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СЪДЪРЖАНИЕ

Prosthetic Dental Medicine

Fixed prosthetic constructions` manufacturing technology – significance for their precision

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Технологии за изработка на фиксирани протезни конструкции – влияние върху точността им

Христина Галева[1] Ива Танева[2], Ралица Раденкова[3]

Summary

Introduction: *To create prosthetic constructions using CAD/CAM technologies, there are many options. The wide variety of production methods necessitates their thorough study and comparison.*

Aim: *The aim of the study is to evaluate and compare productions` methods accuracy for fixed prosthetic constructions using CAD/CAM technologies.*

Material and methods: *With a specialized computer program, a digital design of a fixed prosthetic construction with certain parameters is made. Based on it, 48 prosthetic constructions (n=18) are made using three different technologies: subtractive, additive and hybrid. Each of these constructions was scanned and compared to the prefabricated digital project. The degree of coincidence between the two images is represented by histograms (color maps).*

Results: *The greatest accuracy is shown by the constructions made by subtractive technology (85.24%), followed by those by additive technology (80.84%). Less accurate are fixed constructions made by hybrid technology (55.89%). For statistical treatment of the data, variance analysis, Kolmogorov-Smirnov test at one sample and nonparametric Mann-Whitney test were used. A comparison of the three methods of fabrication for fixed prosthetic constructions shows a statistically significant difference between them.*

Key words: *Fixed prosthetic constructions, CAD/CAM technologies, milling, additive technology, precision.*

Резюме

Въведение: *За направата на протезни конструкции с помощта на CAD/CAM технологии, съществуват множество възможности. Голямото разнообразиена производствени методи води до необходимост от тяхното щателно проучване и сравнение.*

Цел: *Целта на проведеното изследване е да се определи и сравни точността на различни методи за направа на фиксирани протезни конструкции по CAD/CAM технологии.*

Материал и методи: *Със специализирана компютърна програма е направен дигитален дизайн на фиксирана протезна конструкция, с определени параметри. Въз основа на него са*

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изработени 48 протезни конструкции (n=18) по три различни технологии: субтрактивна, адитивна и хибридна. Всяка от тези конструкции е сканирана и сравнена с предварително изработения дигитален проект. Степента на съвпадението между двата образа е представена чрез хистограми (цветни карти).

Резултати: *Най-голяма точност е показана от конструкциите, направени по субтрактивна технология (85.24%), следвани от тези по адитивна технология (80.84%). С най-малка точност са фиксираните конструкции, направени по хибридна технология (55.89%). За статистическа обработка на данните са използвани вариационен анализ, Тест на Колмогоров-Смирнов при една извадка и непараметричен тест на Ман-Уитни. Сравнението на трите метода за изработка на фиксирани протезни конструкции показва статистически значима разлика между тях.*

Ключови думи: *фиксирани протезни конструкции, CAD/CAM технологии, фрезоване, адитивни технологии, прецизност*

Introduction

In CAD/CAM systems, for a construction to be realized, a digital prototype of it must first be created. The stages for the construction to be made are the same as when it is done by a dental technician – outlining the preparation, removing the undercuts, preview a place for a cement layer, etc. The software used in this stage of the digital protocol offers a wide variety of tools for image processing and modeling of structures. [1]

A CAD package for 3D solid state modelling is used for the preparation of the desired digital design. There are many CAD modelers, most often specialized parametric ones are used, developed, and designed specifically for dental purposes. They have rich libraries of ready-made 3D teeth that can be modeled further. After the digital prototype of the future construction is ready, it is placed in a virtual articulator. Simulation of the patient's occlusion is made to avoid and eliminate possible inconsistencies. When the process is fully completed, the fabricated digital model is sent to the CAM package and its physical analogue is realized. [2]

A great advantage of the digital work protocol is the possibility of predictability of the result of the treatment. Virtual treatment planning gives clarity to both the doctor and the patient about the expected result. This allows to consider in advance the patient`s wishes and his expectations. In addition, using various Smile design programs, the patient can easily be motivated to conduct the planned treatment. [3]

In the CAM stage the digital model becomes a physical object [4]. The production methods used can be divided into two main fundamentally different technologies – subtractive and additive technologies. [2]

In subtractive technology, the type of milling machine matters - how many axes of rotation it is, the diameter of the used burs, as well as the type of milling (if it is dry milling or not). [4, 5]

Using an additive technology means that the material is applied layer by layer, building a shape. For every millimeter of the 3D model, between 5 and 20 layers of material are laid. This type of technology also requires supporting structures that protect the construction from collapse. [5] The thickness of the layers may vary. Therefore, some authors investigated the influence of the layer`s thickness laid on the internal and marginal adaptation of the constructions. But no connection has been found between them. [6]

The technologies in which material is added allow the manufacture of both monolithic and bilaminar prosthetic constructions. In the dental practice, additive technologies are used to make different types of prosthetic constructions, orthodontic devices, periodontal splints. [7]

The diversity of production methods necessitates their more thorough study. Different technologies have different

advantages and disadvantages. Most CAD/CAM constructions show clinically acceptable accuracy and marginal adaptation. Different combinations of techniques and materials show different results. Some authors believe that these methods of production are a suitable alternative to the classic ones, even faster and cheaper than them. [8]

According to some authors, Co-Cr constructions for example, made by additive technology, show a better marginal adaptation than the conventional lost-wax technique. [9, 10]

França et al. confirm the better vertical adaptation in constructions made with CAD/CAM technologies – by milling (both zirconium dioxide and Co-Cr metal) compared to cast ones [11]. Pasali et al. confirm these results when examining cast by classical technology and milled implant crowns. Milled crowns have the lowest mean marginal deviations: 81±2 μm [12].

Yang et al. reviewed the available literature comparing the accuracy of metal substructures made by lost-wax technique and selective laser sintering. The results show no statistically significant difference in the accuracy of the two types of technology. [13] A comparison of metal substructures made with additive and lost-wax techniques shows that the internal accuracy of the constructions is similar. [14]

The milling of single crowns of Co-Cr alloy shows a better marginal adaptation than additive techniques. But if it is a multi-unit construction, then additive techniques give better results according to Svanborg's studies. [15] Comparing production methods by making working models, Kim also found higher milling accuracy compared to 3D printing [16].

A study for the influence of the production technique on the marginal adaptation of Co-Cr alloy constructions was conducted by Sarda et al. Three methods were compared: wax milling followed by classical metal casting, milling/sintering and DMLS (Direct Metal Laser Sintering). Although marginal adaptation in all methods studied was within clinically acceptable deviations, a statistically significant difference was found between the classical technology cast substructures and those made by CAD/CAM methods. CAD/CAM constructions show less marginal spacing than cast ones (for milled ones the distance is on average 61.135 μm, 55.39 μm for sintered and 88.44 μm for cast). [17]

Peng et al. compared temporary constructions made using classical technology with those made with CAD/CAM technologies (milling and 3D printing). They also establish better internal adaptation and higher marginal accuracy of CAD/CAM constructions. [18] Similar are the results of the study of Abduljawad et al. on the accuracy of endocrowns made by conventional and digital techniques. [19]

Structures made by digital methods could be substitutes for classical methods according to Liang et al. [20]

The use of these technologies in dental practice, as well as the divergent results of the studies conducted, require their additional research.

Aim

The aim of the study is to evaluate and compare productions` methods accuracy for fixed prosthetic constructions using CAD/CAM technologies.

Material and methods

A prosthetic field was digitalized. With a specialized computer program (Ceramill mind), a digital design of a fixed prosthetic construction was made. A suitable tooth was selected from the virtual library. The necessary adjustments in size, position relative to the adjacent teeth, the location of the central fissure and the height of the approximate edge were made. The space for the cement was defined to be 0.05 mm. The construction was smoothed, sharp edges were removed in places (Fig. 1). This was followed by the production of metal substructures for bilaminar constructions by three different CAM methods: milling, additive and hybrid technology.

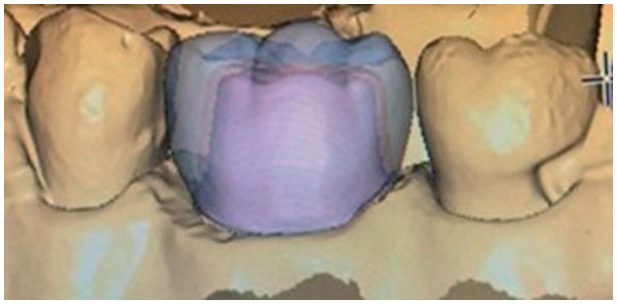

Fig. 1. *Digital design of prosthetic construction*

A total of 50 pcs metal substructures for metal-ceramic single crowns of Co-Cr base metal alloy were made. They were divided into the following groups: Group 1 (Milling), Group 2 (Additive technology) and Group 3 (Hybrid technology).

For the milling of metal constructions was used DMG Ultrasonic 20, which has 5 axes. Milling is a process in which material is taken away. In this case, Co-Cr alloy discs were used, from which the corresponding construction was cut.

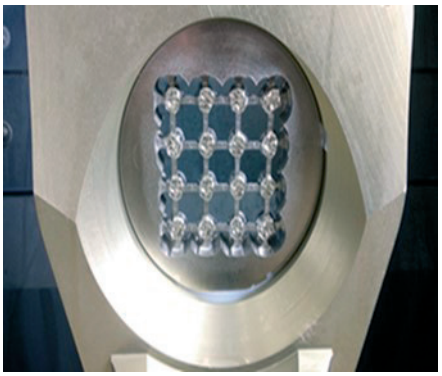

Fig. 2. *Milled constructions*

The substructures from group 2 were made by the method of laser melting with SLM 125HL. After the digital design of the constructions, their positioning and orientation during printing was determined. According to that, a project of the supporting structures was also visualized. Before they were put into production, the layered construction of each of the computer simulation structures can be seen. LPW Co-Cr metal powder was used.

The hybrid technology used the digital models obtained in the scanning of the prosthetic field and the CAD design of the future metal substructure. A prototype of wax material (CopraWax, Whitepeaks, Germany) was made and milled. The resulting prototype is completed by casting it from a metal (Co-Cr metal alloy) by the classical metal casting technology.

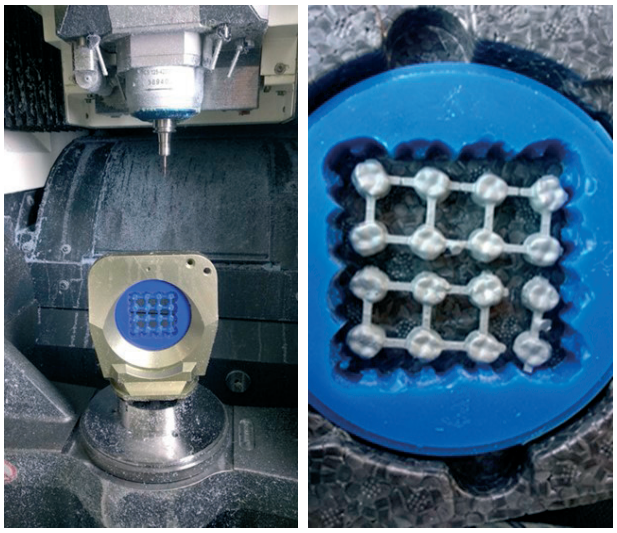

Fig. 3. *Hybrid constructions 3.1. Milled wax material 3.2. Casted metal constructions*

The inner surface of each substructure was scanned with a laser scanner (A Roemer absolute arm 7320s) and compared to the previous digital project.

A Reshaper 3D computer program was used to register and measure deviations from the digital design. The Bestfit algorithm was chosen. The results were represented by color maps (histograms).

Results

A total of 48 pcs substructures were made. When comparing the finished structure with the pre-prepared digital design, a match in the range of +0.05 mm to -0.05 mm, which corresponds to +50 μm and -50 μm, is defined as optimal. Deviations between +0.05 mm and +0.12 mm and -0.05 mm and -0.12 mm were determined to be clinically acceptable. In tables are summarized the results reflecting the registered percentage deviation of the internal surfaces of the metal substructures produced by different methods compared to the previously made digital design.

For statistical treatment of the data, variance analysis, Kolmogorov-Smirnov test at one sample and nonparametric Mann-Whitney test

were used. A comparison of the three methods of fabrication for fixed prosthetic constructions shows a statistically significant difference between them.

Table 1. *Average Matching of Milled Substructures to Digital Project*

Milled/Group 1	N	Mean	Median	SD	Min	Max
Up to+120 µm	18	0,36	0,30	0,30	0,10	1,20
+120 µm to +50 µm	18	11,81	12,50	2,91	6,48	17,00
+50 µm to -50 µm	18	85,24	84,13	2,92	80,55	90,34
-50 µm to -120 µm	18	2,49	2,45	0,80	1,22	4,00
Less than -120 µm	18	0,21	0,20	0,13	0,05	0,49

Table 1 summarizes the results for milled constructions versus digital design as a method of fabrication. They show that in milling, as a method to create metal substructures, an average of 85.24% of the inner surface fully corresponds to the digital project. Deviations in the direction of expansion of the constructions are higher than the shrinkage in their dimensions. Beyond the limits of clinical acceptable are an average of 0.57% of the metal surface.

Table 2. *Results of the comparison of the digital project with the obtained metal substructures produced by additive technology*

Additive technology/ Group 2	N	Mean	Median	SD	Min	Max
Up to +120 µm	18	0,20	0,20	0,14	0,00	0,50
+120 µm to +50 µm	18	10,19	9,68	2,13	7,35	16,00
+50 µm to -50 µm	18	80,84	80,60	2,81	76,40	86,00
-50 µm to -120 µm	18	8,57	7,90	2,60	4,60	13,67
Less than -120 µm	18	0,19	0,20	0,15	0,00	0,70

Considering only the accuracy of the production method, metal substructures made by laser melting shows absolute accuracy compared to the digital project in 80.84% of their inner surface. Below 0.4% are outside the tolerance limits up to 0.12 mm. Again, the expansion of the inner surface in the clinically acceptable range is more than the shrinkage (table 2). The results for the hybrid constructions are similar (table 3).

