table 1: Penetration ability of resin based and glass-ionomer sealant

	n	Penetration ability score Rate (%)	
		0	1
Group 1 Resin based sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein)	15	7	8
		46.67%	53.33%
Group2 Glass-ionomer cement sealant (Fuji Triage, GC Corporation Tokyo, Japan)	15	10	5
		66.67%	33.33%

Table 2: Microleakage of resin based and glass-ionomer sealant

	n	Microleakage score Rate (%)			
		0	1	2	3
Group 1 Resin based sealant (Helioseal-F, Ivoclar Vivadent AG, Liechtenstein)	15	10	2	0	3
		66.67%	13.33%	0.00%	20.00%
Group2 Glass-ionomer cement sealant (Fuji Triage, GC Corporation Tokyo, Japan)	15	3	1	3	8
		20%	6.67%	20%	53.33%

Table 3: Correlation between the penetration ability and the marginal leakage of resin based sealant

	Marginal leakage	Penetration ability		Total
		0	1	
n	0	5	5	10
%		33,33%	33,33%	66,67%
n	1	0	2	2
%		0,00%	13,33%	13,33%
n	3	2	1	3
%		13,33%	6,67%	20,00%
n	Total	7	8	15
%		46,67%	53,33%	

Table 4: Correlation between the penetration ability and the marginal leakage of glass-ionomer sealant

	Marginal leakage	Penetration ability		Total
		0	1	
n	0	3	0	3
%		20,00%	0,00%	20,00%
n	1	0	1	1
%		0,00%	6,67%	6,67%
n	2	2	1	3
%		13,33%	6,67%	20,00%
n	3	5	3	8
%		33,33%	20,00%	53,33%
n	Total	10	5	15
%		66,67%	33,33%	

level-0 microleakage, 2 (13, 33%) samples demonstrate level-1 microleakage and 3 (20, 00%) samples demonstrate level-3 microleakage. Second group contains samples, sealed with glass-ionomer based Fuji Triage. 3 (20%) samples demonstrate level-0 microleakage, 1 (6,67%) demonstrates level-1 microleakage, 3 (20%) samples demonstrate level-2 microleakage, 8 (53,33%) samples demonstrate level-3 microleakage.

Z= -2,38 and p<0.05(p=0.02) indicate that there is statistically significant difference between the microleakage score of the samples from the first group (resin based sealed samples) and the samples from the second group (glass-ionomer cement sealed samples). Microleakage score of the second group samples is significantly higher.

3. Correlation between penetration ability and marginal leakage

a). The first group samples – a resin based sealant (Helioseal F)

t=-0,18 and p>0,05 (p=0,87) indicate that there is no statistically significant difference between the microleakage score and the penetration ability score referring to group 1 samples. Microleakage score is

independent from the level of sealant penetration depth, and penetration ability score does not influence the level of microleakage.

b). The second group samples -a glass-ionomer cement sealant (Fuji Triage)

t=1,03 and p>0,05 (p=0,34) indicate that there is no statistically significant difference between the microleakage score and the penetration ability score referring to group 2 samples. The Microleakage score is independent from the level of the sealant penetration depth, and the penetration ability score does not influence the level of microleakage.

Photos below describe the penetration ability level and the microleakage level of few teeth sections, made while conducting our study.

Photos 1, 2, 3 and 4 were made from teeth sections of group 1 samples which were sealed with Helioseal-F.

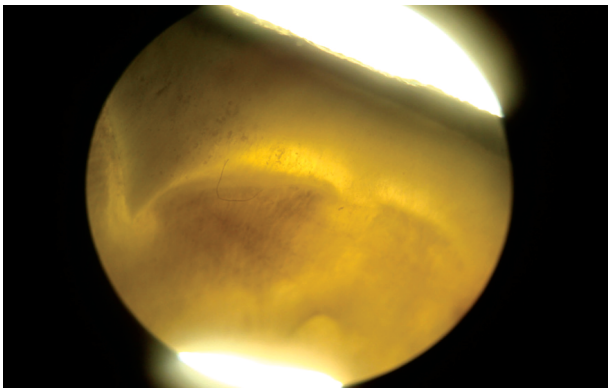

Photo 1. indicates: level 0 microleakage, level 0 penetration ability

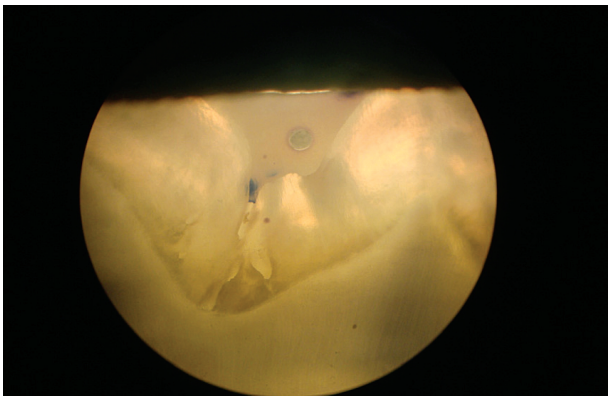

Photo 2. indicates: level 3 microleakage, level 1 penetration ability

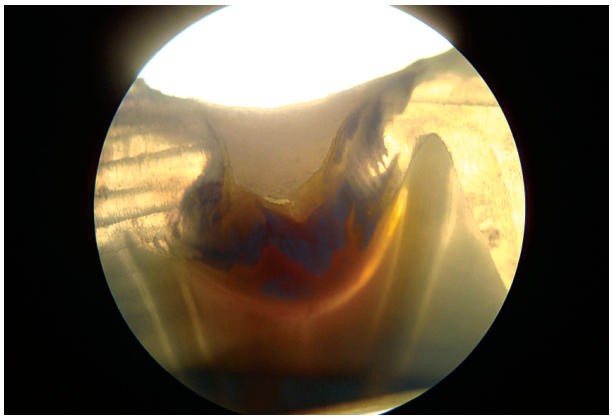

Photo 3. indicates: level 0 microleakage, level 1 penetration ability

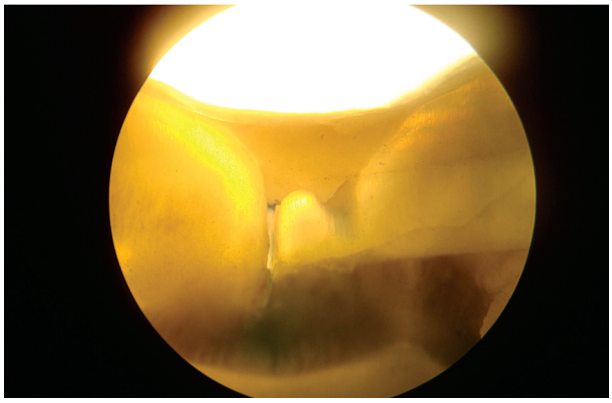

Photo 4. indicates: level 3 microleakage, level 1 penetration ability

Photos 5, 6, 7 and 8 were made from teeth sections of group 2 samples which were sealed with Fuji Triage