Table 3. *Results of the comparison of the digital project with the resulting metal substructures produced by hybrid technology.*

Hybrid constructions/ Group 3	N	Mean	Median	SD	Min	Max
Up to +120 µm	18	0,26	0,20	0,24	0,00	1,03
+120µm to +50 µm	18	28,13	28,30	4,53	16,40	34,30
+50µm to -50 µm	18	55,89	55,85	9,44	45,00	73,20
-50µm to -120 µm	18	15,02	15,25	6,98	6,10	23,65
Less than -120 µm	18	0,19	0,20	0,15	0,00	0,60

Comparing the three investigated production methods, the largest deviations from the digital design can be observed in the constructions made using hybrid technology.

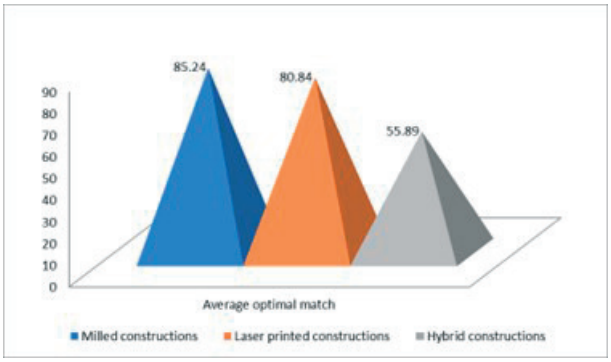

Fig. 4. *Comparison of the optimal match of the digital project with the constructed substructures according to the method of their production*

The match between digital design and realized prosthetic substructures depends on the method used to create them. The comparison of milled, laser melted and made by hybrid technology constructions shows a statistically significant difference (<0.001), both in terms of their optimal match with digital design and within the clinically acceptable expansion and shrinkage of substructures. The highest accuracy is shown by milled ones, followed by laser melted. In hybrid technology, the largest deviation from the design made was recorded (Table 4).

Table 4. *Comparison of the results obtained for the three tested groups*

Indicator	Comparisons		
	Group 1	Group 1	Group 2
	Group 2	Group 3	Group 3
	P	P	P
Up to +120 µm	0,063	0,235	0,532
+120 µm to +50 µm	0,041	<0,001	<0,001
+50 µm to -50 µm	<0,001	<0,001	<0,001
-50 µm to -120 µm	<0,001	<0,001	0,001
Less than -120 µm	0,771	0,759	0,895

Discussion

Identifying the deviations of the finished constructions from the digital project allows us to collect information about the inaccuracies of the various production methods used.

In this study the greatest accuracy compared to digital design was shown by milled constructions – an average of 85.24%. It is the classical manufacturing method for CAD/CAM systems. Kim et al. define milling as the preferred way to make models using CAD/CAM technology because of its high accuracy. [21]

Additive technology, in this case, has a high accuracy (80.84%), close to that of milled constructions, but still less than them. In additive methods, a part of the particles of the respective material are selectively melted, then merged and the corresponding shape is obtained during cooling. These changes lead to internal stresses in the material. This is a possible reason for the lower accuracy of finished constructions compared to milled ones.

The thickness of the layer of material is affected by generating some gradation on the Z-axis even in more precise 3D printers. The thinner the layer of material, the less graduation. The laying of smaller layers leads to an increase in the time needed to produce the construction [22].

Studies by Sadid-Zadeh et al. focus on the relationship between the scanner used, the digital design and the settings of the milling machine, on the internal accuracy of disilicate crowns. They use 2 types of intraoral scanners and the design programs of the respective devices. The experimental subgroups are also divided according to the program set on the milling machine. For each of the scanners, part of the restorations was selected to be milled according to a standard program, and another part – a more detailed one. The results obtained by the authors show that the constructions made after scanning with Trios 3Shape and a base milling program required more adjustment to the prepared tooth. They show a mean marginal

deviation of 188 μm which is outside the values acceptable for clinical purposes. In contrast, the constructions made based on the same scanner, but with a detailed milling program, proved the best marginal adaptation of all investigated – 60 μm. The results demonstrated by the Planmeca PlanScan scan are clinically acceptable, but with worst marginal adaptation than the previous ones. They also have a statistically significant difference in marginal adaptation depending on the milling program chosen. The average marginal distance in the detailed program is 95 μm, and in the base - 124 μm. Milling in detailed mode requires more technical time than in a standard one. The results obtained in this study refer to a 3-axis milling machine. In scientific studies made by us, no different milling modes have been tested, but a 5-axis milling machine has been used. The average marginal distance in the detailed program is 95 μm, and in the base - 124 μm. Milling in detailed mode requires more technical time than in a standard one. The results obtained in this study refer to a 3-axis milling machine. In scientific studies conducted by us, no different milling modes have been tested, but a 5-axis milling machine has been used. [23]

Unlike milled and laser-printed designs, where the difference in accuracy is small, hybrid technologies differ significantly from them. The total match of these constructions with the preceding digital design is only 55.89%. The cutting of the wax material with the milling machine with which the metal is cut should show the same or similar accuracy of the constructions. But the results obtained indicate otherwise. It is possible that the wax material had greater deformations during milling, due to its lower hardness compared to the metal. That could lead to volumetric changes in the wax prototype at this stage of production. This technology also involves replacing the wax material with molten metal by the classic lost-wax technology. In this case, the volumetric changes that occur in the metal used should also be registered, while it changes its physical state.

When making prosthetic constructions using hybrid technology, the number of processes through which the material passes increases. This leads to the accumulation of more factors influencing the volumetric changes and probably this is one of the reasons for the reduced accuracy of the constructions made by this method.

Conclusions:

1. The correspondence between the digital design and the finished prosthetic construction is directly related to the production method.

2. The greatest degree of correspondence between the digital design and the finished prosthetic construction is established by the milling method, followed by the additive method. The greatest deviation is found in the hybrid production method.

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Pediatric Dental Medicine

Risk factors for periodontal health and periodontal diagnosis in childhood and adolescence Literature review

Hristina Tankova[1], Zornitsa Lazarova[2], Liliya Doichinova[3]

Рискови фактори за пародонтално здраве и пародонтална диагностика в детско-юношеска възраст Литературен обзор

Христина Танкова[1], Зорница Лазарова[2], Лилия Дойчинова[3]

Summary

Early diagnosis of the initial reversible forms of gingival inflammation in childhood is essential for oral and periodontal health of adolescents in particular. In the period of stabilizing periodontium between 12 and 14 years of age, the registration of all risk factors, as part of the assessment of periodontal risk in children, ensures early treatment and preventive approach to future periodontal destruction.

Given the change in the modern understanding of periodontal pathology and the adoption of a diagnostic threshold of 10 % engagement of gingival tissues for diagnosis of gingivitis case, the assessment of an overall dentition in at least 4 points around each tooth becomes a key factor in the diagnostic process in children. An emphasis in diagnosis in children with stabilized periodontium is also the assessment of bleeding on probing as an easy, accurate and quick method of assessment of prevalence of gingival inflammation. Another important factor in the diagnostic process is the probing with an electronic periodontal probe, which owing to the standard pressure and pre-calibration, ensures accurate measurement in combination with easy and convenient storage of the patient's data and monitoring of the condition of the periodontal reassessment of adolescents.

The period of stabilizing periodontium in childhood is extremely suitable for early diagnosis of initial gingival inflammation, which is easily treated and initiates sustainable preventive behavior for future periodontal health of adolescents.

Резюме

Ранната диагностика на началните обратими форми на гингивално възпаление в детско-юношеска възраст е от съществена важност за оралното и в частност пародонтално здраве на подрастващите. В периодът на стабилизиране на пародонта между 12 и 14 годишна възраст регистрирането на всички рискови фактори, като част от оценката на риска от пародонтална

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патология при деца, гарантира навременно лечение и превантивен подход по отношение бъдеща пародонтална деструкция.

Предвид промяната в съвременното разбиране за пародонтална патология и възприемането на диагностичен праг от 10% ангажиране на гингивалните тъкани за поставяне на диагноза гингивит, оценката на цяло съзъбие в поне 4 точки около всеки зъб се превръща в ключов фактор в диагностичния процес при деца. Акцент в диагностиката при деца със стабилизиран пародонт е и оценката на провокирано гингивално кървене като лесен, точен и бърз метод за регистриране разпространението на гингивалното възпаление. Още един съществен фактор в диагностичният процес е сондирането с електронна пародонтална сонда, която благодарение на дозираният натиск и предварително калибриране гарантира точно измерване в съчетание с лесно и удобно съхранение на данните на пациента и проследяване състоянието на пародонта при реоценка на подрастващите.

Периодът на стабилизиране на пародонт в детско-юношеска възраст възраст е изключително подходящ за ранна диагностика на началното гингивално възпаление, което се лекува лесно и поставя началото на устойчиво превантивно поведение за бъдещото пародонтално здраве на подрастващите.

Modern scientific knowledge describes the complex etiology of periodontal diseases involving an intricate interplay between the subgingival microbiota, the host immune system and inflammatory immune response. To these, the variety of individual modifying environmental factors are added [1, 2]. All this is especially relevant in childhood and adolescence, when the periodontium is stabilized, and also oral hygiene habits and healthy behaviors regarding oral/periodontal health should be developed. In this regard, periodontal health must not be considered solely in the context of the "plaque hypothesis", but must provide a holistic consideration and evaluation of all factors responsible for the initiation of periodontal pathology in order to maintain balance in the periodontal space [3].

Determinants of periodontal health fall into three main categories: 1. Microbiological factors; 2. Individual factors (at patient level); 3. Environmental factors. Evaluating the relationship between these factors in each patient is an essential component in maintaining periodontal health [3].

1. Systemic risk factors for periodontal health in childhood and adolescence

The pathogenesis of periodontal diseases is strongly affected by various individual factors, such as the host immune response, anatomical features and tissue factors. Most of them are determined by the genetic profile of the host and may be modified by environmental and host behavioral factors. The loss of periodontal tissue is a common finding in certain systemic diseases, which determines systemic factors as risk for periodontal pathology. Albandar et al grouped systemic diseases and conditions affecting periodontal structures into several categories [4].

Some of these diseases lead to the direct development of periodontal pathology due to a defect in the host immune response to the subgingival microflora. Others are the result of incorrectly structured tissues that are more susceptible to the inflammatory reaction in tissues. Although these conditions are relatively rare, especially in children, their mechanism of action plays an important role in diagnostic and therapeutic aspects [4].

Some of the systemic risk factors affecting gingival status are: hyperglycemia, haematological diseases (leukemia), eating disorders. Studies in childhood found a high risk of developing inflammatory destructive processes in the periodontium in patients with poorly controlled type 1 diabetes. The severity of gingival inflammation in these cases depends more on glycated haemoglobin control than plaque control [5, 6]. A study of periodontal status conducted on 116 children (30 children with diabetes, 25 with asthma, 34 – healthy and

27 with orthodontic treatment) in Sofia showed that 63 % of children with diabetes also suffered from gingival pathology. The authors found that diabetic patients had almost double plaque levels, indicating that the dental biofilm is likely to be a leading factor in the pathogenesis of inflammatory changes in gingiva of these patients [7].

The literature lacks information regarding the exact role of nutrition in the initiation and progression of periodontal diseases. However, the role of ascorbic acid (vit. C) in the construction of periodontal structures and in particular collagen synthesis is well documented [8]. Scurvy occurs in childhood relatively rarely, mainly in families with low socio-economic status in certain geographical regions [9].

Smoking is one of the major behavioral risk factors in the pathogenesis of periodontal diseases [10]. Flooding the market with e-cigarettes and smokeless tobacco is increasingly intriguing for adolescents, which poses the risk of creating addictions with negative consequences for periodontal health [11].

The treatment of some systemic diseases is associated with the intake of certain drugs (antiepileptic, immunosuppressant, calcium antagonists), which are often the cause of gingival enlargement [12]. Characteristic clinical signs of drug-induced hyperplasia are usually found in the frontal sections of the gingiva just a few months after starting their intake [13]. In addition, scientific studies have shown that their prevalence is particularly common in childhood [13].

Hormonal changes associated with puberty are part of the systemic risk factors associated with periodontal health. Dynamics in sex steroid hormone levels during puberty have a transient effect on the gingival status of adolescents, which could negatively affect the host immune response to certain microorganisms. All of this results in an exaggerated gingival inflammation in the presence of even relatively small amount of plaque [14].

The study of literature related to the impact of sex hormones on periodontal health in children shows the role of these regulatory molecules in the progression of periodontal pathology and in healing processes in periodontium. The effects they have are dependent on the sex and physiological condition of the patients, with the impression that not all patients react in a similar way to elevated levels of sex hormones [15]. This suggests that maintaining periodontal health depends primarily on good plaque control, and to a lesser extent, on fluctuation in plasma hormone levels.

2. Dental biofilm – a risk factor in periodontal pathology in childhood and adolescence

The oral ecosystem undergoes different stages of transformation during the mixed dentition period. This is due to the eruption of permanent teeth, changes in hormonal levels during puberty, and also other factors related to children's oral hygiene and eating habits [16].

The subgingival biofilm in children with mixed dentition showed reliably higher proportions of gram-negative anaerobic microorganisms compared to the same biofilm in temporary or permanent dentition [17].

A recent study found that *C. Gingivalis* from the Socransky green complex is isolated in 100 % of subgingival samples in healthy children. As children grow up, microbial complexes become more complicated by adding microorganisms from the orange complex (*P. micros, P. intermedia*) and in individual cases microorganisms from the red complex (*T. forsythia, T. denticola*) [18].

Modern studies on subgingival microflora in children with gingivitis have shown that the predominant microorganisms are representatives of the Socransky red and orange complexes. In 2013, Yang et al. studied via Real Time PCR 77 subgingival samples of molars and incisors taken from 35 adolescents. The results showed that *P. gingivalis, P. intermedia* and *T. forsythia* were found in higher amounts in children with gingivitis compared to healthy children. The authors also found that *P. gingivalis, T. forsythia* and *F. nucleatum* were more common in children with moderate and severe gingivitis than in patients with mild forms of inflammation, and *P. intermedia* was only found in severe forms of gingivitis. In addition,

the researchers found a correlation between the values of the periodontal indices used (GI, SBI, PD) and the quantities of *P. gingivalis, T. forsythi, F. nucleatum* and *P. intermedia* [19].

An own 2020 study conducted on 34 children aged 10-14 with established plaque-induced gingivitis showed that the predominant periodontopathogens are the representatives of the Socransky orange and red complexes. The authors studied 9 control strains of MO using Real Time PCR, recording that the highest proportions were P. *intermedia* and *P. micros (*orange complex) in 70 % of the children studied. In turn, *T. denticola* and *T. forsythia* (red complex) were isolated in 52.9 % of children with plaque-induced gingivitis [20].

From the literature study, it can be concluded that the subgingival microflora in healthy children is presented by less pathogenic microorganisms from the Socransky green complex, while in children with gingivitis there is gradually a tendency for quantitative and species diversity, as well as complex relationships between species. This suggests that the transition from health to disease (gingivitis) follows the principles of the primary ecological settlement.

3. Other risk factor for periodontal health in childhood and adolescence

3.1. Carious process

Given the high caries activity in childhood and adolescence, carious lesions and/or obturations located near the gingival edge are risk factors in periodontal pathology. The subgingival contour and adaptation of approximal obturations is also essential for plaque control and is therefore directly related to gingival health. Overhanging subgingival obturation edges, incorrect adaptation to the tooth surface, the presence of micro crevices lead to significant plaque accumulation and respectively difficult cleaning [21].

An epidemiological study of 457 children aged 10-14 showed that more than half (59 %) of registered carious lesions in children were risky for periodontal health. As risky to periodontal health, the authors considered carious lesions located along the approximal/cervical area of the tooth crown, as they created conditions for increased plaque build up and difficulty cleaning, as well as the presence of carious edges that irritate the adjacent gingiva. The same study showed that the relative share of risky obturations was 32 % compared to the total number of obturations recorded. The authors considered as risky obturations the ones that are located approximal/cervical with irregular marginal adaptation, lack of exact interdental contact, as well as those where there is a micro crevice between the obturation material and the dental structure [20].

3.2. Orthodontic anomalies and treatment

Untreated orofacial malformations have a negative impact on the quality of life in adolescents, as they are usually associated with embarrassed function, difficult cleaning, and in some cases also with pain [22].

A group of scientists found that the chewing forces that are generated in the presence of a deep bite can accelerate the development of periodontal disease [23]. Another common orthodontic anomaly is tooth crowding, which leads to irregular interdental contacts and makes oral hygiene procedures difficult to apply, especially in the absence of manual abilities in adolescents [24].

On the other hand, treatment of orthodontic anomalies, especially with fix appliances, is often the cause of low plaque control due to cleaning difficulties. Often, orthodontic treatment is the cause of the development of gingival enlargement, the main reason for this is the difficulty of cleaning and mechanical irritation from the orthodontic wires [25].

3.3. Width of the attached gingiva in the mandibular frontal area

The presence of reduced width of the attached gingiva in the lower frontal tooth area in children is a risk factor for both future gingival recession and localised periodontal destruction. This indicator is essential in terms of the prevention of future periodontal complications. In orthodontic treatment, it is necessary to consider, especially of the lower front teeth, to prevent future complications [25].

In 2018, leading European and American periodontologists recommended the introduction of the concept of periodontal phenotype, which

combines the gingival phenotype (representing the three-dimensional gingival volume) and the thickness of the vestibular bone plate (or so-called bone morphotype). The periodontal phenotype may undergo changes related to various environmental factors or treatment [26].

The thin periodontal phenotype increases the risk of gingival recessions and is considered one of the local risk factors for periodontal pathology. Evaluation of the periodontal phenotype is carried out using a probe that enters the gingival sulcus. When the probe is visible through the sulcus, it is assumed that there is a thin periodontal phenotype. It is important to note that regardless of the thickness of the gingiva, maintaining periodontal health is possible with an optimal oral and hygienic regime [26].

4. Periodontal diagnosis in childhood and adolescence

4.1. Gingival indexes

The diagnostic process includes the registration of specific clinical signs and symptoms, the combination of which characterizes a specific disease. In the context of periodontal pathology, clinical methods of recording the prevalence and severity of gingival inflammation are based on a visual evaluation of changes affecting marginal part of gingiva. In addition to the change in contour, color and consistency, provoked gingival bleeding and the volume of gingival crevicular fluid are essential for the assessment of gingival status [27].

Numerous international studies have demonstrated the widespread prevalence of gingival inflammation in childhood [28, 29, 30, 31, 32]. Different gingival indexes [48] are used to evaluate this data and to allow comparison between the different groups studied to objectifies the clinical condition of the gingiva [33].

Scientists have found experimentally that there are specific interactions between microorganisms from the dental biofilm and gingival tissues of the host [34]. However, the amount of dental biofilm required to initiate gingival inflammation, as well as its association with the rate of progression, varies considerably between individuals [3].

Given that dental biofilm plays an essential role in the initiation of periodontal inflammation and also that plaque control is the foundation of periodontal health, assessment of dental plaque should be a regular component of periodontal examination for routine clinical practices and research purposes [35]. To this effect, many plaque scoring methods are available. They are mostly based on a subjective assessment of the amount of tooth surface covered by plaque, ordinal ratings of plaque extension or the presence/absence of plaque at specific sites [35].

The modern concept of periodontal pathology, aimed at local risk factors, requires the application of the indexes for objectification of gingival health and oral-hygiene status to be applied to the entire dentition, and if possible, at least in four points around each tooth. Evaluation of representative teeth or surfaces alone cannot reliably indicate the condition of gingival tissues [36, 37]. Although the assessment of the whole dentition makes it difficult to study a large number of patients due to an extension of the examination time and the significant discomfort of children, it is preferable when assessing the prevalence of periodontal diseases in childhood [27].

Bleeding on probing as a clinical sign of tissue inflammation has been included in the methodology of various gingival indexes since 1958. Various scientific studies have found that gingival bleeding precedes visual changes in gingival tissues and is the earliest and objective criteria for tissue inflammation [38, 39]. In addition, the lack of provoked gingival bleeding is a sure sign of gingival health [3].

Modern studies have found that the assessment of gingival bleeding has shown several additional benefits in favor of its use in clinical practice: 1) it is an obvious, objective clinical sign that can be easily assessed and recorded; 2) at the gingival level it is associated with the severity of the inflammatory state [39]; 3) with appropriate training, it is possible for general practitioners of dental medicine to achieve and maintain high levels of reproducibility in the interpretation of the results of the study; 4) at patient level, the results can be used to compare

and monitor the dynamics of inflammation during treatment and as a means of motivating patients [20].

Most of the gingival indexes known in the literature rely on visual evaluation of one or more of the following clinical parameters: change in color of the gingiva, change in the contour of the gingiva, presence of bleeding on probing [3].

The change in the color and contour of the gingiva can be assessed non-invasively – visually, while the provoked bleeding requires the use of a periodontal probe, dental floss, interdental brush or wooden interdental cleaner. Some of the indexes include both visual and invasive assessment criteria (probing), while others are based either on one or the other alone [33]. Thus, gingival inflammation can be assessed by quantitative clinical indicators, which are based on a combination of symptoms of inflammation and the degree of gingival involvement [40].

Numerous scientific studies worldwide have shown that the most commonly used parameters for objectification of gingival health are the gingival index of Loe & Silness and bleeding on probing. The Gingival Index of Loe & Silness, which is part of an index system for the evaluation of plaque accumulation and gingival inflammation (Silness & Loe/Loe & Silness), combines visual signs of inflammation in tissues and probing to evaluate the provoked gingival bleeding with the patient's oral hygiene status. The correlation between histological findings in gingival tissues and clinical signs of inflammation reported by the index has been experimentally demonstrated. The volume of inflammatory infiltrate in connective tissue increases directly proportionally with an increase in the grades of the index [41]. Applying the index to the entire dentition, which is a priority in modern diagnostics in view of the possibility of detecting single areas affected by inflammation, creates difficulty and is time consuming. The subjective nature, when considering visual signs of inflammation, may be the cause of misinterpretation of the condition of gingival tissues.

It becomes clear from the literature review that there are a variety of methods for diagnosis of inflammatory diseases of periodontium, based on various gingival indexes and criteria. However, it can be concluded that an accurate and easily applicable method of assessing gingival inflammation and its prevalence is bleeding on probing (BOP). The implementation protocol is relatively easy, and when calibrating operators, gives minimal deviations, which makes it reliable when assessing gingival status.

4.2. Probing – Method for evaluation Periodontal Status

The diagnostics protocol for gingival diseases relies primarily on probing as the gold standard in the assessment of depth of gingival sulcus, provoked gingival bleeding, integrity of epithelial attachment. Periodontal probing is a sensitive method for assessment, with improper conduct being defined as one of the ten most common causes of failure in periodontal practice [42, 2].

Conventional periodontal probes are the gold standard for assessing depth of gingival sulcus, provoked gingival bleeding, and epithelial attachment level [43]. A major disadvantage of these probes is the lack of controlled force during the probing process. Van der Velden found that a change in probing force from 0.15 to 0.75 N resulted in a direct increase in probing depth [44].

Studies have shown that electronic probes measure the anatomical base of the periodontal pocket, so the data obtained exceed those obtained with the first generation probes, an average of 1.58 mm. Such probes are: Florida probe (FP), presented by Gibbs et al. in 1988 and with a proven higher level of accuracy than manual probes [45]; Ultra Sonographic Probe was created at NASA to detect cracks in aircraft hulls. The probe is an ultrasonic instrument that integrates diagnostic medical ultrasound techniques with artificial intelligence to detect and diagnose periodontal diseases [46].

In third-generation electronic probes, accuracy in correlation with standard pressure (25 g) is highlighted as advantages, making the examination easier, faster, standardized, and accurate. The audio-visual signals allow easy orientation, and the software can be modified according to different measurement schemes,

automatically transferring the data to the docking station, and displaying the status, allowing comparison of the latest data with previous measurements. The probes offer an automatic periodontal risk assessment of the patient, which is extremely important for both the clinician and the patient's training and motivation, especially if patients are children [47, 48]. A major disadvantage of these probes is the lack of tactile sensitivity when conducting the evaluation [48].

A comparative analysis of the effectiveness of the mechanical versus electronic periodontal probe PA-ON (Orangedental) in periodontal diagnosis was applied to 28 children aged 12-14 years. The authors examined four parameters regarding periodontal diagnosis with both probes – depth of gingival sulcus, bleeding on probing, duration and sensitivity during probing. The results show that in terms of depth of gingival sulcus, the electronic periodontal probe registers at the same probing point a shallower gingival sulcus compared to the mechanical periodontal probe, which suggests that electronic probes have a significant advantage in periodontal diagnosis in childhood due to precalibration of the instrument. The assessment of the rest parameters of a comparative analysis found no differences between an electronic probe and mechanical periodontal probes [20]. Similar results for effectivenes with electronic parodontal probing was found from another researchers [49, 50].

It is apparent from the literary review that probing as an element of the diagnostic protocol is sensitive and delicate, and may mislead the clinician when the protocol of examination is incorrectly applied. At the same time, modern studies of the latest generation of electronic periodontal probes show an easy protocol of operation and minimization of errors in reporting the status of gingival status. However, the characteristic of the pediatric periodontium, as well as the specificity of the childhood age, require additional studies related to the effectiveness of different types of periodontal probes in the diagnosis of periodontal pathology.

Conclusion

The assessment of all risk factors for periodontal health is the foundation of the holistic approach in periodontal prevention. The incidence of carious lesions and obturation as well as orthodontic anomalies in children and adolescents shows a high prevalence. This fact leads to increased plaque accumulation, which, in combination with improperly formed oral hygiene habits, creates conditions for periodontal pathology. In this regard, the complex methodology and determination of the interrelationships between the individual etiological/risk factors for periodontal health is key in the diagnosis and prevention of this type of pathology in children.

Early diagnosis of the initial reversible forms of gingival inflammation in childhood is essential for oral and periodontal health of adolescents in particular. Given the change in the modern understanding of periodontal pathology and the adoption of a diagnostic threshold of 10 % engagement of gingival tissues for diagnosis of gingivitis case, the assessment of an overall dentition in at least 4 points around each tooth becomes a key factor in the diagnostic process in children. An emphasis in diagnosis in children with stabilized periodontium is also the assessment of bleeding on probing as an easy, accurate and quick method of assessment of prevalence of gingival inflammation. Another important factor in the diagnostic process is the probing with an electronic periodontal probe, which owing to the standard pressure and pre-calibration, ensures accurate measurement in combination with easy and convenient storage of the patient's data and monitoring of the condition of the periodontal reassessment of adolescents.

The period of stabilizing periodontium in childhood is extremely suitable for early diagnosis of initial gingival inflammation, which is easily treated and initiates sustainable preventive behavior for future periodontal health of adolescents.

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Periodontal Prevention in Children and Adolescents Literature review

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Пародонтална профилактика в детско-юношеска възраст. Литературен обзор

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Summary

The most common periodontal disease at the age of 10-14, immediately after the eruption of the permanent dentition, is the initial localized form of plaque-induced gingivitis. At this age, a preventive approach to this type of oral pathology is key to the enduring strategic goals of maintaining periodontal health throughout a person's life.