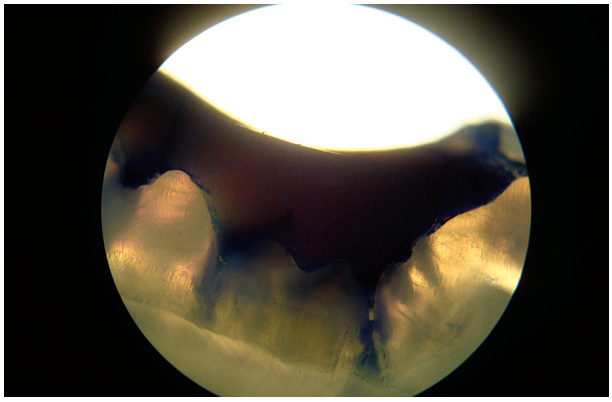

Photo 5. indicates: level 3 microleakage, level 1 penetration ability

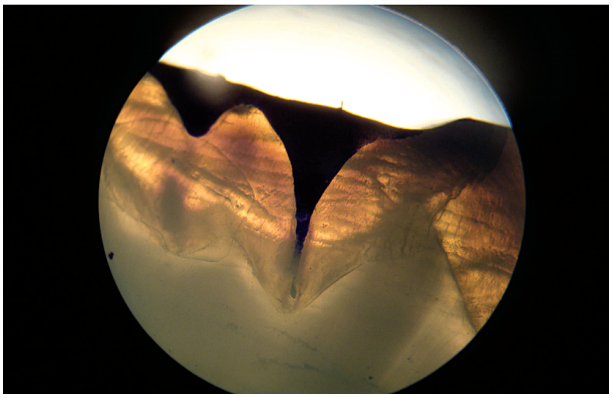

Photo 6. indicates: level 3 microleakage, level 1 penetration ability

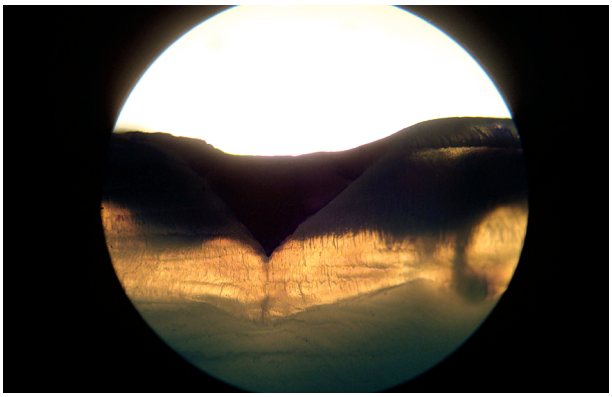

Photo 7. indicates: level 0 microleakage, level 0 penetration ability

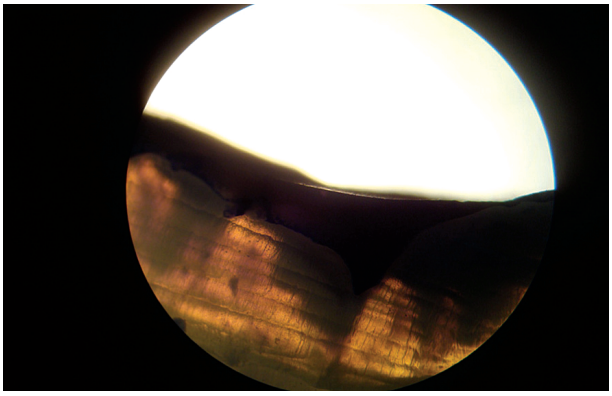

Photo 8. indicates: level 3 microleakage, level 0 penetration ability

Conclusion

Pit-and-fissure sealants have been used for nearly 5 decades to prevent and control carious lesions on primary and permanent teeth. Sealants are still underused despite their documented efficacy and the availability of clinical practice guidelines.11,12 International dentistry and paediatric dentistry guidelines recommend sealing the primary and permanent molars in children and adolescents to prevent the onset of cavities and minimize the progression of noncavitated occlusal carious lesions.13,14 Sealant efficiency depends on the ability of achieving strong bond with enamel of occlusal surface. This bond is greatly responsible for the level of microleakage in the interface enamel-sealant. The main reasons for sealant loss are addressed to microleakage, sealant depth penetration and placement technical skill.

Penetration depth is an important parameter that may increase the longevity of the sealant15 and affect the retention and adaptation of the sealant.16 Penetration of the sealant into the complete depths of pits and fissures, its lateral wall adaptation and subsequent retention are the key factors in the longevity of these restorations.17 The advantage of in vitro over in vivo studies is, that there is a possibility to determine the absolute depth of pits and fissures and the level of microleakage.

Results in our study considering penetration ability suggest that both tested materials: resin based and glass-ionomer sealants could penetrate total length of the fissure. Even in situations when penetration does not occur completely, the results are satisfying. Cowey et al recorded penetration of 70% for both resin based and glass-ionomer sealants.18 Petrovic et al concluded penetration of 80% for resin based and glass-ionomer sealants of entire fissure depth.19

No sealant remains perfectly adapted to the dental structure over time, and all will suffer some degree of microleakage. This is because the coefficient of thermal expansion of sealants is 2–4 times greater than that of enamel. Therefore, the constant temperature changes in the oral cavity give rise to the formation of gaps that facilitate the penetration of bacteria at the interface between the sealant and the enamel.20

Our study results considering microleakage demonstrated greater microleakage in samples sealed with a glass ionomer cement sealant when compared with a resin based sealant, similar results observed Ganesh and Shobha21, Gunjal, Nagesh and Raju22, Rirattanapong, Vongsavan, and Surarit.23 In contrast, Markovic et al24 using a fluorine-releasing resin sealant and a glass ionomer modified with acidic monomers and Pardi et al25 using a self-curing unfilled LCRBS , a fluid composite, a fluid compomer and a RMGIS, detected no significant differences in microleakage between the different materials.

No material is able to penetrate down to the bottom of deep and narrow fissures; it is understandable that some clinicians suspect that there are microorganisms in unfilled space or that the sealant is often placed over an incipient caries lesion. However, there is evidence that bacteria cannot remain vital and that caries lesion stops if the sealant is placed over an incipient lesion. Sealing material eliminates nourishment sources for S. Mutans and converts an active lesion into the passive caries lesion.26 Hence, authors feel that clinically maximum depth of penetration and good adaptation is more important than the complete penetration of the sealant to the base of the fissure.

The association between the risk of caries and complete loss of retention of pit and fissure sealants is significant with LCRBS, but not with glass ionomer sealants, probably due to their ability to release fluorine.27 Frencken and Wolke28 showed that, although detachment of the ionomer was observed clinically, the sealing material was retained at the bottom of the pits and fissures microscopically, with the sealing material exerting its preventive effect at the bottom of the cavity.

The logical assumption that a material that releases fluoride, such as a glass-ionomer cement, would provide an added benefit to the retentive blocking of the fissure by a resin sealant, has been tested many times with various glass-ionomer materials, sometimes in direct comparison with resin materials. There is no data that support the use of a glass-ionomer sealant in preference to a resin sealant, mainly due to the poorer retention of the glass-ionomer materials. In fact, the recent report of the ADA Council of Scientific Affairs reported that 'Resin-based sealants are the first choice of material for dental sealants' and that 'Glass-ionomer cement may be used as an interim preventive agent where there are indications for placement of a resin-based sealant but (where) concerns about moisture control may compromise such placement.29

Our findings, concerning penetration ability and microleakage of the glass-ionomer sealant and the resin based sealant, suggest using these sealants as an effective treatment modality in preventive dentistry. Sealants from this study have shown high level of penetration ability, although a glass-ionomer sealant showed better results. Regarding the microleakage level, a glass-ionomer sealant demonstrated a higher level of microleakage compared with a resin based sealant. Considering fluoride release ability factor of the glass-ionomer sealant, the preventive ability continues, although showing higher level of microleakage.

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APPLICATION OF THE CEPHALOMETRIC ANALYSIS IN ASSESSING THE EXTRACTION THERAPY IN INDIVIDUALS WITH DIFFERENT TYPE OF GROWTH

ПРИМЕНА НА КЕФАЛОМЕТРИСКАТА АНАЛИЗА ВО ОДРЕДУВАЊЕ НА ЕКСТРАКЦИОНАТА ТЕРАПИЈА КАЈ ИНДИВИДУИ СО РАЗЛИЧЕН ТИП НА РАСТ

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Abstract

All dental, skeletal and muscle components of the orofacial region are in interrelation and connection. Disturbances of the growth and development of the orofacial region often lead to occurrence of different types of facial deformities and different orthodontic anomalies in sagittal, transversal or vertical direction. The assessment of the plan of orthodontic treatment of those irregularities encompasses overall and extensive analysis of several parameters starting with the age of the person, extra-oral and intraoral characteristics of the individuals, analysis of roentgenograms and cephalograms, and gnatomeric analysis as well. All this confirms the status and importance of facial aesthetics in planning and determining the orthodontic treatment. Analyses based on the values of the craniomandibular angle (SN/MP) determine the type of growth which could be vertical or hyperdivergent and horizontal or hypodivergent. Each entity has its own skeletal, dental and soft tissue characteristics. Cephalometric analysis is an essential part of these analysis, and is of great value in assessing the plan of orthodontic treatment confirming or rejecting the decisions or dilemmas in conducting the treatment with or without extraction of teeth, which mostly depends on the degree of crowding in the mandibular front , the assessment of position of the incisors and the aesthetic line, the maxillary crowding, and the size of the horizontal incisive step overjet, as well the periodontal health and overall health of the oro-dental complex. **Key words:** cephalometric analysis, growth pattern, tooth extraction.

Апстракт

Сите дентални, скелетни и мускулни компоненти на орофацијалната регија се во меѓусебна поврзаност и интеракција. Отстапувањето во растот и развојот на орофацијалниот систем честопати води кон појава на различни типови на фацијални деформитети и различни ортодонтски неправилности во сагитален, трансверзален или вертикален правец. Одредувањето на планот на третман на истите, подразбира севкупна и опсежна анализа на повеќе параметри почнувајќи од возраста, екстраоралните и интраоралните карактеристики на индивидуата, анализа на рентгенграфски и кефалометриски снимки, гнатометриска анализа. Сето ова го потврдува значењето на фацијалната естетика при планирањето и утврдувањето на ортодонтски третман. Анализата заснована врз вредностите на кранио-мадибуларниот агол (SN / MP) го одредува видот на раст кој може да биде вертикален или хипердивергентен и хоризонтален или хиподивергентен. Секој ентитет има своја карактеристика на скелетните, денталните и орофацијаланите мекоткивни структури. Кефалометриската анализа како дел од овие анализи, е од огромно значење во одредување на планот на ортодонтскиот третман и истата ја потврдува или отфрла одлуката и дилемата за спроведување на третман со или без примена екстракција, кој во голема мера зависи од типот на раст, од степенот на збиеност во мандибуларниот фронт, естетската линија, максиларната збиеност и големината на хоризонталната инцизивна стапалка, периодонталното здравје. Сето ова го потврдува значењето и важноста на фацијалната естетика во планирањето и одредувањето на ортодонтскиот третман. **Клучни зборови:** кефалометриска анализа, тип на раст, екстракција на заби.

Introduction

Growth and development of the craniofacial system is an individual and genetic induced process, which presents in different variations in the size and form of these structures. Morphological and clinical characteristics of these changes are in correlation with the individual growth potential. As a result of different growth patterns and combinations of anteroposterior and vertical dimensions during that period, different facial characteristics evolve. Teeth, muscles, and bones are in interrelation and interconnection during growth and they tend to emphasize or

camouflage initial deformities. Their disproportions and malposition often lead to development of malocclusion and certain facial abnormalities.

One of the prime and primary tasks of orthodontics is to direct the growth and development of the orofacial region and establish a balance between all parts of that system, and with that, create a proper occlusion, function and esthetics. There are several diagnostic methods for gaining a proper and correct diagnosis of skeletal disharmonies. Profile cephalometric is among the most important and it allows us to estimate the individual growth and development, to estimate the dimensions of the facial skeleton, the interrelation of bone and soft tissues, and the characteristics of the bases of jaws and dentoalveolar relations. That's why in orthodontics, proper diagnosis is of primary importance and according to it, an adequate implementation of the orthodontic treatment.

Therefore, it is of utmost importance in orthodontics to determine the correct diagnosis and an adequate implementation of the treatment plan.

Estimation of growth reveals that postnatal growth of the face occurs mostly in depth, then in height, and at least in width. Even in the same anatomical structure like the mandible; ramus and corpus of the lower jaw enrich their dimensions with different intensity in different periods. Nanda came to conclusion that the upper and lower facial components of the anterior facial height, don't grow alike. In that manner, the importance of cephalometry in the estimation and assessment of the growth potential of every individual is bigger. The roentgen cephalometry technique was introduced by Hofrath and Broadbent who enabled the application of X-rays for assessment of longitudinal growth of individuals. In its beginnings, cephalometry developed as means to study growth and development, but later its purpose was expanded on prediction of the growth and development, for diagnosis and planning of the treatment, and estimation of the progress of the treatment as well. Steiner emphasizes that analysis is not complete until it is personalized for each patient. Several orthodontist clinicians made some improvements and supplemented the current cephalometric such as Sassoni, Tweed, Steiner, Shwartz, Ricketss, Solow[1-4].

The cephalometric analysis consists of series of measurements designed to measure different geometric parameters, which precisely determine these anatomy-morphological facial structures based on four basic parameters: size, form, position and orientation. With this analysis, we gain directions for the orthodontic diagnosis and treatment plan. The decision to reduce the number of teeth in orthodontic practice always encounters a big dilemma. Orthodontists traditionally follow a specific diagnostic procedure, which allows them to be confident in making proper decisions regarding the plan of the treatment. The cephalometric analysis helps them to estimate the proper plan individually, and decisions for extraction are easier when it's a clear case, not a "limited "one[5,6].

There are several parameters which are of great help in making that decision. Some of them are focused on the estimation of the anterior vertical growth of the face, as the axis of the mandible (Y- axis) according to Downs. This angle is in correlation with the parameter of sagittal length of the mandible, namely, a bigger antero-posterior dimension of the corpus of the mandible correlates with increased vertical growth, which is followed by increased anterior facial height and greater opportunity for development of irregularities in the vertical dimension and an open bite, thus reflecting on soft tissues and extraoral appearance of the individual. (convex or concave profile with increased anterior facial height, especially in the lower anterior region). The craniomandibular angle SN/MP is considered to be a more stable parameter which is independent of the change in the sagittal dimension of the mandible, and therefore it is also used for defining individuals with different types of vertical growth, like individuals with vertical or hyper divergent types of growth where the values of this angle are greater than 32˚, and hypo divergent growth - where the angle SN/MP is less than 32˚. In determining the direction of mandibular growth and rotation, there is also the angle that makes the Frankfurt's horizontal and mandibular plane of Tweed (FMA angle), the ratio of the posterior and anterior face height or the so-called Jarabak ratio, as well as the Vert Index of Ricketts[7], which are complementary to the overall analysis.

Guo Y. and ass.[8] conducted an analysis of the impact of the morphological characteristics of malocclusion class II grade 1 on the decision to carry out treatment with a reduction in the number of teeth, studied in 4 groups where different extraction therapies were performed. Namely, in one of the groups, two maxillary first premolars were extracted; in the second - two maxillary first premolars and one mandibular incisor; in the third – the first premolars in the upper and lower jaws, and in the fourth group - two maxillary first premolars and two mandibular second premolars. Their examinations proved that the statistically significant factors responsible for a different extraction protocol were as follows: the crowding in the mandibular frontal segment, the molar correlation, the type of growth, the size of the horizontal incisal step, and the protrusion of the lower lip.

Kim[9-11] uses a specific model of determining the so-called extraction index by applying several parameters ODI - pointer of a vertical maxilla-mandibular correlation, which is an indicator of the size of the vertical incisal step (the sum of the angles AB/MP and SpPl/FH); APDI – indicator of the anteroposterior dysplasia of the maxilla-

mandibular correlation (sum of the angles FH/NPg, NPg/AB and SpPl/FH; CF - balance indicator for horizontal and vertical orofacial skeletal components -Σ (ODI + APDI) and EI -extraction index - which determines whether there is a need for extraction or not, {Σ of CF + IIA (interincisal angle) + value of protrusion or retraction of the lips} - and is in correlation with the horizontal and vertical components, the inter-incisal angle and the position of the lips, which directly affect the appearance of the face and its aesthetics. In order to determine the type of face, the position of the lips and the characteristics of the soft tissue profile, Merrifield used an angle (Z) made by the Frankfurt horizontal and the aesthetic line (E-line). According to Ricketts[13], one of the important variables in determining the need for extraction is the distance of the lower lip from the E-line (which touches the tip of the nose and the tip of the chin). Namely, when the lips have an inadequate projection, it's difficult for the orthodontist to decide on extraction, as opposed to the position when the lips pass the E-line, when the extraction decision is easier to be made. This, in fact, confirms the importance of facial aesthetics in planning and determining the orthodontic treatment[14-20].

Many authors have conducted analyses of the need to carry out an extraction therapy in orthodontics.

According to Konstantonis et al.[21], the decision on the need to carry out the extraction therapy, depends on several changeable variables such as: the degree of crowding in the mandibular front, the aesthetic line, the maxillary density, and the size of the horizontal incisal step.

The crowding of the teeth in the maxilla, along with the size of the horizontal incisal step in individuals with class I malocclusion, is an indicator of the projection of the teeth and the soft tissue structures, which plays an important role in balanced dental and facial aesthetics. Excessive overjet is usually observed in cases with dentoalveolar bi-maxillary protrusion which are routinely addressed and treated by removing the four first premolars.

Often, in individuals with malocclusion class I, increased overjet occurs when mandible crowding is present.

According to Sivakumar[22], there is a disagreement about the effect of extractions of premolars on the dentofacial vertical dimension. It is thought that the orthodontic movement of posterior teeth towards the front or the medial line, after the extraction of the first premolars, leads to a reduction in the vertical dimension.

Shearn[23] and Woods[24] have come to the conclusion that the type of growth has a major influence on the decision to extract mandibular premolars in subjects with class II grade 1 malocclusion, as well as the size of the horizontal incisal step.

According to Guo et al.[8] while examining subjects with malocclusion class II grade 1, the extraction of maxillary premolars is indicated in patients with a horizontal type of growth, while bi-maxillary extraction of premolars is conducive to individuals with normal or vertical type of growth.

Other studies have suggested such an approach to extraction therapy in individuals with hyper-divergent or vertical type of growth, while treatment without extraction is indicated in individuals with meso-divergent (normal) type of growth[25].

Schudy 26 also points out that teeth extraction leads to "closing the bite". This philosophical approach is also represented by Sassouni and Nanda[27].

Regarding the treatment of class III malocclusion, Beltrao[28], starting from the cephalometric analysis of Kim and assessing the need for extraction with it, comes to a conclusion that these subjects give good and stable results in terms of aesthetics and function, and are obtained by applying a camouflage orthodontic treatment. This is especially true for individuals with open bite and hyperdivergent type of growth, and is a solid alternative to the surgical approach to this malocclusion.

Discussion

In orthodontics, extractions are often subject of discussion, and their percentage has significant variations over the years depending on the trend of treatment and other various factors.

In the treatment of class I malocclusion in modern orthodontics, there are two main therapeutic approaches: extraction and treatment without tooth extraction. Extractions are routinely used to address the crowding of teeth, and to reduce dental intrusion, as well as soft tissue protrusion above them. Alternative treatment is performed by widening (expansion) the dental arches. The rate of extraction in orthodontics shows strong variations depending on the decade and socioeconomic factors.

In diagnosing and planning treatment, the orthodontist examines a series of variables and parameters that give way to the final decision. These variables are measurements of cephalometric records and model analysis, taking into account both the age and gender of the patient. Other factors, such as periodontal condition, restorations and congenitally absent or extracted teeth, are also affecting the decision to extract. After taking in consideration all of the above factors, the treatment plan is determined and whether the need for extraction is justified or not[6,7].

The study of Konstantinos et al.[21] shows that the rate of extractions in subjects with class I malocclusion, is 26.8%, and is in relative consensus with the findings of

other authors. They implement the so-called discriminatory analysis, according to which the study of the ratio of 4 variables in Class I determines the need for the implementation of an extraction therapy. These are the degree of crowding in the mandibular front, the aesthetic line, the maxillary crowding, and the value of the horizontal incisal step.