The asymptomatic course of the initial forms of gingival inflammation in childhood and adolescence is often the reason for the lack of adequate care, which leads to a gradual complication of the clinical picture in the future. Building long-lasting knowledge and skills to maintain oral/gingival health is a key factor in primary periodontal prevention in children. The development of specific group/individual preventive programs constructed based on the specific age characteristics of children, especially at the age of 12-14 years immediately after stabilization of the permanent dentition, is of extremely great importance to create appropriate behavior for maintaining oral/gingival health throughout a person's life. The use of modern interactive methods, as well as specifically selected game and demonstration methods, engage attention and create motivated and aware behavior, which guarantees the development of a lasting preventive attitude to gingival health in adolescents.

The age period 10-14 is suitable for creating sustainable, aware, lasting knowledge, skills and motivated health behavior to maintain oral health. With a certain motivation of the children, the initial gingival inflammation, mainly related to the dental biofilm, is easily treated and with the participation of the child himself, when he is trained and motivated for self-control and self-evaluation.

Резюме

Най-често срещаното пародонтално заболяване във възрастта 10-14г., непосредствено след пробива на постоянното съзъбие е началната локализирана форма на плак-индуциран гингивит. В тази възраст, превантивният подход към този тип орална патология е ключов за трайните стратегически цели свързани с поддържане на пародонталното здраве през целия живот на човек.

Безсимптомното протичане на началните форми на гингивално възпаление в детско-юношеска възраст, често пъти е причина за липсата на адекватни грижи от страна на пациентите, което води до постепенно усложняване на клиничната картина в бъдеще. Изграждането на трайни познания и умения за поддържане на оралното/гингивално здраве е ключов фактор в първичната пародонтална профилактика при деца. Разработването на специфични групови/индивидуални

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профилактични програми конструирани на базата на специфичните възрастови характеристики на децата, най-вече във възрастта 12 – 14 г. непосредствено след стабилизиране на постоянното съзъбие, е от изключително голямо значение за създаване на подходящо поведение за поддържане на орално/гингивално здраве през целия живот на човека. Използването на съвременни интерактивни методи, както и специфично подбрани игрови и демонстрационни методи, ангажират вниманието и създават мотивирано и осъзнато поведение, което гарантира изграждането на трайно превантивно отношение към гингивалното здраве в подрастващите.

Възрастта 10-14г. е подходяща за създаване на устойчиви, осъзнати, трайни познания, умения и мотивирано здравно поведение за поддържане на орално здраве. При определена мотивация на децата, началното гингивално възпалние, свързано предимно с денталния биофилм, се лекува лесно и то с участието на самото дете, когато то е обучено и мотивирано за самоконтрол и самооценка.

1. Prevalence of periodontal pathology in children and adolescents

Periodontal diseases are the second most frequent group of plaque-induced oral diseases in children and adolescents. They affect the periodontium and are inflammatory (gingivitis) or inflammatory-destructive (periodontitis) with the leading etiological factor being the dental biofilm [1, 2, 3, 4].

Many epidemiological studies reveal a high prevalence of gingival diseases in childhood, but the presence of large differences in the results of different author groups creates a prerequisite for discussions [5, 6, 7]. Variations may be observed due both to differences in the prevalence of the disease in certain populations, and also to the use of various diagnostic criteria when conducting the studies.

After 1980, Bulgarian authors studied the periodontal status and treatment needs in children and adolescents using the Community Periodontal Index for Treatment Needs (CPITN index), establishing a progressive increase in periodontal diseases with age [8, 9, 10]. While Krumova and colleagues found that 55% of 15-year-old children had gingival inflammation, Atanasov and colleagues recorded periodontal involvement in over 90% of adolescents of the same age [10, 11] .

Almost 30 years later, a National Program for the Prevention of Oral Diseases in Children from 0 to 18 years of age was implemented on the territory of the country. To objectify the periodontal status, the CPITN index was once again used, finding that approximately 2/3 of 18-year-olds suffer from periodontal pathology.

In 2010, Peycheva registered the state of the periodontium in over 1300 children from the city of Plovdiv aged 12-18. The Loe & Silness gingival index was used to objectify the condition of the gingiva and the degree of gingival inflammation on representative teeth. From the obtained results, it is clear that the prevalence of gingival inflammation in the examined children is over 38% [12].

Our own epidemiological study assessed the prevalence of periodontal diseases in the age group of 10-14 years revealed that 64% of the examined children had gingival bleeding above 10%, that is, registered gingival inflammation. The survey was conducted in the 2019-2020 period in the region of Sofia city and included a total of 457 children, and the full mouth bleeding score (FMBS) index was used to register the periodontal status [13].

There are relatively few studies on periodontal pathology in children on the territory of Bulgaria. Several epidemiological studies have been conducted in the last 20 years, and the rest have a different main purpose, with periodontal status being only part of the study [8, 9, 10, 11, 12]. In general, the prevalence of periodontal pathology in children in the territory of the country varies between 40 and over 90%.

Globally, the prevalence of gingival diseases in children and adolescents also shows varied results depending on the indices used. To assess the periodontal status, most author groups use the Loe & Silness (GI) gingival index, but with a different diagnostic threshold. While at a diagnostic threshold GI>2 the authors found a prevalence below 20% [14], at a lower diagnostic threshold (GI≥0, GI≥1) the prevalence shows a more serious involvement of the population – from 64% to over 90% [15, 16, 17].

To assess the periodontal status in children,

some author groups use the community periodontal index (CPI). It is noteworthy that the relative share of children affected by gingival inflammation with this diagnostic parameter is about 37% [18, 19].

In the last 5 years, in connection with the new concept of periodontal health, the use of bleeding on probing as an accurate criterion for assessing the state of periodontal tissues has become increasingly necessary [20]. The extent of provoked gingival bleeding is key when it comes to assessing the condition of the gingiva. Boneta et al, for example, accept the presence of provoked gingival bleeding even at one gingival point as an indicator of gingival inflammation. Thus, the authors found over 80% prevalence of gingival pathology in 12-year-old children [21]. When adopting a diagnostic threshold of 10% affected by provoked bleeding gingival units, the values for the prevalence of gingival inflammation in childhood significantly decrease – 29.6% [22].

The literature reference demonstrates that the trend for high prevalence of gingival diseases in children and adolescents continues to be an actual problem. The cited authors found values for the prevalence of gingival diseases ranging from 19% to over 90%. The differences obtained by different author groups are mainly due to the use of different diagnostic thresholds or different indexes to objectify the gingival status. For the purposes of epidemiology, the most commonly used indices are the WHO-accepted Community Periodontal Index for Treatment Needs (CPITN) and the Loe & Silness Gingival Index (GI). With the introduction of the latest classification of periodontal diseases in 2017 and the acceptance of bleeding on probing as the earliest and objective method to evaluate gingival inflammation, more and more author groups use provoked gingival bleeding (BOP) as the main diagnostic criterion in their studies [20].

2. New classification of periodontal diseases from the point of view of children and adolescents

Under the auspices of the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) between November 9 and 11, 2017 in Chicago (USA), contemporary problems and their resulting consequences related to periodontal pathology were discussed [20]. The essence of the new concept laid down in the modern classification of periodontal diseases is related to emphasizing the local risk factors and the inflammation caused by them in the gingiva in the context of the general gingival status of the patient. Experts unanimously agree that the presence of a "limited field of gingival inflammation" (BOP - up to 10%) is still not enough to make a diagnosis of " gingivitis case", but this condition is of interest from the point of view of a preventive approach in periodontology and is reflected in the latter classification as "site specific" inflammation (" gingivitis site") [20, 23]. This form of incipient gingivitis, left untreated, can relatively quickly progress to localized gingivitis [24].

The review of periodontal health and plaque-induced gingivitis (PIG) includes several aspects: 1) introduction of the term "incipient gingivitis"; 2) a description of the extent and severity of gingival inflammation; 3) a description of the extent and severity of gingival enlargement; 4) reduction of categories in the dental plaque induced gingival disease taxonomy. This new concept emphasizes precisely the preventive approach in childhood and adolescence [24].

In the present classification, the term 'pristine periodontal health' is introduced, which denotes the healthy periodontium in the absence of histological signs of periodontal inflammation combined with the absence of clinical changes in the periodontal space. In contrast, 'clinical periodontal health' is a term used by the authors to describe the absence of clinically detectable periodontal inflammation against the background of intact or reduced periodontium (after treatment) [20]. In both cases, the authors considered 'health' to be the clinical absence of bleeding on probing (BOP) affecting more than 10% of a patient's gingival units.

This new scheme is based on evidence related to what is observed at the histological level changes in the periodontium, before the clinical manifestation of a pathological process. The situation is similar after applied treatment for inflammatory-destructive changes in the periodontium, when we achieve stabilization

and speak of 'clinical periodontal health' [2].

This new paradigm in the concept of periodontal health defines a new emphasis in periodontal prevention, especially in the child-adolescent age, when the initial reversible forms of gingival inflammation occur, which are very often without a clinical manifestation or with one that is not registered by the patient and even by the dentist when the purpose of the examination is different from an assessment of the periodontal status. Oftentimes, periodontal health in children and adolescents is not even the subject of preventive programs, and children remain without the necessary knowledge and motivation to maintain 'clinical periodontal health' [13].

3. Programs for periodontal prevention in children and adolescents

3.1. General principles and guidelines in periodontal prevention in children

Periodontal diseases, as a common finding in childhood, should not be neglected. The asymptomatic course of initial periodontal pathology is the reason for applying a screening method for assessing the risk of periodontal disease in children and adolescents and using methods to register the earliest changes in periodontal status during regular preventive examinations. Dentists who treat children, as well as those specializing in pediatric dentistry, are the ones who can first diagnose the initial changes in the gingival tissues included in the current classification of periodontal diseases. The emphasis of these changes in the modern reading of periodontal pathology determines our interest in the prevention of children's periodontal health.

The primary prevention of periodontal diseases is part of the complex oral prevention and includes all preventive measures aimed at limiting the development of clinically evident inflammation in the periodontium. In the context of the modern understanding of periodontal health, this means maintaining a "clinical periodontal health " [2]. In turn, the assumption of chronic gingival inflammation is a prerequisite for future inflammatory-destructive complications in the periodontium [25, 26].

American Academy of Pediatric Dentistry (AAPD) recommendations, in relation to oral/periodontal health in children, mainly focus on individual and professional plaque control in order to prevent periodontal complications [27]. According to the AAPD's latest revision of Adolescent Oral Health, emphasis on periodontal prevention includes the following guidelines:

- Motivation and commitment of children to the problems of periodontal health.
- Health education related to the etiology, characteristics and prevention of
periodontal diseases;
- Oral hygiene program aimed at individual plaque control,
oral health self-assessment, diet;
- Evaluation of the risk of periodontal diseases at a certain time interval
according to individual needs;
- Regular professional plaque control [28, 29, 30].

In 2015, the European Federation of Periodontology held a workshop focused on primary prevention of periodontal diseases. Data from the workshop supports the belief that individually and professionally administered plaque control significantly improves gingival inflammation and is a key element of any preventive program [30]. When it comes to children, however, the described guidelines can only be effective when they are supported by appropriate motivational programs to create proper oral health habits [13].

The application of various prophylactic measures aimed at gingival/periodontal health aims to achieve correct oral behavior in an optimal volume, the goal of which is the control of bacterial colonization [31]. The implementation of these preventive measures is carried out with the active participation of the children-patients to whom they are directed, and depending on the age, cognitive and emotional-social characteristics, the approaches may differ.

3.2. Motivation as an element of oral/periodontal prevention

The relationship between motivation, education and building health behavior for oral/

periodontal health is essential in the process of primary periodontal prevention [27].

Motivation is the result of the interaction between an individual, the environment and behavioral factors. Although human behavior can change continuously, it always remains at the level of individual motivation [32, 33]. It is these features of motivation as a process that determine the need to assess the individual psychosocial characteristics of children.

Human motivation is a combination of observations, ideas, feelings, desires, hopes, attitudes, values, and many other factors that create, maintain, and regulate behavior to achieve desired goals. Everyone's motives change with age and are usually oriented towards current goals [32, 33]. The set of all factors that can influence children's motivation must be carefully analyzed and adapted to the needs of a modern motivational program. In addition, it is necessary that the dynamics of the motivation process flow smoothly from one momentary goal to another in order to maintain a certain level of interest in adolescents [33].

In recent years, motivational interviewing (MI) has gained popularity in behavioral therapy as a method for positive change in an individual's attitudes and behavior. Motivational interviewing is about structuring conversations in such a way that children convince themselves to make a change based on their own values and interests. It is a collaborative style of conversation to enhance a person's own motivation and commitment to change. The four key processes in MI are engagement, focusing, evoking and planning [34].

Correctly structured and conducted motivational interviewing promotes the change in the behavior of patients, related to the common risk factors for periodontal pathology such as: oral hygiene, improper nutrition, harmful habits. This gives reason to apply it in the motivation of children as part of periodontal prevention according to the individual characteristics of the interviewees [34].

3.3. Education as an element of oral/ periodontal prevention

Education is reduced to the information processing processes of individuals, through which they acquire individual experience that they use in their behavior. Learning brings together personal experience and the influence of the environment in which new experiences and habits are acquired. Health education is a set of planned educational sessions, the purpose of which is to induce conscious actions to ensure better health [33].

With his theory of 'multiple intelligences', published in 1983, Howard Gardner stated that learning is a universal human process that happens to everyone according to the same principles. Gardner argued that each person's level of intelligence actually consists of many separate „intelligences" [35]. They are: 1) logical-mathematical, 2) linguistic, 3) spatial, 4) musical, 5) physical-kinetic, 6) interpersonal, 7) personal, 8) naturalistic and 9) existential [36].