According to a study conducted by Proffit[29] at the University of North Carolina in the 1950s, only 10% of cases were treated with the extraction of four first premolars. In the next decade, the percentage reaches its peak by 50% and remains at that level until the 1980's, when it begins to gradually decrease. Reducing the rate of extraction is due to the lack of evidence in literature on the stability of treatment after extraction, as well as the unproven theory that extraction is associated with TMJ dysfunction. Numerous studies suggest that more recent findings in orthodontics, along with the tendency for more protruded lips, brings the extraction rate up to 30%, and thus it reaches the level of the early 1990s.[30-32].

According to the regression formula, the decision for extraction in subjects with malocclusion Class II division 1 depends largely on three variables: anterior mandibular crowding, molar correlation and the type of facial growth. These are also the findings of Nelson[33], who came to the conclusion that the correction of malocclusion Class II division 1, is largely manifested by dental, and then by vertical changes.

The study of Al-Nimri[34] also concludes that the decision to extract the first or second premolars in the mandible is a result of crowding in the mandibular dental arch, the inclination of the maxilla-mandibular angle, and the relation between the anterior and posterior facial height.

The horizontal incisal step is also an important factor determining the need for extraction. In a certain group of patients with malocclusion class II grade 1 with increased overjet, the extraction of maxillary premolars is often carried out as an alternative to orthogonal surgery[35,36]. In cases with a large horizontal incisal step and a good or potentially good mandibular dental arch, extractions may only be limited to the upper dental arch[37].

Starting from the aesthetic point of view, there are opposed opinions on the position and the shape of the lower lip, which according to some, is largely determined by the position of mandible incisors[38,39], while others suggest that the horizontal position of the lower lip is a result of the position of mandible incisors, while its vertical position is primarily determined by the incisal edge of the maxillary incisors[40].

The treatment of malocclusion Class III mainly involves the use of fixed appliances, in combination with extraction, and is one of the options for non-surgical approach in the treatment of skeletal anomalies. The application of the arc technique with a greater number of curves, or the so called multi loop edgewise archwire –MEAW, is used for the treatment of more severe forms of Class III malocclusion. The extraction index in this technique will depend on the vertical incisal step indicator, the anteroposterior dysplasia indicator, as well the aesthetic line, the inter-incisal angle, and the position of the lips. Mandibular third molars are often extracted when using this technique.

Lin and Gu[41] concluded in their study that more severe forms of Class III malocclusion in permanent dentition can be successfully treated by extraction of mandibular second molars, especially in people with vertical type of growth. This allows greater inclination and movement of the teeth distally, as well as noticeable changes in the soft tissue profile.

Conclusion

Today, facial beauty is an important physical attribute in modern society. Therefore, in orthodontics, the attainment of facial harmony and aesthetics becomes the main imperative. Changes in the dento-alveolar structures, from the aspect of movement of the teeth, the formation of remodeling processes in the alveolar ridges, changes in the dimensions of the dental arches, also affect the change in soft tissue structures and perioral tissues, which significantly change the patient's apparent appearance.

The standards in orthodontic diagnosis and planning of orthodontic treatment aim to determine the type of skeletal malformation and its correction. Assessing the type of skeletal irregularity includes analyzing multiple craniofacial parameters that define the facial type, the placement of the jaw bases relative to the cranial base, as well as the ratio of the dento-alveolar structures. In every diagnostic system, it is quite challenging to set the normative values, and in order to determine the presence and extent of the disorder, basic signs of irregularity must be known.

Establishing the need for an extraction therapy in persons with different vertical type of growth must be performed only with an individual assessment of multiple parameters and in accordance with the goals of orthodontic treatment.

In malocclusion Class II division 1, theextraction of two maxillary premolars is suggested in cases with expressed distal molar correlation, horizontal type of growth, mild crowding in the mandibular anterior region, and large overjet-larger than 7 mm. Extractions of four first premolars would be performed in individu-

als with pronounced crowding in the mandibular front, an intermediate expression of distal molar correlation, vertical type of growth, and noticeable protrusion of the lower lip. The meso-divergent type of growth requires the extraction of first maxillary premolars and a second mandibular at moderate compression in the mandibular front and not that much pronounced distal molar correlation and less noticeable lower lip.

As for the treatment of malocclusion Class III, camouflaging treatment usually involves the proclination of the maxillary incisors and the retroclination of mandible incisors to correct the opposite, i.e. negative horizontal incisal step. The need for extraction stems from the size of the "negative" overjet and is carried out in the mandibular dental arch.

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INFLUENCE OF DIET AND LIFESTYLE ON CARIES OCCURRENCE

ВЛИЈАНИЕТО НА НАЧИНОТ НА ИСХРАНА И ЖИВОТНИТЕ НАВИКИ ВРЗ ПОЈАВАТА НА КАРИЕС

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Abstract

Aim: The aim of this research is to investigate the influence of the diet and lifestyle on the occurrence of caries in children of up to 15 years of age and the possibility of dental status improvement by means of dental education. **Materials and Methods:** During the research, 150 children, divided in three age groups – under 9, 9-13 and over 13 years of age, were interviewed answering a questionnaire of 37 questions. Their dental status was then examined, and the children were given recommendations for further dental treatment, information about proper oral hygiene and the advantages of a healthy diet. After 6 – 8 months, the children underwent a secondary examination, in order to observe the effects of the recommendations and the counseling from the previous period. **Results:** The results show that the initial DMFT index increased with the age group: 2.61 (under 9 years), 5.2 (9-13 years) and 7.38 (over 13 years of age). Increased caries occurrence had been registered in children that consume sugary or carbonated beverages, in children that consume sweets frequently or on a regular basis, that brush their teeth occasionally or in the morning only, and in children who have their teeth examined less than twice a year. After 6-8 months, the results show improved DMFT index in the age groups of under 9 (2.51) and over 13 years (7.25). **Conclusions:** A relationship between certain dietary and lifestyle habits and the occurrence of caries had been observed, as well as the improvement of the dental status due to recommendations and counseling. **Keywords:** caries, diet, oral hygiene, prevention, DMFT, children dentistry.

Апстракт

Цел: Цел на ова истражување е да се испита влијанието на начинот на исхрана и животните навики врз појавата на кариес кај деца до 15 годишна возраст, како и можноста за унапредување на денталниот статус преку едукација. **Материјали и метода:** За време на истражувањето беа анкетирани 150 деца поделени во три возрасни групи – до 9 г., 9-13 г. и над 13 г., кои одговараа на прашалник составен од 37 прашања. Потоа беше извршен стоматолошки преглед и беа дадени препораки за натамошен третман како и предавања за одржување на оралната хигиена и за предностите на здравиот начин на исхрана. После 6 – 8 месеци беше спроведен контролен стоматолошки преглед за да се согледаат ефектите од препораките и советите дадени поретходно.

Резултати: Резултатите покажуваат дека почетниот КЕП индекс се зголемува со возраста на децата и изнесува 2,61 (до 9 г.), 5,2 (9-13 г.) односно 7,38 (над 13 г.). Зголемено присуство на кариес е забележано кај деца кои често конзумираат зашеќерени и газирани пијалаци, кај деца кои често или редовно конзумираат слатки, кај деца кои забите ги мијат повремено или само наутро и кај деца кои имаат редовни стоматолошки прегледи поретко од два пати годишно. После 6-8 месеци, резултатите покажуваат подобрен КЕП индекс во групите до 9 г. (2,51) и над 13 г. (7,25). **Заклучок:** Постои извесна врска помеѓу навиките во исхраната и животните навики и појавата на кариес, како и подобрување на денталниот статус преку едукација и советување.

Клучни зборови: кариес, исхрана, орална хигиена, превенција, КЕП, детска стоматологија.

Introduction

The oral health is part of the overall health status and together they form an unbreakable bond. Caries and parodontopathy are the most common oral health issues in modern humans. Alongside diabetes, heart-related conditions and malignant diseases, they are known as Civilization Illnesses and they share common risk-factors related to diet, sugar intake, lifestyle and unhealthy habits[1]. The whole population is affected by caries, starting at infancy, but also at adult age[2]. In the past, the percentage of caries-affected population had been far lower than in modern times. The fast lifestyle, accompanied by frequent consumption of fast food, wide-spread intake of soft, sticky and highly processed foods, along with insufficient oral hygiene, contribute to the development of dental caries[3]. If we account for the genetic pre-disposition and microorganisms as well, it is only a matter of time when the caries will occur.

When the caries really does occur and is not treated, it can lead to serious health problems – from pain and abscesses, to system-wide infections and tooth loss.

Caries causes lower life quality and eating difficulties, and the more advanced it is, the more difficult and painful the treatment will be[5]. Therefore the role of the pedodontist is very important – the preventive check-ups for early diagnosis and treatment, fissure sealants, teeth fluoridation and re-mineralization, education of (especially) young people about maintenance of appropriate oral hygiene and diet – what is considered a healthy food and its influence on the body growth and development. Healthy offspring means healthy future.

Caries is multi-causal infectious disease of the dental tissue, that occurs as an interaction among various local and general, exogenous and endogenous factors over a sufficiently long time period. Main factors playing key-role in the caries process are the host (the tooth), the dental plaque (cariogenous micro-organisms and the oral hygiene), the diet and the temporal factor. Additional factors involved in the process are the saliva, patient age, gender, socio-demographic factors, genetic pre-disposition etc.

The relationship between the oral health and the diet is synergetic. The diet influence can be systematic – endogenous (that acts during all development stages and influences the production of the organic matrix, teeth germs and their mineralization) or local – exogenous, in the post-eruption period. The local influence can be physicomechanical (firm and abrasive food involves the whole masticatory apparatus and causes increased excretion of alkalic saliva rich in calcium and phosphates, that enables physiologic teeth self-cleaning) or chemical (intake of acidic foods or beverages lowers the pH to critical levels for caries formation and demineralization occurs).

Bacteria thrive in biofilms. A biofilm is a mixed population of various bacteria attached to certain surface The dental plaque is a classic example of biofilm, enabling its inhabitants easy access to nutrients, cross-feeding (one type of bacteria feeding on another type), waste disposal of bacterial metabolism (bacteria feeding on other bacteria metabolic waste), and creation of favorable pH environment. Of all food types, the most cariogenous are the fermentable carbohydrates, such as sucrose (common sugar), that under the influence of the microflora is fermented to glucose and fructose. Streptococcus mutans are the most cariogenous bacteria highly selective of sucrose and able to firmly adhere to the tooth surface even in presence of water-proof glucan. By fermenting various sugars, it produces acids and can metabolize in low pH in the mouth[7]. Glucan is responsible for the creation of the dental plaque and can attract certain bacteria that can interconnect and affix to the teeth. It is water-insoluble and prevents the saliva to neutralize the acidic reaction in the dental plaque. After sugar intake, the acids that are produced penetrate the plaque in several seconds, and in 1-2 minutes its pH level drops under 5,5 creating favorable conditions for demineralization. After a while, between 20 min. and 2 hours depending on the salivation, pufferization capacity of the saliva, the structure and quantity of plaque in the mouth, the pH level normalizes, calcium and phosphates return to the enamel and re-mineralization occurs. If sugars are pre-dominant in the diet, there won't be a possibility for remineralization, i.e. the demineralization prevails over remineralization manifesting in caries in its earliest stages – macula alba. It is reversible, since only demineralization occurred, without any cavity. If the demineralization frequently surpasses remineralization during longer time periods, a cavity occurs in the enamel, later progressing to the dentin[4]. In young teeth, the dentin is thinner and therefore caries can spread more quickly into the pulp, resulting in pain, abscesses and infections spreading, leading to children developing fear of dental treatments[5].

Epidemiological data presents caries as a pandemic disease, as an important health issue occurring at early infant age and spreading quickly. More than 40% of 5 years-old children in the developed countries already suffer from caries, and the situation in the developing countries is even worse. It has negative consequences on the overall health, having in mind that is connected to lung, cardiac and arthritic inflammations[8].

Conservative dental treatments are expensive. According to the World Health Organization (WHO) assessments, in most of the developed countries they account for 5-10% of the overall public health expenses and take the fourth place in the expense ranking. The developing countries in general can afford only a very small share of their public expenditure for oral health needs, since the major part of it is spent on emergency treatments and pain relief[13].

The condition and the appearance of teeth have a significant influence on the visual image of a person, and therefore on the self-confidence, social interactions and everyday life. The teeth also play very important part in speech and vocal communication[14].

Therefore, prevention methods such as regular dental examinations, fissure sealing, and fluoridation, as well as education on appropriate teeth brushing, gum care, maintenance of oral hygiene and healthy diet are key factors in caries prevention.

By implementing good preventive measures, the developed countries in North America and Europe have observed a decline in the prevalence of caries. The preventive measures combined with healthy lifestyle and improved healthcare helped the developed countries to confine dental caries under control. Unfortunately, that is not the case in the developing countries, where dental caries causes economic problems as well[1, 6].

Aim

The aim of this research is to confirm the influence of the following groups of factors on caries occurrence:

- diet, lifestyle, socio-economic and demographic factors
- children education on appropriate diet, maintenance of oral hygiene and regular dental examinations

In order to accomplish this goal, 150 children in the following three age groups were included:

- children under 9 years of age,
- children aged between 9 and 13 years and
- children over 13 years of age.

The children were interviewed answering a questionnaire of 37 questions about their demographic background, diet and lifestyle. Each child had a detailed examination of the dental status and instructions on recommended dental treatments were given to the parents. Afterwards, the children were given information about the structure of the oral cavity, the number of teeth and their corresponding function, about how to maintain proper oral hygiene and healthy diet. The lectures were accompanied by flyers and adapted to children's age.

After 6-8 months, the children had a secondary dental examination, the new dental status was recorded and recommendations on further treatment was given where necessary.

Material and method

The following materials and methods were used to accomplish the goal of the research:

- Survey questionnaire
- Group or individual lectures adapted to the age of the respondents, containing:
  - introductory information about the oral cavity, the number and function of teeth and the importance of their preservation,
  - guidelines for appropriate maintenance of oral hygiene,
  - information about the importance of regular dental examinations,
  - explanations and recommendations on how to check for dental plaque at home and usage of fluorides
  - information about the importance of an appropriate diet and its influence on the development of teeth and the whole body,
  - explanation about the food pyramid
- reminding flyers (adapted to the respondents age)

The examinations were conducted according the WHO recommendations, noting the DMFT (decayed, missing, and filled teeth) index.

Results

The results of the research are given in the tables and figures are presented below.

Table I: Personal and family data

Personal and family data	Respondents	Percentage
03. Gender		
a) male	86	57.33%
b) female	64	42.67%
05. Age Group		
a) up to 9 years	42	28.00%
b) 9-13 years	92	61.33%
c) over 13 years	16	10.67%
06. Residence		
a) urban	121	80.67%
b) rural	29	19.33%

Personal and family data	Respondents	Percentage
07a. Mother's education		
a) elementary school	11	7.33%
b) secondary school	54	36.00%
c) university	85	56.67%
07b. Father's education		
a) elementary school	14	9.33%
b) secondary school	46	30.67%
c) university	90	60.00%
08a. Mother's employment		
a) employed	109	72.67%
b) unemployed	41	27.33%
08b. Father's employment		
a) employed	138	92.00%
b) unemployed	12	8.00%

Out of total of 150 respondents (Table I), 28% were under 9 years of age, 61% were between 9 and 13, and 11% were older than 13 years. The gender distribution was in favor of males – 57%, while 43% were female.

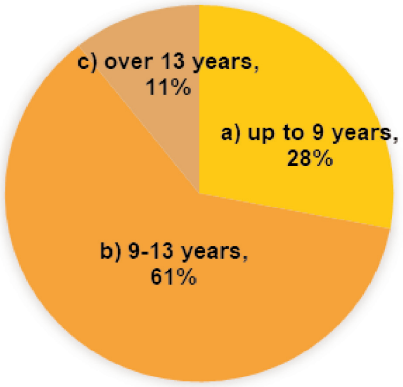

Figure 1: *Respondents distribution by age*

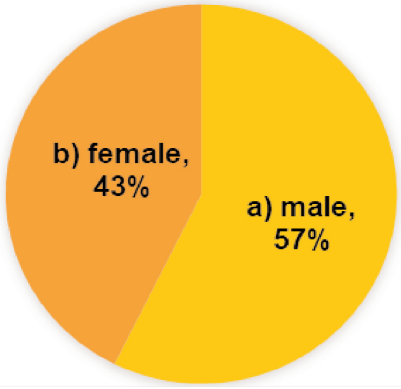

Figure 2: *Reposndents distribution by gender*

Table II: Oral hygiene maintenance

Personal and family data	Respondents	Percentage
09. Teeth brushing frequency		
a) never	7	4.67%
b) occasionally (rarely)	19	12.67%
c) in the mornings only	4	2.67%
d) in the evenings only	54	36.00%
e) in the mornings & in the evenings	65	43.33%
f) after each meal	1	0.67%

Personal and family data	Respondents	Percentage
10. Teeth brushing duration		
a) 1 min.	22	14.67%
b) 2 min.	116	77.33%
c) 3 min.	12	8.00%
11. Toothbrush type		
a) soft	45	30.00%
b) medium	104	69.33%
c) hard	1	0.67%
12. Mouthwash usage		
a) yes	53	35.33%
b) no	97	64.67%
13. Dental floss usage		
a) yes	28	18.67%
b) no	122	81.33%
14. Interdental brush usage		
a) yes	7	4.67%
b) no	143	95.33%
15. Mobile orthodontic appliance usage		
a) yes	33	22.00%
b) no	117	78.00%
16. Fixed orthodontic appliance usage		
a) yes	23	15.33%
b) no	127	84.67%
17. Vitamins/supplements usage		
a) never	49	32.67%
b) occasionally	99	66.00%
c) on a regular basis	2	1.33%
18. Fluorides usage		
a) never	102	68.00%
b) occasionally	44	29.33%
c) on a regular basis	4	2.67%
19. Fluorides used		
a) Tooth Mousse	17	11.33%
b) tabl. NaF	26	17.33%
c) topical fluoridation	5	3.33%
d) not used	102	68.00%