The central idea in Gardner's theory of multiple intelligences is that each person learns in his or her own way. Some students need to read a text to understand the information, while others need to hear the information in the form of a lecture. Other students learn information best through diagrams or pictures. Every child has all intelligence, but one of them is more pronounced. Gardner's theory is not related to intelligence as a cognitive ability, but as an intermediate unit allowing easier perception of a given information [36].

An own study was conducted on the dominant intelligence of 21 children from the 6th grade in a Sofia school, and the purpose of the study was the selection of specific methods for motivation and training in harmony with the prevailing intelligence of the specific children. The results showed that the highest relative share of children (85.7%) had dominant musical, physical-kinetic and natural intelligence. In second place in terms of frequency (61.9%), extroverted intelligence is found, and children of this type best perceive knowledge in a group through introduction to group work, discussion, competition. About half of the children (47.5%) have positive visual-spatial intelligence, which is characterized by sensitivity to colors, shapes, lines and relationships between objects in space. Linguistic and introverted intelligence are relatively rarely (38.1%) positive. Logical-mathematical intelligence (28.6%) was the least frequently found in the studied group of children [13].

People acquire knowledge in different ways,

each with their own unique mental abilities and talents. Understanding certain facts or possessing specific skills is primarily related to students‘ ability to synthesize information with a certain context and successfully apply it to a given situation. It requires critical thinking to tackle a problem. In this regard, the hierarchy of cognitive abilities and the level of intellectual competence can be assessed using B. Bloom‘s taxonomy [37].

As early as 1956, Benjamin Bloom developed a system that categorized the level of abstraction of questions often used in education [37]. According to Bloom‘s taxonomy, the presentation of certain information to students should follow a specific sequence. Presenting information in this way allows students to absorb it gradually, according to their learning styles and abilities. Students from different levels have the opportunity to reach different levels of the pyramid, but every student should be able to achieve something.

From the literature review, it is clear that motivation and training in a preventive program can be applied in heterogeneous groups of students. By planning topics to cover all different levels and learners in one group, educators can create an environment that targets a wide range of learning styles, interests, and abilities. In the context of oral prevention, this type of training brings together ideas from Bloom and Gardner‘s taxonomy [36, 37]. The application of these principles can be done after a preliminary assessment of the children to determine the levels of knowledge, followed by the determination of the dominant style of intelligence of all children. The next step is to analyze the obtained results and adapt the studied topic based on the different levels and learning styles in a given group.

3.4. A comparative study of different periodontal preventive programs in children and adolescents

The implementation of a structured preventive program, tailored to the specific characteristics of the objects on which it will be applied, is of key importance for the effectiveness of oral prophylactics. Numerous studies at the individual and group level show a positive effect of different types of preventive programs, the main goal of which is to maintain oral health [38, 39, 40].

Hugoson et al. conducted a study on 400 youth and tracked the effectiveness of three different periodontal preventive programs. The youths were divided into one control and three experimental groups as follows: Group I – ‘Karlstad Model’. Young people from this group undergo a preventive examination every two months, and on the first visit they receive information related to gingival diseases and oral hygiene instructions, the following visits are for control and re-motivation. Some of the participants undergo professional oral hygiene on each visit. II group - individual training. Young people from this group undergo a preventive examination 3 times in a two-week interval, and the methodology is the same as that of the previous group. Group III – group training. The young people are divided into groups of 10 people each, and the methodology is the same as in the previous group. The results show that the greatest improvement in the gingival status is observed with the ‘Karlstad model’, where there is a combination of both an individual approach in motivation and training, as well as frequent preventive examinations, some of which also include professional oral hygiene. The influence of the individual and group prophylactic program did not show statistically significant differences in the state of the gingival indices, probably due to the lack of sufficiently frequent visits including remotivation [39].

A 2009 study involving a cognitive behavioral approach demonstrated greater effectiveness in individual behavioral change regarding oral hygiene habits compared to traditional oral hygiene instruction. 38 patients, divided into two groups, received oral hygiene instructions weekly for 3 weeks. The experimental group underwent a 10-minute consultation using the Farquhars method using a six-step methodology. The methodology is an application of the individual-effective theory of behavior change. The six steps include: 1) awareness of the problem; 2) creating confidence and commitment; 3) behavioral awareness; 4) developing and implementing a specific plan; 5) evaluation of the created plan; 6) prevention of relapses. The results at the end of

the study showed that in the experimental group the periodontal status objectification indices were significantly lower compared to the control group [40].

Another team of authors studied 300 children aged 12 years, and the study went through three stages: an initial assessment of health knowledge through a survey; motivation and training; final assessment of knowledge 6 weeks after the motivational program. The children were divided into three groups - in the first group the motivation included audio-visual means, in the second group the motivational program was the same, but with the help of chalks, blackboards and pictures, in the third group no motivation and training was conducted. The authors registered statistically reliably more correct answers in the final evaluation of knowledge in the group with audio-visual motivation, and the same was registered in the evaluation of the oral hygiene indices compared to the other two groups [41].

The application of motivational programs as a part of primary periodontal prophylaxis can be implemented with a larger number of participants. One of the appropriate methods of motivation and health education for periodontal health in children are considered to be those based on the principles of 'group dynamics', where a variety of methods are included in a group education and motivation setting with the conscious participation of more children. The purpose of health education in this case is to inform, educate and build on previous health knowledge in combination with the creation of new health habits and oral hygiene skills, and in the conditions of interaction with other children. Different types of games, experimental, interactive and other methods are especially suitable. Key to group prevention programs is that they must include elements to influence nearly the entire spectrum of intelligence characteristics according to H. Gardner in order to reach all participants. Expectedly, some of the methods used would be intriguing to one group of children and others would be highly appreciated by another group.

3.5. Effectiveness of individual plaque control agents - a comparative study

As it has already become clear, individual plaque control and training for its effective implementation are a major focus in oral/periodontal prevention [27]. The most common means of removing dental biofilm is the toothbrush and the appropriate toothpaste.

Periodontal prevention in children and adolescents includes certain rules for choosing a toothbrush and paste, training on the correct method of brushing the teeth, according to the age of the child, his already acquired or missing brushing skills and oral hygiene habits, against the background of certain health knowledge and motivation [27]. On the other hand, the different types of toothbrushes (electric, ultrasonic, sonic, etc.) that flood the market and are increasingly used by children, even before getting used to the standard mechanical toothbrush, require specific training methods that definitely are neglected by parents and even dentists.

The effectiveness of different personal oral hygiene products depends on several main factors - motivation, knowledge and manual skills of the subject. Electric toothbrushes simulate the movements of mechanical toothbrushes through lateral and rotational movements of the brush head. The popularity of these electronic oral hygiene tools is great, and their cost is significantly higher than that of standard mechanical brushes. However, the question remains, which of these childhood plaque control agents is better?

Studies in world literature regarding the effectiveness of different types of brushes date back almost 30 years ago. The results obtained by various author groups unequivocally show a preponderance of the effectiveness of electrical devices, both in terms of the removal of the dental biofilm and in terms of indices related to the assessment of the gingival status [42, 43, 44, 45, 46].

Davidovich et al. compared the effectiveness of an electric toothbrush to a mechanical toothbrush in children aged 3 to 9 years, and the authors examined the oral hygiene status at three visits - at the first visit, after 7 days and after another 7 days. The team concluded that an electric toothbrush was more effective in removing dental biofilm [58]. A meta-analysis showed that electric toothbrushes that work through the rotation-oscillation mechanism

showed better control of dental biofilm and gingival inflammation compared to sonic and mechanical toothbrushes [46, 47].

A comparative study in childhood found that the use of an electric toothbrush resulted in an almost 30% greater reduction in plaque build-up compared to the use of a mechanical toothbrush [48]. Later, Garcia-Godoy and colleagues proved a similar regularity when comparing the effectiveness of electric and mechanical toothbrushes in children from 6-11 years of age [49].

Jongenelis and co-authors, in turn, found an almost double reduction in plaque build-up when using electric toothbrushes compared to mechanical toothbrushes. The authors studied children with complete temporary or mixed dentition [50]. Similar results were obtained by other authors in children aged 4-7 years when using sonic toothbrush Philips Sonicare for children [51].

Another study of 182 patients with gingival inflammation compared the effectiveness of sonic brushes to mechanical brushes over a 4-week period. The authors concluded that the sonic toothbrush was significantly more effective [52].

A study from 2021, comparing the performance between an electric, ultrasonic and mechanical toothbrush, again demonstrated superiority in the removal of dental biofilm with electric devices. An interesting finding of the authors, however, is the fact that they registered more serious tooth abrasion when using the ultrasonic toothbrushes [42].

There are no studies in the literature on the effectiveness of different types of toothbrushes as part of specialized programs for primary periodontal prevention in children and adolescents.

Conclusion

The most common periodontal disease at the age of 10-14, immediately after the eruption of the permanent dentition, is the initial localized form of plaque-induced gingivitis. At this age, a preventive approach to this type of oral pathology is key to the enduring strategic goals of maintaining periodontal health throughout a person's life.

The asymptomatic course of the initial forms of gingival inflammation in childhood and adolescence is often the reason for the lack of adequate care, which leads to a gradual complication of the clinical picture in the future. Building long-lasting knowledge and skills to maintain oral/gingival health is a key factor in primary periodontal prevention in children. The development of specific group/individual preventive programs constructed based on the specific age characteristics of children, especially at the age of 12-14 years immediately after stabilization of the permanent dentition, is of extremely great importance to create appropriate behavior for maintaining oral/gingival health throughout a person's life. The use of modern interactive methods, as well as specifically selected game and demonstration methods, engage attention and create motivated and aware behavior, which guarantees the development of a lasting preventive attitude to gingival health in adolescents.

The age period 10-14 is suitable for creating sustainable, aware, lasting knowledge, skills and motivated health behavior to maintain oral health. With a certain motivation of the children, the initial gingival inflammation, mainly related to the dental biofilm, is easily treated and with the participation of the child himself, when he is trained and motivated for self-control and self-evaluation.

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Study of root dentin thickness in immature permanent teeth

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Изследване на дебелината на кореновия дентин при постоянни зъби с незавършено кореново развитие

Красимир Христов[1], Ралица Гигова[2]

Summary

Introduction: *Treating permanent children's immature teeth presents every clinician with many challenges. An understanding of their internal structure and anatomy is crucial for the final clinical success.*

Aim: *To determine the thickness of the root walls in immature upper permanent molars.*

Materials and methods: *Twenty permanent maxillary third molars with incomplete root development were scanned with a desktop X-ray microtomograph. For determining dentin thickness, measurements were made in the root wall's vestibular, medial, distal, and palatal directions on three transverse sections - apical, middle, and coronal.*

Results: *The measured dentine thickness was greatest buccally along the entire length of the mesio- and distobuccal roots. In the palatal root this applied to the palatal wall. Apically, the thinnest wall was the distal on mesial and palatal root, and mesial on distal root.*

Conclusion: *Due to the peculiarities of the anatomy of the root canals and the different thicknesses of the dentin, special attention is required in the disinfection procedures and their mechanical preparation during endodontic treatment.*

Резюме

Въведение: *Лечението на постоянни детски зъби с незавършено кореново развитие поставя всеки клиницист пред редица предизвикателства. Разбирането на вътрешната структура на постоянните зъби с отворен апекс, както и доброто познаване на анатомията на корените им е от съществено значение за крайния клиничен успех.*

Цел*: Изследване на дебелината на стените на кореновите канали при постоянни горни молари с незавършено кореново развитие.*

Материали и методи: *Обект на настоящето изследване бяха 20 постоянни максиларни трети молара с незавършено кореново развитие. Всеки зъб образец бе сканиран с настолен рентгенов микротомограф. За определяне на дебелината на дентина бяха извършени измервания във вестибуларна, медиална, дистална и палатинална посока на кореновата стена на напречни срезове от апикална, средна и коронарна трета.*

Резултати: *При медио- и достобукалните корени най-голяма е дебелината на дентина букално по цялата им дължина от коронарна към апикална посока. При палатиналния корен това важи за палатиналната стена. Апикално, най-тънки са дисталната стена на медиалния и палатален корен и медиалната на дисталния корен.*

Заключение: *Поради особеностите на анатомията на кореновите канали и различната дебелина*

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на дентина се изисква специално внимание при процедурите на дезинфекция и механичната им обработка при ендодонтско лечение.

Introduction

Treating permanent children's teeth with incomplete root development provides every clinician with many challenges [1]. Endodontic treatment creates problems in disinfection, instrumentation, and three-dimensional obturation because their root canals are wide and their dentin walls are thin [2]. It is proven that immature permanent teeth with pulp necrosis are more prone to fracture due to their thin roots [2, 3]. Understanding the internal structure immature permanent teeth and a good knowledge of their root anatomy is essential for their treatment. Canals were found not to be located in the center of the root in cross-section [4]. The location of the canals, which are close to the furcation, makes the amount of dentin removed during mechanical instrumentation essential because of the existing risk of perforations, the clinical treatment of which in most cases is complicated and unpredictable [5].

Successful endodontic therapy requires complete disinfection and three-dimensional obturation of root canals, which depends to a large extent on a good knowledge of root canal morphology and its variations [6]. Canal morphology is highly variable and complex [7]. Due to the thin dentinal walls of the root canals of teeth with incomplete root development, mechanical instrumentation is often challenging to perform [1]. Understanding the anatomical and physiological features linked to clinical treatment protocols is crucial for the final treatment result. Maxillary first molars are the second most common teeth after mandibular first molars to be treated endodontically [8]. The internal anatomy of maxillary molars is extremely complex morphologically, compromising the endodontic treatment's success [9]. The complex anatomy of the canals, lateral canals, bifurcations, isthmuses, and other potentially inaccessible areas encountered in maxillary molars endanger their chemo-mechanical treatment [9]. For these reasons, understanding the complex morphology of root canals is essential to the success of endodontic treatment [10]. There are not enough studies on root morphology and thickness of dentin in teeth with incomplete root development. The present study aimed to determine the thickness of the root canal walls in permanent molars with incomplete root development at a stage of root walls close to the final length in the coronal, middle and apical third of the root.