Table III: Caries occurrence vs. tooth brushing frequency

09. Tooth brushing frequency	Carious teeth	Respondents	Carious teeth per person
a) never			
A. Before the lecture	40	7	5.71
B. Six months after the lecture	15	7	2.14
b) occasionally (seldom)			
A. Before the lecture	127	19	6.68
B. Six months after the lecture	46	19	2.42
c) in the mornings only			
A. Before the lecture	26	4	6.50
B. Six months after the lecture	4	4	1.00
d) in the evenings only			
A. Before the lecture	225	54	4.17
B. Six months after the lecture	84	54	1.56
e) in the mornings & in the evenings			
A. Before the lecture	246	65	3.78
B. Six months after the lecture	90	65	1.38
f) after each meal			
A. Before the lecture	1	1	1.00
B. Six months after the lecture	1	1	1.00

Table IV: Dentist visits

Dentist visits	Respondents	Percentage
20. Chosen family dentist		
a) yes	150	100.00%
b) no	0	00.00%
21. Distance between residence and family dentist		
a) up to 500m	12	8.00%
b) 500m-1000m	61	40.67%
c) 1km-2km	16	10.67%
d) over 2km	61	40.67%
22. Dentist visits frequency		
a) when an issue arises	59	39.33%
b) semi-annually	63	42.00%
c) annually	25	16.67%
d) bi-annually	3	2.00%

Table V: Caries occurrence vs. tooth brushing frequency

22. Tooth brushing frequency	Carious teeth	Respondents	Carious teeth per person
a) when an issue arises			
A. Before the lecture	332	59	5.63
B. Six months after the lecture	122	59	2.07
b) semi-annually			
A. Before the lecture	158	63	2.51
B. Six months after the lecture	50	63	0.79
c) annually			
A. Before the lecture	156	25	6.24
B. Six months after the lecture	59	25	2.36
d) bi-annually			
A. Before the lecture	19	3	6.33
B. Six months after the lecture	9	3	3.00

Table VI: Dietary habits

Dietary habits	Respondents	Percentage
23. Daily water consumption		
a) 0. 5l (up to 2 glasses)	7	4.67%
b) 1l (3-4 glasses)	38	25.33%
c) 1. 5l (5-6 glasses)	80	53.33%
d) 2l (7-8 glasses)	25	16.67%
24. Beverage consumption frequency		
a) never	0	00.00%
b) occasionally	132	88.00%
c) every day	18	12.00%
25. Consumed bevarage type		
a) natural juice	53	35.33%
b) non-carbonated sugary beverage	30	20.00%
c) soda	67	44.67%
26. Consumed chewing gum type		
a) not used	44	29.33%
b) with sugar	41	27.33%
c) without sugar	65	43.33%

Personal and family data	Respondents	Percentage
27. Number of meals per day		
a) 1-2	0	00.00%
b) 2-3	34	22.67%
c) 3-4	95	63.33%
d) 3 main & 2 snacks	21	14.00%
28. Sweets/cookies/cakes/chocolate consumption frequency		
a) very rarely	1	0.67%
b) rarely	77	51.33%
c) 3-4 times a week	49	32.67%
d) every day	23	15.33%
29. Snacks consumption frequency		
a) very rarely	1	0.67%
b) rarely	66	44.00%
c) 3-4 times a week	64	42.67%
d) every day	19	12.67%
30. Pastry consumption frequency		
a) very rarely	3	2.00%
b) rarely	64	42.67%
c) 3-4 times a week	61	40.67%
d) every day	22	14.67%
31. Sandwiches/pizza consumption frequency		
a) very rarely	7	4.67%
b) rarely	67	44.67%
c) 3-4 times a week	53	35.33%
d) every day	23	15.33%
32. Fresh fruits consumption frequency		
a) very rarely	3	2.00%
b) rarely	45	30.00%
c) 3-4 times a week	80	53.33%
d) every day	22	14.67%
33. Raw vegetables (salads) consumption frequency		
a) very rarely	3	2.00%
b) rarely	43	28.67%
c) 3-4 times a week	84	56.00%
d) every day	20	13.33%
34. Milk and dairy products consumption frequency		
a) very rarely	0	0.00%
b) rarely	37	24.67%
c) 3-4 times a week	80	53.33%
d) every day	33	22.00%

Personal and family data	Respondents	Percentage
35. Cereals consumption frequency		
a) very rarely	1	0.67%
b) rarely	72	48.00%
c) 3-4 times a week	59	39.33%
d) every day	18	12.00%
36. Rice/potatoes/pasta consumption frequency		
a) very rarely	2	1.33%
b) rarely	30	20.00%
c) 3-4 times a week	94	62.67%
d) every day	24	16.00%
37. Weight		
a) underweight	9	6.00%
b) healthy weight	97	64.67%
c) overweight	31	20.67%
d) obese	13	8.67%

Table VII: Caries occurrence vs. beverages consumption frequency and type

24-25. Beverages consumption	Carious teeth	Respondents	Carious teeth per person
a) natural juice			
b) occasionally			
A. Before the lecture	122	51	2.39
B. Six months after the lecture	51	51	1.00
c) every day			
A. Before the lecture	9	2	4.50
B. Six months after the lecture	5	2	2.50
b) non-carbonated sugary beverage			
b) occasionally			
A. Before the lecture	138	23	6.00
B. Six months after the lecture	51	23	2.22
c) every day			
A. Before the lecture	40	7	5.71
B. Six months after the lecture	12	7	1.71
c) soda			
b) occasionally			
A. Before the lecture	310	58	5.34
B. Six months after the lecture	107	58	1.84
c) every day			
A. Before the lecture	46	9	5.11
B. Six months after the lecture	14	9	1.56

Table VIII: Caries occurrence vs. sweets consumption frequency

28. Sweets consumption	Carious teeth	Respondents	Carious teeth per person
a) very rarely			
A. Before the lecture	2	1	2.00
B. Six months after the lecture	1	1	1.00
b) rarely			
A. Before the lecture	226	77	2.94
B. Six months after the lecture	93	77	1.21
c) 3-4 times a week			
A. Before the lecture	275	49	5.61
B. Six months after the lecture	97	49	1.98
d) every day			
A. Before the lecture	162	23	7.04
B. Six months after the lecture	49	23	2.13

The total dmft (primary dentition DMFT) index in the first round of the research was 2.11, and in the second round (6-8 months later) it was 1.79.

The total DMFT index in the first round of the research was 4.72, and in the second round (6-8 months later) it was 4.69.

Table IX: Caries occurrence vs. sweets consumption frequency

Index value	Age group			
Dentition	**a) up to 9 years**	**b) 9-13 years**	**c) over 13 years**	**Total**
deciduous teeth (dmft)				
A. Before the lecture	2.87	1.43	0.00	2.11
B. Six months after the lecture	2.18	1.09	0.00	1.79
permanent teeth (DMFT)				
A. Before the lecture	2.61	5.20	7.38	4.72
B. Six months after the lecture	2.51	5.22	7.25	4.69

Discussion

The subject of this research are school-aged children. School age is the period when children obtain permanent oral hygiene habits. The mouth reflects our health, and there is no overall health without oral health.

The World Dental Federation (FDI) recommends that teeth be brushed twice a day (9). This research shows that 43.33% of the surveyed brush their teeth both in the morning and in the evening, compared to 12.67% that rarely brush, and 4.67% that don't brush at all (Table II). These results correlate to the dental caries rates in Table III. The respondents that brush occasionally, or only brush in the morning have the highest number of carious teeth per person on average, 6.68 and 6.5 correspondingly. Those that only brush their teeth in the evening have 4.17, and those that brush both in the morning and in the evening have 3.78 carious teeth per person on average. The second round of examinations shows improvement in all categories, partly attributed to the lectures on proper diet and oral hygiene, but mostly as a result of the suggested treatments, which often resulted in family dentist visits and carious teeth repairs.

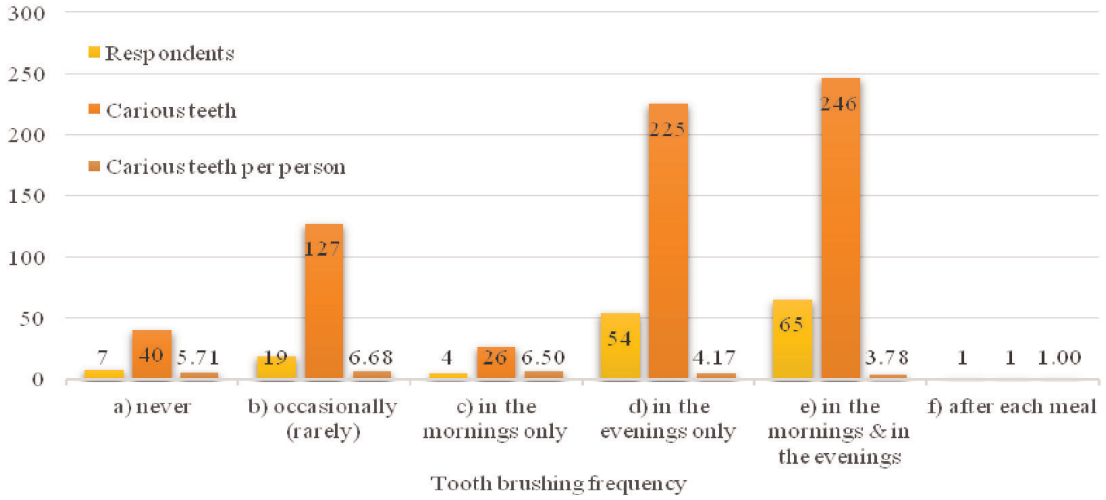

Figure 3: *Caries occurrence vs. tooth brushing frequency at the beginning of the research*