Materials and methods

Twenty immature permanent maxillary third molars extracted due to orthodontic reasons were used for the study procedures. The samples met the following criteria:

• absence of fractures and/or defects and/or cracks on the roots;

• incomplete root development in the stage of root walls close to the final length;

• macroscopic root anatomy similar to that of a maxillary first permanent molar, with three distinct roots – mesiobuccal, distobuccal, and palatal.

After their extraction, the teeth were cleaned with gauze soaked in hydrogen peroxide and stored in a 10% formalin solution. Each specimen was scanned with a SkyScan desktop X-ray microtomograph (Bruker, Massachusetts, United States), X-ray tube voltage 100 kV, and current magnitude 100 μA, with a 0.55 mm copper filter. The beam used was conical, with a single voxel size of 12 μm. On the transverse sections, the first image with evident walls was taken as the apex of the root canal, and the first section with enamel was taken as the neck (enamel-cementum border). The length of the root canal was taken as the distance from the orifice of the canal to the apical foramen, after which the root was divided into three equal parts - apical, middle, and coronal. For determining dentin thickness, measurements were made in the vestibular, medial, distal, and palatal directions of the root wall on three transverse sections - apical, middle, and coronal (Figure 1).

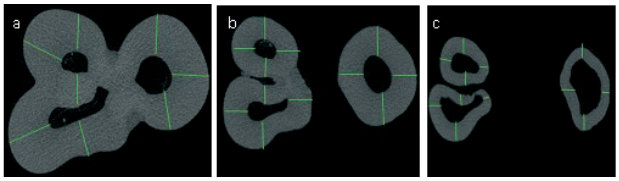

Figure 1. *Microradiographic image of dentin thickness in the three zones: a. coronary; b. middle; c. apical zone.*

Results

The results showed that the thickness of the dentin gradually decreased in the direction from the cemento-enamel junction to the apex of the tooth. In mesiobuccal (MB) root, the thickness of the dentin is most significant buccally in all three measured zones (coronal, middle, and apical). The greatest mean thickness was found at coronal level. The same trend was observed in the distobuccal (DB) root, where the thickest layer of dentin was found coronally in the buccal area. The dentin thickness was most significant on the palatal (P) wall in the palatal root, with the average value being lower than the other roots (Table 1).

Table 1. *Dentin thickness in different root regions in immature third molars*

	Coronal third (mm)	Middle third (mm)	Apical third (mm)
Mesiobuccal canal			
d	1.58±0.17	0.63±0.13	0.44±0.25
m	1.47±0.19	0.82±0.19	0.69±0.15
b	**2.19±0.28**	1.17±0.26	0.75±0.19
p	-------	1.16±0.22	0.47±0.16
Distobuccal canal			
d	1.55±0.33	0.87±0.18	0.64±0.11
m	1.58±0.62	0.79±0.12	0.51±0.12
b	**2.2±0.60**	1.14±0.34	0.65±0.09
p	--------	1.12±0.29	0.54±0.10
Palatal canal			
d	1.7±0.54	1.16±0.21	0.48±0.09
m	1.54±0.48	1.31±0.19	0.55±0.08
b	-------	1.25±0.38	0.66±0.13
p	**1.84±0.33**	1.34±0.36	0.53±0.18

Discussion

The present study investigated root dentin thickness in teeth with incomplete root development at a stage of root walls close to the final lenght. A good knowledge of the characteristics of the tooth's root canals and the internal complex three-dimensional morphology is essential and beneficial for a long-term treatment success [11]. Permanent molars with incomplete root development have different variations in the morphology of their roots, the thickness of the dentin during the development, and the number of the canals. This creates many difficulties in their treatment [12]. This study proves that in the mesio- and distobuccal root, the buccal walls are thicker than the others along its entire length from the coronal to the apical direction. In the palatal root, the palatal wall was the thickest. Dentin is thinnest in the middle third of the mesio- and distobuccal root mesially and distally. In the apical third of all roots and along all walls, the dentine thickness is the thinnest and varies between 0.75 and 0.44 mm (Table 1). Endodontic treatment of such teeth with necrotic pulp is challenging due to technical limitations in processing, instrumentation, irrigation, and obturation and the increased risk of root fracture.

The thickness of the dentin in the distal zone of the mesiobuccal root of the maxillary molars, located closest to the furcation, is called the danger zone because it is the most at risk of perforation in case of transportation of the root canal during its instrumentation [5]. In

our study, the dentin thickness in this area was found to vary from 0.44 to 1.58 mm (Table 1). Other authors found values between 0.88 and 0.98 mm in maxillary first molars with complete root development (9).

In addition to root canal anatomy, knowledge of dentin morphology and root zone thickness is essential for any endodontic treatment's success [13]. Root development after the tooth eruption is characterized by root elongation, increasing wall thickness, and narrowing of the root canals in the apical region. Any disturbance in the blood supply to Hertwig's sheath due to pulp necrosis can impair cell proliferation and differentiation, causing arrest in root development [1]. Treatment techniques for immature permanent teeth are severely limited because although infected and necrotic pulp tissues can be removed, the remaining dentin walls remain thin, brittle, and weak, which can lead easily to fractures [14].

The leading causes of pulpal and periapical inflammation are bacterial invasion and colonization of the root canal system [15]. In order to achieve regeneration, the canal walls must be thoroughly disinfected, and the degree of disinfection required is higher than in traditional endodontic therapy [16]. The most important reasons for the negative outcome of regenerative treatment are considered to be the long-term persistence of the periapical lesion, the cytotoxic effect of irrigants, the early stages of root development, and improper control of the intracanal infection [17, 18]. Nair et al consider resistant microorganisms and reinfection as the main factors of treatment failures [19]. Bacteria in the canal can resist chemical and mechanical preparations, surviving in isolated and hard-to-reach areas of the canal system [20, 21]. According to microbiological and histological observations, microorganisms can survive despite the usage of intracanal medications [20, 22]. Like conventional endodontic therapy, biofilm can remain in the canal system after disinfection without mechanical instrumentation during a regenerative endodontic procedure. Histological observations of cases of failed revascularization show that the lack of mechanical instrumentation is the main reason for the highly colonized bacterial walls of the canals, respectively, for the failure of the treatment. Most bacteria reside in the apical rather than the coronal portion of the canal, forming a biofilm and penetrating the dentinal tubules [17]. Biofilm microorganisms are firmly attached to the canal walls, and their removal requires mechanical instrumentations combined with irrigants. Although mechanical instruments significantly reduce the number of microorganisms, they are generally not recommended for regenerative endodontic procedures [23, 24]. Disinfection in these cases should be achieved using irrigation solutions and intracanal medications with minimal or no mechanical cleaning [25].

Another problem is that mechanical cleaning can weaken the already thin root walls or remove remnants of vital tissue in the apical part of the canal [26]. However, current instrument-free regenerative endodontic protocols leave many doubts about whether achieving adequate root canal disinfection of infected immature permanent teeth is possible. Failure to achieve this results leads to failure in the treatment [17, 27, 28].

Conclusion

Due to the peculiarities of the anatomy of the root canals and the different thicknesses of the dentin, special attention is required during the disinfection procedures and their mechanical cleaning during endodontic treatment.

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Psycho-emotional state and bruxism in school-aged children during the COVID-19 pandemic

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Психо-емоционално състояние и бруксизъм при деца в училищна възраст по време на COVID-19 пандемия

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Summary

The unprecedented global pandemic of COVID-19 has had a significant impact on the daily life and psycho-emotional state of both adults and children. One of the most affected groups was the young students of 7-10 years, because of their early inclusion to digital environment and distance learning, which led to their social isolation and stagnation at home.

***Aim:** The aim of the present study is to investigate the impact of the COVID-19 pandemic on the psycho-emotional state of children aged 7-10 years and its relationship with bruxism.*

***Materials and methods:** The object of the study are 267 children aged 7-10 years. Anamnestic data on bruxism and psycho-emotional status during the pandemic were obtained from a parent through a questionnaire for 241 children. The results were statistically processed with SPSS-19.*

***Results:** In the case of 31.5% of the children, the parents indicate that the pandemic has rather influenced their behavior. More than ¼ of these children were found to be positively affected by staying home. The response „The child is more anxious, restless, nervous" due to the COVID pandemic is more common in children with bruxism than in those without. In 38.2% of the children, the parent indicated „loneliness due to isolation" as the child's predominant feeling during the pandemic. The feeling of anxiety prevails in the group of children with bruxism, in comparison with those without*

***Conclusions:** Almost 1/3 of the parents surveyed indicated that the COVID-19 pandemic has rather affected their children's behavior. The predominant feeling that the pandemic has caused the studied children is „loneliness due to isolation". In children with bruxism, the behavior changed to „more anxious, restless, nervous" and the predominant feeling associated with the pandemic for them was more often anxiety, in comparison to children without bruxism.*

***Key words:** bruxism, pandemic, psycho-emotional state, anxiety*

Резюме

Безпрецедентната световна пандемия от COVID-19 оказа значително влияние върху ежедневието и психо-емоционалното състояние както на възрастните, така и на децата. Едни от най-засегнатите групи бяха малките ученици от 7-10 години, тъй като се наложи ранно приобщаване към дигитална среда и дистанционно обучение, което доведе до тяхната социална изолация и застой у дома.

***Цел:** Целта на настоящото изследване е проучване на влиянието на пандемията от COVID-19 върху психо-емоционалното състояние на деца от 7-10 години и връзката му с бруксизъм.*

***Материали и методи:** Обект на изследването са 267 деца от 7 – 10 години. От родител бяха*

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получени анамнестични данни за нощен бруксизъм и психо-емоционално състояние по време на пандемията чрез анкета за 241 деца. Резултатите бяха статистически обработени със SPSS-19.

Резултати: *При 31.5% от децата родителите посочват, че пандемията по-скоро е повлияла тяхното поведение. При над ¼ от тези деца се установява положително повлияване от оставането вкъщи. Отговорът „детето е по-тревожно, неспокойно, нервно" поради COVID-пандемията се среща по-често при децата с бруксизъм, отколкото при тези – без. При 38.2% от децата родителят е посочил „самота поради изолация" като преобладаващо чувство у детето по време на пандемията. Чувството за тревожност преобладава в групата на децата с бруксизъм, в сравнение с тези – без*

Изводи: *При почти 1/3 от изследваните деца родителите са посочили, че COVID-19 пандемията по-скоро е повлияла тяхното поведение. Преобладаващото чувство, което пандемията е предизвикала при изследваните деца е „самота поради изолацията". При децата с бруксизъм поведението се е променило към „по-тревожно, неспокойно, нервно" и преобладаващото чувство, свързано с пандемията, за тях е по-често тревожност, в сравнение с децата без бруксизъм.*

Ключови думи*: бруксизъм, пандемия, психо-емоционално състояние, тревожност*

Introduction

The global pandemic caused by the SARS-CoV-2 virus has led to significant changes in the daily life of the population, covering all age groups. This inevitably had an impact on both the physical and mental health of people. Children are one of the most sensitive groups, as they cannot fully understand the problem and the reason for the new demands on them. School closures and social isolation have led to stress and anxiety [1,2,3].

Distance education became necessary during the pandemic and lead to long hours spent in front of electronic devices (tablet, computer, smartphone) even for the youngest students from 7 – 10 years [4]. At this early age, children's psycho-emotional development is very intense and dynamic and therefor they are very sensitive to changes around them, as well as easily susceptible to fears and anxiety [5,6]. Some studies suggest that strong attachment, absent-mindedness, irritability, and fear that family members may contract the disease are the most commonly identified behavioral problems in children [2,7]. A Chinese study found that children often experience depression and anxiety, or both, due to quarantine [8]. Another article from India indicated that the children studied most often felt helpless, anxious and scared [9].

Accumulation of additional stress and emotional burden can lead to the appearance or complication of some parafunctions such as bruxism [10,11,12]. It is a condition where the patient grinds/clenches his teeth involuntarily during the day (awake) or night (sleep bruxism) [13]. Bruxism in children is often associated with emotional factors, high levels of anxiety, stress [14,15]. Data from the literature indicate that the changes that occurred during the COVID-19 pandemic had a mainly negative effect on children both in a psycho-emotional aspect and in increasing the frequency of bruxism [10,12,16,17]. Considering the main risk factors for bruxism in a psycho-emotional aspect and the complex impact of the pandemic on children's mental health, we consider it important to study it in children with bruxism and in those without.

Aim

The aim of the present study is to study the impact of the COVID-19 pandemic on the psycho-emotional state of children aged 7-10 years and its relationship with bruxism.

Material

In the present study, we examined 267 children aged 7-10 years attending „Nikolay Petrini" and „Hristo Smirnenski" elementary schools, in the territory of the city of Yambol. After completing a KENIMUS-approved written informed consent by a parent, they were provided with a questionnaire to complete. Of all children, 241 returned completed questionnaires.

Methods

Questionnaire method

Questionnaire method for studying nocturnal bruxism and risk factors related to it, including the COVID-pandemic: general condition and diseases of the child, allergies, eating habits; teeth grinding (bruxism); orofacial symptoms and habits; masticatory muscle fatigue/pain, bad habits, impact of the COVID pandemic on physical activity, screen time, nutrition, psycho-emotional state and bruxism. The questions related to the psycho-emotional profile of the children were selected in collaboration with a child psychologist.

The statistical program IBM® SPSS® Statistics 19 was used for statistical processing of the results. A 95% confidence interval ($p<0.05$) was chosen for the level of significance at which the null hypothesis is rejected. Descriptive analysis and cross tabulations and T-test were used.

Results

The changes in the daily life of children and adults inevitably affected their physical and mental state. Since parents have a direct view of their children and their development, we asked them in the provided survey whether the COVID-pandemic has rather affected their child's behavior or if they have not observed a change. Fig. 1 shows the results of the answers analysis:

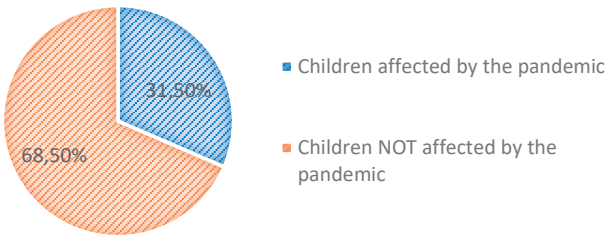

Fig.1. *Frequency of the impact of COVID-19 on children's behavior*

The data showed that in 76 children (31.5%) the parent reported that the COVID-19 pandemic had rather affected the child's psycho-emotional state and behavior ($p<0.05$).

Parents who answered positively to the above question were asked to choose which of the listed statements most accurately describes the change in the child's behavior due to the COVID-19 pandemic. The distribution of the different patterns of behavior change that were indicated by the parents is presented in Table 1.

Table 1. *Distribution of the different behavior patterns in the examined children*

	n	%±SP	t
The child is more anxious, restless, nervous[1]	7	9.2%±3.3	$t^{1,2}=0.53$ $t^{2,5}=2.50$
The child is more apathetic, indifferent, unmotivated[2]	9	11.8%±3.7	$t^{1,4/3,4}=2.45$ $t^{2,6}=1.14$
The child is more disobedient and difficult to control[3]	7	9.3%±3.3	$t^{1,5/3,5}=3.02$ $t^{4,5}=0.56$
The child is under additional stress[4]	18	23.7%±4.8	$t^{1,6/3,6}=1.66$ $t^{4,6}=0.80$
Staying at home had a positive effect on the child[5]	21	27.6%±5.1	$t^{2,3}=0.53$ $t^{5,6}=1.36$
Combination of more than 1 behavior pattern[6]	14	18.4%±4.5	$t^{2,4}=1.93$
Total	76	100%	

The parents of 21 children indicated that staying at home had a rather positive effect on their child (27.6%). A relatively high percentage of parents (23.7%) thought that the child was subjected to additional stress. A combination of behavior patterns is also common - in 14 children (18.4%). The remaining 3 models are evenly distributed and with low frequency.

When we analyzed the previously mentioned results, in relation to bruxism, we obtained the following outcomes, presented in Fig.2.

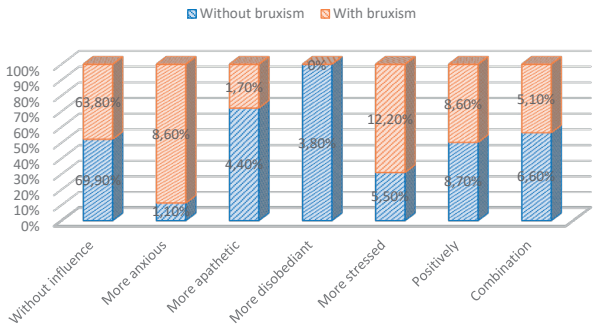

Fig.2. *Distribution of the impact of the COVID-pandemic on children's behavior and bruxism*

The data in the figure show that the response "The child is more anxious, restless, nervous" due to the COVID-pandemic occurred more often in children with bruxism (P<0.05). Also in their group, the answer „The child is under additional stress" is also found with greater frequency, but without statistical significance (P>0.05). On the other hand, the response „The child is more disobedient and difficult to control" prevailed in children without bruxism (P<0.05). For the rest of the answers, the distribution between the two groups of examined children is relatively even. Parents also had to answer a multiple-choice question about the prevailing feelings the pandemic had caused in their child. The results are presented in Table 2.

Table 2. *Distribution of the predominant feeling related to COVID-19 in the examined children*

	n	%±SP	t
Parent did not specify[1]	96	39.8%±3.2	$t^{1,2}$ = 6.65 $t^{2,4}$= 6.25
Fear of illness[2]	34	14.1%±2.2	$t^{1,3}$= 11.71 $t^{2,5}$= 2.89
Anxiety[3]	4	1.7%±0.8	$t^{1,4}$= 0.37 $t^{3,4}$= 11.28
Loneliness due to isolation[4]	92	38.2%±3.1	$t^{1,5}$= 9.56 $t^{3,5}$= 2.59
Other[5]	15	6.2%±1.6	$t^{2,3}$= 5.21 $t^{4,5}$= 9.14
Total	241	100%	

Most often, the parents were not able to determine what feeling the pandemic caused in their child and did not specify one (39.8%). Among those who indicated, „loneliness due to isolation" (38.2%) prevails, followed by „fear of illness" (14.1%).

When comparing the results obtained above in regards to bruxism, we obtained the following data presented in Fig.3.

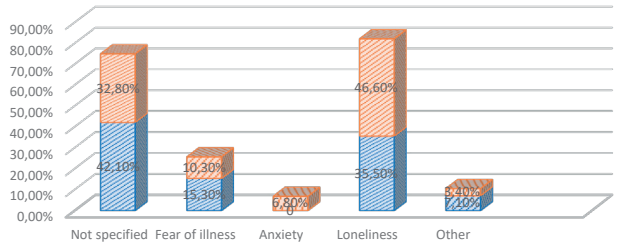

Fig.3 *Distribution of children's reaction to the COVID-pandemic and bruxism*

We found that only the feeling of anxiety prevailed significantly in the group of children with bruxism, compared to those without (P<0.05). 46.6% of children with bruxism felt lonely, compared to 35.5% of those without (P>0.05). No statistically significant difference was found in the other groups either.

Discussion

The significant impact of the global pandemic on almost all aspects of our lives has lead to conducting numerous scientific studies. Their goal is to better understand and analyze the impact on the mental and physical condition of children and adults. In a study of behavioral changes during the pandemic, a group of authors from China found that between 4.7–10.3% of the children showed behavioral changes due to the pandemic and the resulting changes in their daily lives [18]. In our research, the results support this study. They showed that for 31.5% of the children, the pandemic rather affected their behavior, with most often staying at home having a positive effect on 27.6% of them. In 23.7% of cases with affected behavior, parents reported that the child was subjected to additional stress.

Other studies also confirm the strong impact of the extraordinary situation during the COVID-19 pandemic on the psycho-emotional development of children in the direction of more stress, anxiety, depression, fear, etc. [2,7,8,9,19].

It is known that bruxism is often associated with stress and psycho-emotional state, although its etiology is still unclear and multiple risk factors may be involved [20,21].

Different studies also confirmed that children with bruxism during the pandemic showed increased levels of stress and anxiety [10,12,16]. These findings were supported by our results as well, as statistical significance was found for the response "anxiety" which was more common in children who grind their teeth.

According to data from the literature, during the pandemic, children most often suffer from social isolation and loneliness, along with fear of contracting COVID-19 for themselves and their families [2,5,6,7,19]. In our research, almost 40% of the parents were unable to identify their child's feelings during the pandemic, 38.2% indicated "loneliness due to isolation" and 14.1% indicated "fear of getting sick". These results confirm the strong impact of the pandemic on the psycho-emotional state of children.

Conclusion

The results obtained from the present study show that the COVID-19 pandemic has had a serious impact on the behavior and psycho-emotional state of children aged 7-10 years. In children with bruxism, these changes are significantly more often associated with increased anxiety and nervousness, which indicates the sensitivity of the child's psyche to changes in everyday life. Although the pandemic is now an unpleasant memory, the impact it may have had on the younger generation should be considered.

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Periodontology

Application of Microneedling and Injectable-PRF for enhancement of the gingival thickness – preliminary results. A case report

Zdravka Pashova-Tasseva[1]

Приложение на микронийдлинг и инжекционен PRF за подобряване на гингивалната дебелина– предварителни резултати. Клиничен случай

Здравка Пашова-Тасева[1]

Summary

Introduction: *Patient treatment outcomes depend on many factors, one of which is the tissue phenotype. Knowledge of specific soft tissue characteristics leads to predictable results and minimizes the risk of adverse effects. The identification of the gingival phenotype is gaining increasing importance in various fields of dentistry. Various surgical and non-surgical techniques have been proposed and used for its enhancement. The application of injectable-PRF is becoming more popular, including in the area of periodontology. The combined utilisation of microneedling and injectable-PRF could represent possibility for improvement of the gingival thickness.*

Materials and methods: *A 31-years old female patient, non-smoker, normoglycemic, with upcoming orthodontic treatment, with a thin gingival phenotype, underwent non-surgical gingival thickening procedures in four visits. The procedures were performed in an interval of 10 days in combination of Microneedling and injectable-PRF.*

Results and discussion: *After performing the full course of MN procedures in combination with i-PRF, a thickening of the gingival tissues was detected already after the first month, which was maintained until the sixth month after the last procedure. For this reason, the proposed technique could represent alternative non-surgical technique for thickening of gingival tissues in natural teeth. Further studies and longer-term follow-up are needed to obtain results with statistically significant values.*

Key words: gingival phenotype, gingival thickness, injectable platelet rich fibrin

Резюме

Въведение: *Резултатите от лечението на пациентите зависят от много фактори, един от които е тъканният фенотип. Познаването на специфичните характеристики на меките тъкани води до предвидими резултати и минимизира риска от нежелани ефекти. Идентифицирането на гингивалния фенотип придобива все по-голямо значение в различни области на денталната медицина. За неговото подобряване са предложени и използвани различни хирургични и нехирургични техники. Приложението на инжекционен PRF става все по-популярно, включително и в областта на пародонтологията. Комбинираното използване на микронийдлинг и инжекционен PRF може да представлява възможност за подобряване на дебелината на гингивата.*

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Материали и методи: *31-годишна жена, не-пушачка, нормогликемична, с предстоящо ортодонтско лечение, с тънък гингивален фенотип, беше подложена на процедури за нехирургично удебеляване на гингивата, проведено в 4 посещения. Процедурите бяха извършени на интервали от 10 дни с комбиниране на микронийдлинг и инжекционен PRF.*

Резултати и дискусия: *След извършване на пълен курс микронийдлинг в комбинация с инжекционен PRF беше установено удебеляване на гингивата още на първия месец, което се запази и на шестия месец след последната процедура. Поради тази причина предложената техника може да представлява алтернативна нехирургична техника за удебеляване на гингивалните тъкани при естествени зъби. Необходими са по-нататъшни изследвания и проследяване, за да се получат статистически значими резултати.*

Ключови думи: гингивален фенотип, гингивална дебелина, инжекционен PRF

Introduction

Periodontal phenotype is a term uniting gingival phenotype (includes gingival thickness and width of keratinized gingiva) and bone morphotype (refers to buccal bone plate). Three categories of periodontal phenotype are distinguished: thick flat, thick scalloped and thin scalloped [1]. The clinical significance of the periodontal phenotype refers both to the risk of specific tissue problems and to the effective resolution of pathological changes. It is known that insufficient gingival thickness in the vestibular area is a prerequisite for the occurrence of gingival recession, both in the area of natural dental crowns and in places undergoing restorative procedures, orthodontic or implantological treatment, periodontal plastic surgery, but also non-surgical periodontal therapy [2,3]. For this reason, the clinician's ability to recognize the thin gingival phenotype is essential. As a logical counterpoint, the thickness of the gingiva as well as a sufficient area of width of the keratinized gingival tissue gives a predictive character in the implementation of various treatment modalities [4].

Clinical studies provide convincing evidence of a positive effect when applying i-PRF in relation to cartilage and bone tissue, dental pulp, tissue healing, periodontal tissues, incl. and the parameters characterizing the gingival phenotype – gingival thickness and keratinized gingival width. The application of i-PRF in dentistry is based on the biological effects of the blood product such as regenerative potential; increased synthesis of collagen type 1; increased angiogenesis when used simultaneously with a bone graft; improves soft tissue healing; reduces the risk of postoperative recessions in coronary-positioned flap procedures applied in clinical situations with very deep gingival recessions; augmentation of gingival thickness, periodontal pocket reduction and loss of clinical attachment in periodontal regeneration procedures etc.[5-11].

The clinical significance of the gingival phenotype is of interest to clinicians. Methods for its improvement are developed that are easy to perform, do not pose a risk to the patient and are applicable in daily dental practice by both specialists and general dentists. In the last few years, approaches to augment gingival thickness by various injection techniques using hyaluronic acid, i-PRF, MN (microneedling) in combination with i-PRF have been discussed. In a study conducted by Ozsagir et al. compared the effectiveness of i-PRF and MN in combination with i-PRF. The team applied the technique to augment the gingival phenotype in patients with thin gingival tissues. At monthly follow-up for 6 months, the data gave reason to note an increase in gingival thickness with statistical significance. Microneedling is a method that supports the penetration of active substances into target tissue, thereby enhancing the efficacy of the applied substance. The research was conducted under the so-called split mouth design suggesting comparison of areas treated with i-PRF alone and adjacent areas treated with MN in combination with i-PRF. A statistical difference was found in favor of the second technique in terms of increasing the thickness of the gingiva [10,14]. Regarding the invasive nature of the procedure (taking venous blood - two tubes per procedure, four procedures at a certain time interval), the technique offers an alternative through procedures requiring flap preparation, suturing and suture removal, as well

as the potential for a second surgical bed - donor bed of palatal mucosa; long recovery period, often accompanied by limitations in daily activities, risk of bleeding, risk of compromised healing, infection and others. However, the durability of the results remains unexplored - also a challenge in terms of long-term effectiveness of the technique. According to statistical data obtained from author`s research in a small Bulgarian population it was found that in the studied representative sample, the second most common gingival phenotype was thin scalloped - 35.7% of all examined individuals. 42.9% of individuals with a thin scalloped gingival phenotype were found to have gingival inflammation, supporting the claim that thin gingival tissues are more vulnerable in the presence of an inflammatory stimulus [15]. Based on these own studies on the prevalence of the gingival phenotype in the Bulgarian population and especially the association of a thin scalloped gingival phenotype with the occurrence of gingival recessions and the risk of occurrence of a mucogingival problem in orthodontic and prosthetic treatment, I propose to test a scientific hypothesis of effectiveness in the application of microneedling (MN) and i-PRF in the non-surgical modification of gingival phenotype.