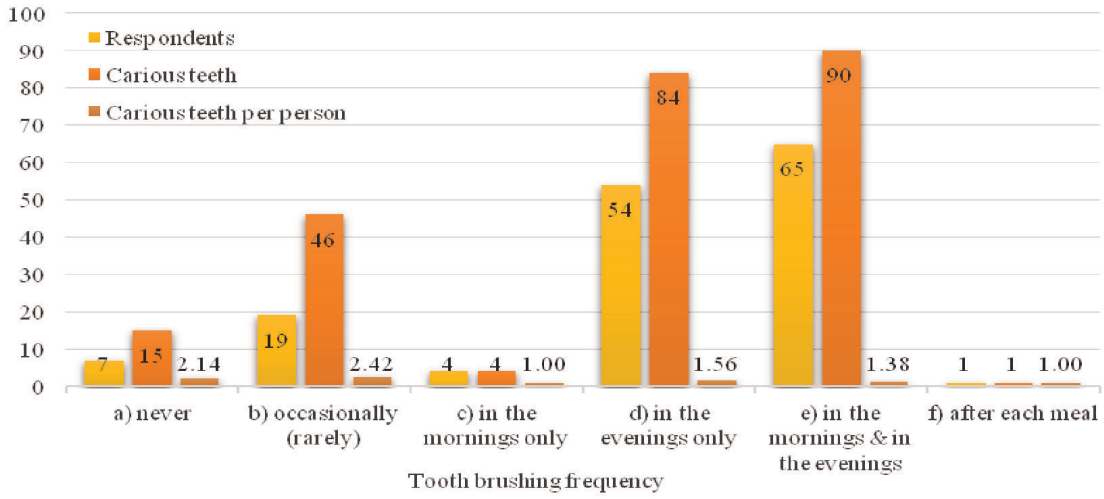

Figure 4: *Caries occurrence vs. tooth brushing frequency six months later*

The FDI also recommends brushing for at least 2-3 minutes[9]. Our research (Table II) indicates that 77.33% of the respondents brush for at least 2 minutes, which is encouraging. However, most of the respondents neither use mouthwash (64.67%), dental floss (81.33%), interdental toothbrush (95.33%), nor fluoride products. When flossing fully erupted permanent teeth[10], lower caries and gingivitis rates[11] are expected.

22% of the respondents wear mobile, while 15.33% wear fixed orthodontic appliances. In some cases, respondents wearing fixed orthodontic appliances also had some of their permanent teeth extracted.

Since 2008 Macedonia has had a strategy for oral diseases prevention for children aged 0-14. This strategy includes lectures in schools and kindergartens, mandatory dental checkups, fissure sealing of healthy permanent teeth, and fluoridating. The data from the first visit of our respondents showed a large number of sealed teeth. Most of the patients that didn't have the teeth sealed and we recommended that they should do so, had their teeth sealed after 6 months. It is partly due to our advice, as well as the regular checkups in school.

It is quite encouraging that all the children responded that they had a family dentist (Table IV), however only 42% practice regular checkups, while 39.33% only visit their dentist when an issue arises. A strong correlation exists between caries occurrences and the frequency of dentist visits (Table V) – namely, children visiting their dentist only when an issue arises have 5.63, children with bi-annual checkups 6.33, children with annual checkups have 6.24 while children that visit their dentist semi-annually have only 2.51 carious teeth on average.

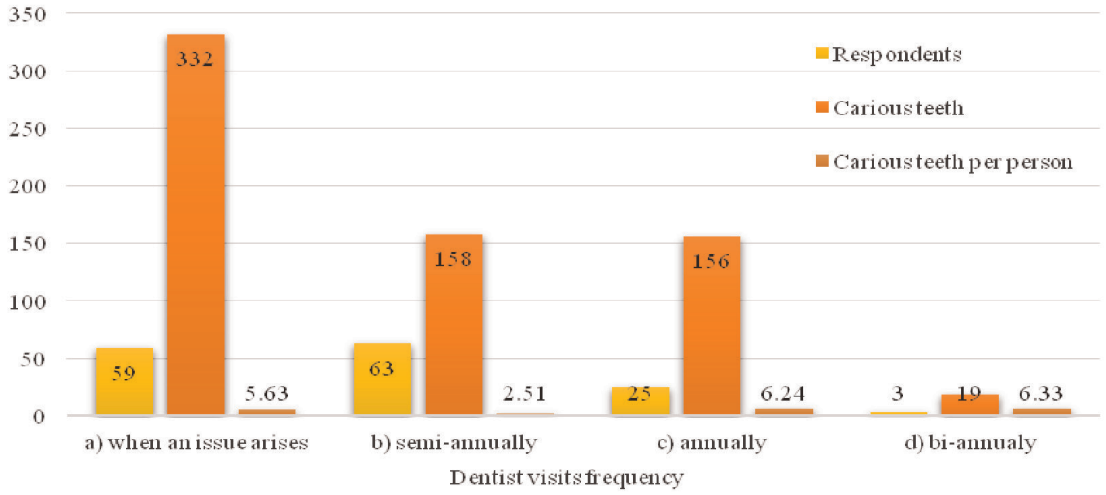

Figure 5: *Caries occurrence vs. dental visits frequency at the beginning of the research*

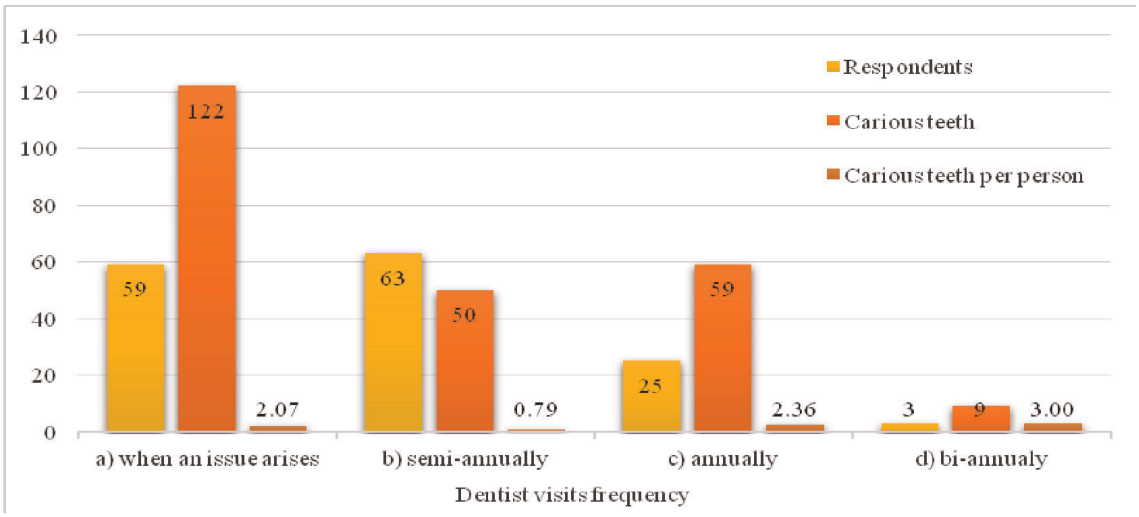

Figure 6: *Caries occurrence vs. dental visits frequency six months later*

Bad dietary habits are hard to get rid of (table VI) – 97 respondents (about 2/3 of the total number) enjoy non-carbonated sugary (20%) or soda (44.67%) beverages. It has been proven that caries is 33% more frequent in people who drink 2, 3 or more sugary drinks per day (12). According to our research (Table VII), respondents drinking non-carbonated sugary drinks occasionally have 6.00, and those drinking them every day have 5.71 carious teeth per person on average; those that drink soda drinks occasionally have 5.34, those drinking soda drinks every day have 5.11 carious teeth per person on average; those drinking natural fruit juices occasionally have 2.39 carious teeth per person on average, while those drinking natural fruit juices every day have 4.50 carious teeth per person on average. This indicates that even natural fruit juices because of their high sugar content can contribute to caries occurrence when consumed daily.

According to Table VI, 15.33% of the respondents consume sweets every day, while 32.67% consume sweets 3-4 times a week. The former group (Table VIII) has 7.04, while the latter has 5.61 carious teeth per person on average. The respondents that rarely consume sweets have 2.94 and those that very rarely consume sweets have 2.00 carious teeth per person on average. The strong positive correlation with the DMFT index proves that sugary drinks and sweets significantly affect caries rates.