Case presentation

A 31-year-old woman, non-smoker, normoglycemic, meeting the inclusion criteria (adult; diagnosis periodontal health; thin scalloped gingival phenotype in the area of interest – lower mandibular frontal teeth area; non-smokers; GT < 1 mm) is informed about the type and sequences of the following procedures and have signed an informed consent. Periodontal tissue quality is assessed due to impending orthodontic treatment. The clinical assessment of gingival thickness was performed via TRAN method (transparency of the periodontal probe inserted in the gingival sulcus) and the accuracy of the estimation was confirmed with measurements with digital calliper. The area of interest (the mandible frontal teeth) was anesthetized with Lidocaine spray. For each procedure, venous blood is taken with a blood collection system. 1 tube of 13 ml for i-PRF (purple), which do not contain anticoagulant, was taken at each procedure. Immediately after blood collection, the tube was placed in a centrifuge and centrifuged for 3 minutes at 700 rpm (60 g force) in a PRF Duo Centrifuge. The resulting autologous i-PRF product was dispensed into two 1.0 cc syringes and injected with a 30G 4 mm needle.

Fig.1. *Clinical appearance of the patient.*

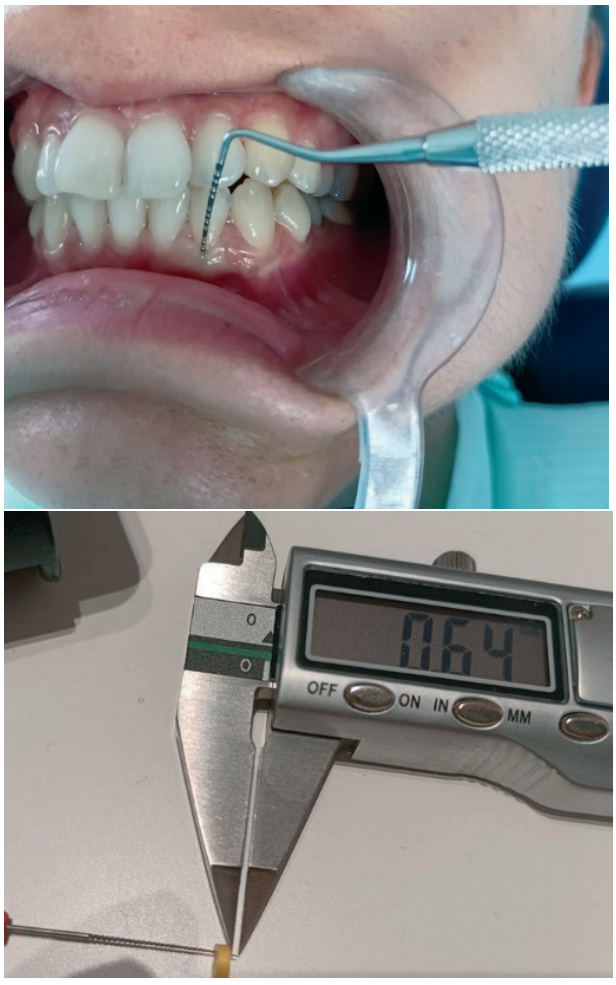

Fig.2. *Tran method (transparency of the periodontal probe) and digital calliper evaluation of the thin gingiva.*

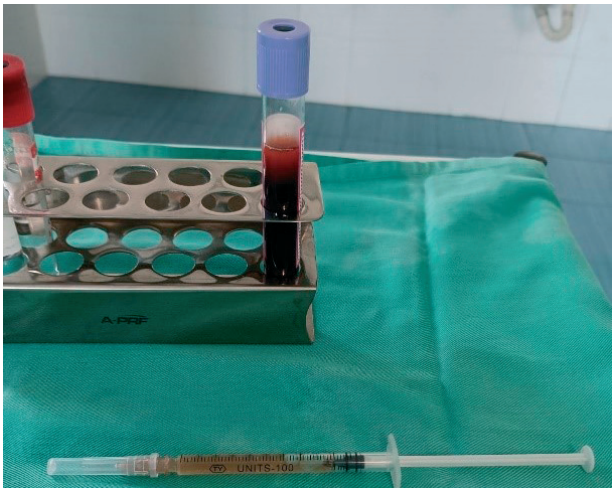

Fig.3. *Injectable PRF – 13 ml tube and 1 ml product in a syringe.*

Fig.4. *Microneedling of the gingiva with 30G 4 mm needle.*

Fig.5*. Injecting of i-PRF.*

The patient was instructed not to brush the treated area the day of the procedure.

Results

The re-evaluation of the gingival thickness was performed on the first, third and sixth month after the last procedure. The measurements in the treated area were performed under topical anaesthesia with Lidocaine spray and the data was obtained with digital calliper. The results are summarised in a table.

Table 1. *Results after re-evaluation*

	#43	#42	#41	#31	#32	#33
Initial measurements	**0.56**	**0.52**	**0.48**	**0.46**	**0.51**	**0.52**
1 month	0.90	0.78	0.61	0.60	0.69	0.81
3 month	0.89	0.83	0.63	0.61	0.72	0.84
6 month	**0.93**	**0.84**	**0.64**	**0.61**	**0.73**	**0.88**

Conclusion

The daily dental practice is based on the principles of precision diagnostics. Knowledge of the specificities of soft tissues ensures the selection of an appropriate treatment modality and enables the implementation of a predictive treatment. Among the variety of techniques for augmenting the gingival phenotype, non-surgical techniques such as those described in the manuscript are gaining popularity. In the presented clinical case, the simultaneous application of MN and i-PRF positively affected gingival thickening. For this reason, the proposed technique could represent an alternative to the non-surgical thickening of gingival tissues in natural teeth. Further studies and longer-term follow-up are needed to obtain results with statistically significant values.

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ИЗИСКВАНИЯ КЪМ АВТОРИТЕ
за публикуване в сп. „Проблеми на денталната медицина”

Списание “Проблеми на денталната медицина” се издава от ФДМ - МУ София, от 1973 г. по две книжки годишно. Приемат се за печат научни разработки свързани с денталната медицина, като преподавателите от ФДМ са с предимство при отпечатване.

Материалите са представят в два екземпляра на английски език, формат А4 с подписите на всички автори на последната страница. На последната страница трябва да бъде посочен пълен адрес, телефон и e-mail на отговорния автор за кореспонденция. Същият следва да съгласува препоръките за корекции /направени от рецензентите и редколегията/ с всички съавтори.

С подаването на ръкописа авторите автоматично се съгласяват да предоставят изключителни авторски права на Факултета по дентална медицина – МУ София върху него, ако се приеме за публикуване. Материалите и процедурите, използвани в научните изследвания, трябва да отговарят на установените етични критерии при експерименти с хора или животни и да са в съответствие с Правилника за работата на Комисията по етика на научните изследвания в Медицински университет – София (КЕНИМУС) и да имат разрешение от тази комисия. Пациентите не трябва да се посочват с имена, инициали или фотографии, чрез които могат да бъдат идентифицирани.

Авторите са отговорни за всички твърдения, становища, изводи и методи на представяне на данните от техните изследвания в дадените ръкописи.

Предложените научни материали се публикуват само след рецензиране и одобряване от Редакционната колегия на списанието.

Изисквания към научните материали

Настоящите изисквания са в съответствие с Recommendation for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals, Updated December 2013, www.icmje.org и „Единни изисквания към ръкописи предложени за отпечатване в биомедицински списания” – N Engl J Med 1997; 336: 309- 15.

Приемат се за публикуване следните видове научни материали:

1. **Оригинални научни статии** - до 10 стандартни страници /30 реда, 60 знака на една страница включително таблици, фигури и друг онагледяващ материал и библиография;
2. **Литературни научни обзори** - до 15 стандартни машинописни страници, включително таблици, фигури и друг онагледяващ материал и библиография
3. **Казуистика** - до 3 стандартни машинописни страници, включително таблици, фигури и друг онагледяващ материал и библиография.

Ръкописите следва да бъдат напечатани или принтирани едностранно на стандартна машинописна бяла хартия А4 (210 х 297мм).

Шрифт Times New Roman, 12 pt, междуредие 1,5, полета от ляво и дясно – 2 см; от горе и долу – 2,5 см. Страниците трябва да бъдат номерирани долу дясно;

Първа страница:

Заглавие на английски език, без съкращения, в Bolt;

Имената на авторите изписани с пълно име и фамилия, на английски, като под черта (Footnote) се изписват академичните длъжности и научни степени на авторите и тяхната месторабота - Медицински Университет София, след което се изписва Факултет по дентална медицина и съответната катедра.

Резюме: трябва да бъде на отделна страница (*отделен файл*), на английски език, с изписаните по същия начин автори и месторабота. Обемът на резюмето да не надхвърля 250 думи. Резюмето да включва въведение, цел, материал и методи, резултати, Ключови думи (да се използват термини цитирани в MEDLINE или от рубриките на Index Medicus).

Заглавието, резюмето и имената на авторите трябва, освен на английски, да бъдат предоставени и на български език.

Структурата на оригинална научна статия. Статията трябва да включва: въведение, цел и задачи, материал и методи, резултати, обсъждане, изводи/заключение и библиография. Отбелязването в текста на номера на цитираните литературни източници да се поставя в квадратни скоби и да е с размера на шрифта на самия текст, пример: [1]. Не се приема за научно доказателство представянето на материал в абсолютни стойности, без статистическа обработка. Неправилно е да се дублира един и същи материал представен в таблица и графика. В текста не следва да се повтаря цифровата информация показана в таблицата, а да се направи анализ на информацията. Допуска се използването само на стандартни общоприети съкращения, като не се допускат съкращения в заглавието и резюмето.

Таблици, фигури, снимки, диаграми и други онагледяващи материали трябва да бъдат дадени в текста и на отделен файл (на електронен носител).

Таблиците трябва да се номерират с арабски цифри, като се започне от 1 в последователността на позоваването им в текста. Тази номерация трябва да бъде независима от номерацията на фигурите. Заглавието на таблицата се разполага в средата над таблицата например: **Таблица № 1 - Механични свойства**

Първата дума от наименованието на всяка колона или ред трябва да започва с главна буква. Когато в дадена колона или ред се използват единици на величини, те трябва да се записват в средата на колоната

под наименованието на колоните със светъл шрифт (в Si система). Данните трябва да се представят в лесноразбираема и прегледна форма. Използването на големи и сложни таблици трябва да се избягва, например чрез представяне на данните в две или повече прости таблици.

Статистическа обработка:

- Да се опише статистическия метод, да се дефинират статистическите термини и използват общовалидни статистически съкращения и символи. Да се посочи нивото на значимост;
- Задължително е спазването на условните знаци при попълване мрежата на таблицата, а именно: при промили, продецимили и т.н. не се използва точка или запетая, а разредка от един знак. Напр. един милион – 1 000 000;
- Цифровите резултати да се дават освен като деривати (напр. в проценти) и в средни стойности.

Структура на литературен обзор. Литературният обзор трябва да представлява аналитичен преглед на литературата по определени научни теми свързани с денталната медицина. Трябва да бъде представена актуална информация (50% от последните 5 години) в логична последователност, като определени научни тези трябва да бъдат подкрепени от научни доказателства цитирани в съответните научни статии. Добре е да бъдат цитирани нови методики, обем изследван материал въз основа на който се правят съответните научни изводи. Трябва да се цитират проучвания за и против съответната теза, както и мнението на автора на обзора.

Препоръчваме използването на принципите на изработване на мета-анализ при представяне на обзорен материал по определена научна тема.

Структура на казуистика. Казуистиката е представяне на добре документирани, интересни клинични случаи. Статията трябва да е по- кратка (до 3-4 страници). Въведението трябва да е по-разширено в сравнение с това на оригинална научна статия, като трябва да бъде кратък литературен обзор по темата на представения казус. Не трябва да следва структурата на научна статия. Представения клиничен случай трябва да следва класическата схема за клинично изследване и документиране.

Книгопис

Библиографията се изписва на **латиница** и **следва текста на статията**. Всеки източник се номерира с арабска цифра и се подрежда **последователно според появата в текста** по фамилията на първия автор. **Важно!** Литературните източници на кирилица трябва да бъдат преведени на латиница (на английски език), а накрая се изписва оригиналния език на статията в квадратни скоби напр. [in Bulgarian]. Данните се оформят по следния начин:

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Пример: Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV-infected patients. *N Engl J Med.* 2002;347(4):284-7.

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Пример: Peneva M, Tzolova E, Kabakchieva R, Rashkova M. Oral embryology, histology and biology. Textbook of Pediatric Dentistry. ed: East-West: Sofia; 2009 p. 232.

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Пример: Krasteva-Panova, A. Summary of changes in the oral cavity and subjective complaints. In: Krasteva-Panova, A, A. Kisselova-Yaneva, B. Girova, Vl. Panov, Ad. Krateva, An. Bobeva. Edited by Zahari Krastev. Oral lesions. Sofia: Ivan Sapundziev; 2011. p. 240-248.

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