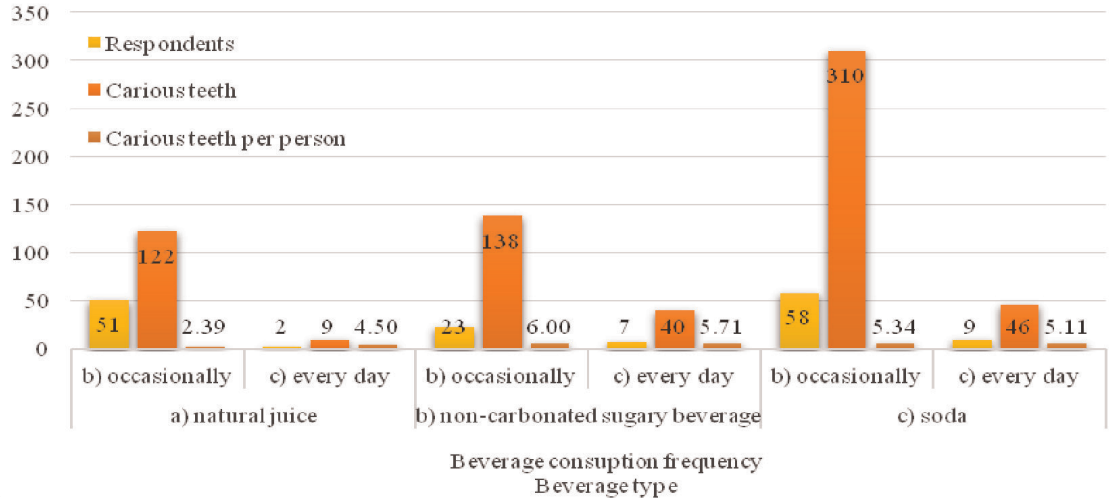

Figure 7: *Caries occurrence vs. consuming beverages frequency and type*

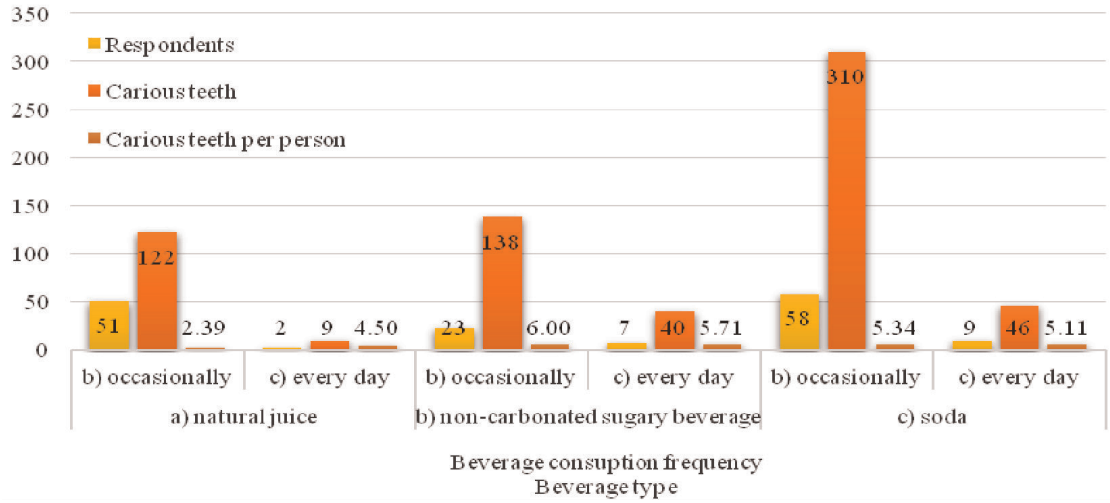

Figure 8: *Caries occurrence vs. consuming sweets frequency*

Over 40% of the respondents consume snacks and pastries 3-4 times a week, and about a third of the children don't consume fresh fruits or vegetables (Table VI) frequently enough.

Bad habits are expectedly more noticeable in the above 13 age group because of the start of adolescence accompanied by intense emotional changes when the child often rebels against adults and authority figures (the dentists being a part of that group) [10]. This explains the high DMFT index value for the age group (Table IX) – 7.38 (at the beginning of the research), compared to the other two age groups: 5.20 (1.43 for deciduous teeth) for the 9-13 age group, and 2.61 (2.87 for deciduous teeth) for the under 9 age group. The dmft index change from 2.87 to 2.18 after 6 months for the under 9 age group is attributed to some carious teeth being extracted (mostly due to the teeth being shed). The results of the research also indicate that caries occurrence does not differ significantly between males and females.

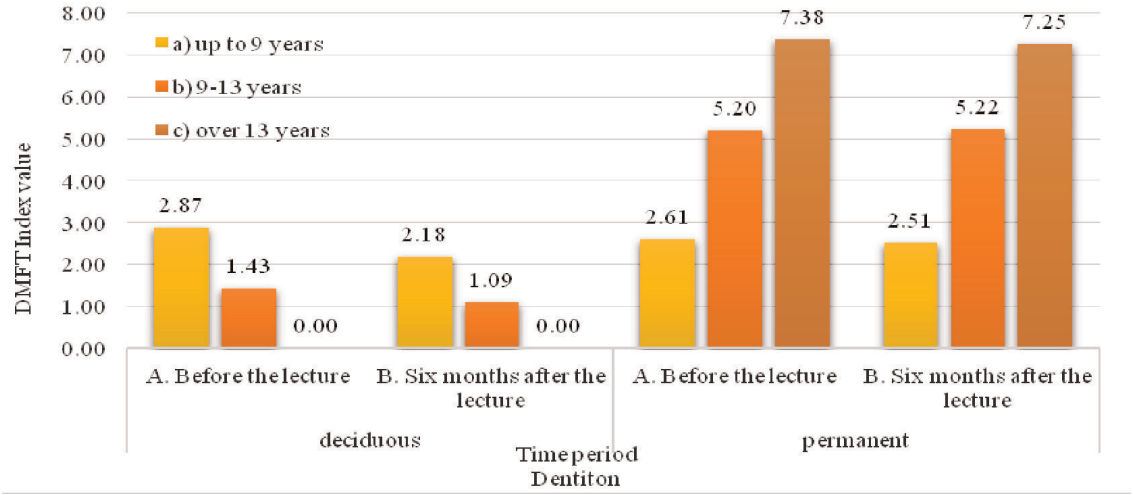

Figure 9: *Distribution of indices over time*

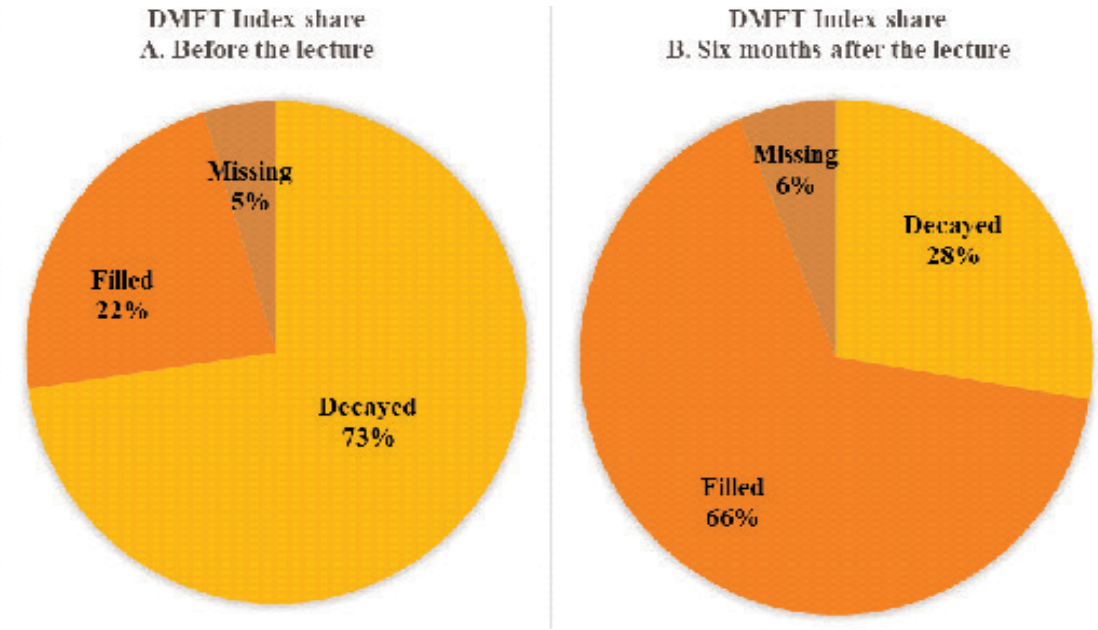

Figure 10: *DMFT index shares at the beginning of the research and six months later*

The research confirms the expected results. Preventative dental measures and activities should be implemented for the primary school children group. Sweets, unhealthy snacks and sugary drinks should be removed, or greatly reduced from the children's diets. At the same time, milk, dairy products and cereals should be encouraged for their caries-preventing attributes. The results of this research can contribute to the enrichment of our scientific knowledge regarding the effect of eating and living habits on dental caries in our environment.

Conclusion

The prevention of caries as multi-causal disease can only be achieved through a multi-pronged approach. Proper oral hygiene, balanced diet, fluoride prophylaxis and regular dental visits significantly help oral health.

Dental health education and motivation of the whole populace (including pregnant women, toddlers, preschool and school-aged children, adults, parents, educators etc.) can improve overall dental health.

Motivation is one of the more significant, if not the most significant component of successful promotion of dental health. The research indicates that parent involvement yields better results for preadolescent children. It was also noticed that adolescents are better motivated by outlining the negative effects of caries, i.e. the positive effects of good dental health on social interactions, especially with the opposite gender.

Children should be provided with correct and concise information on the benefits and the necessity of regular dental visits and oral health care. At the same time, for best results, the information should be adapted and geared towards the target age group and communicated in an innovative and unconventional manner.

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