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Therapeutic and diagnostic principles in dental medicine II

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On behalf of the Organizing and Scientific Committee, we are pleased to welcome you all at the International Scientific Conference in Dentistry 2022 Novi Sad.
The Scientific and Organization Committee have made an effort to plan a conference that is scientifically satisfactory and interesting, although it is held on-line due to pandemic situation caused by COVID -19.
You will be met with an exceptional program covering different topics, from basic research areas to areas within daily practice of Restorative Dentistry, Endodontics, Prosthodontics, Oral Surgery and Implantology, Periodontology, Pediatric and Preventive Dentistry.
We really hope that next year these uncertain times will be behind us, and that you will have opportunity to experience the traditional hospitability of Novi Sad, to strengthen the existing friendships and create a lot of new ones.

President of the Organizing Committee
Prof. dr Tatjana Puskar

President of the Scientific Committee
Prof. dr Milica Jeremic Knezevic

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INVITED LECTURES

ACCURACY AND EFFICIENCY OF INTRA-ORAL SCANNING IN FIXED PROSTHODONTICS

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Abstract: *The clinical applications for intraoral scanners in fixed prosthodontics have increased significantly in the last decade, enhancing the entire treatment plan and procedure. The accuracy of digital impressions is essential to obtain high-quality restorations, as well predictable treatments. Two variables, "trueness" and "precision", describe the accuracy of a digital impression and there are some challenging factors that can influence the characteristics of the final digital model. The main advantages of intraoral scanning are the possibility to completely replace the conventional impression, to reduce the discomfort for the patient, and the overall costs of the impression materials. This paper will focus on the main advantages of IOS and the benefits for the patients and for the clinicians.*

Key words: *digital impression, CAD/CAM, accuracy, intraoral scanner)*

Introduction

With the aim to decrease as much as possible the clinical times and to errors that occur during the technological stages of fixed partial dentures (FPD) and removable dentures, the intraoral scanners technology (IOS) has progressed extremely fast, currently being able to record the anatomical features of an arch in less than 20 seconds.
The introduction of digital impressions is mainly due to the versatility of 3D models, which are used both in treatment planning, as well as the design of FPD and removable denture design, guided surgical treatments and orthodontic treatments.
Intraoral scanners can reproduce a surface by emitting a light wave, usually LASER, then the reflection from the surface of interest is captured by a digital camera through various methods (triangulation, confocal microscopy, coherent optical tomography, etc.). The captured wave will be transmitted to a processing software, which generates a multitude of points like a mesh, which represents the digital reconstruction of the respective surface.
The main reasons considered when switching from conventional to digital, are related to scanning speed, ergonomics, the purchase and maintenance price and in a lower degree the aspects related to digital impression quality, highlighted by the accuracy of a scanner. The accuracy of a measurement is a qualitative indicator of the ability of the instrument to generate values close to the value of the measured parameter. Accuracy is essential when it comes to FPD on both natural teeth and implants, as the slightest discrepancies between the prosthetic part and the tooth / implant can lead to undesirable consequences [1-3].
When evaluating the accuracy of an IOS, two parameters are analyzed, namely trueness and precision (Fig. 1). It is important to differentiate between the two parameters as they analyze different aspects of a measurement [4,5].

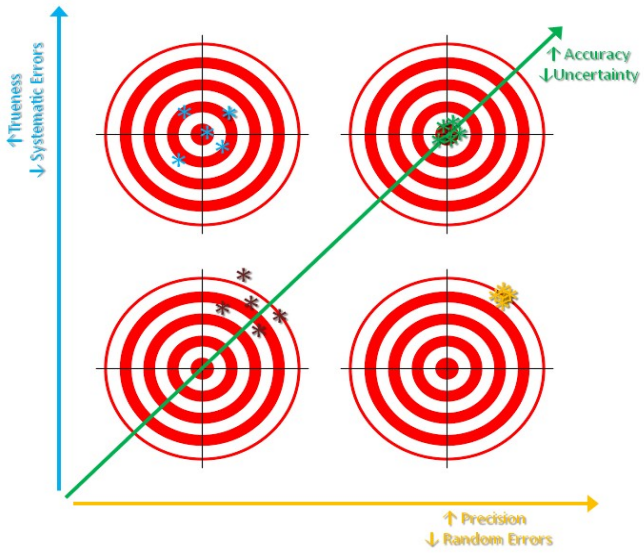

Figure 1. Trueness and precision-graphical representation [6].

All inaccuracies that occur during the measurement process are numerically highlighted by the standard deviation or coefficient of variation [7]. This shows the degree of variation / dispersion within a group of values. The lower the dispersion, the closer the values in that group are to the average.

There are several factors that influence the accuracy of a scan. Among these factors, the most frequently involved in digital impression distortion are ambient light, the distance between the scanning tip and the object's surface, the scanning protocol, the degree of wetting of the surface, and the type of material of the scanned surface [8].

To assess the impact of all these factors that can influence the accuracy and efficiency on intraoral scanning, a number of studies were conducted in the Prosthodontics Department of the Faculty of Dentistry, University of Medicine and Pharmacy 'Victor Babes' from Timisoara [9-11].

1. ABUTMENT GEOMETRY INFLUENCE ON THE ACCURACY OF DIGITAL AND CONVENTIONAL IMPRESSIONS

A series of central maxillary incisors made of resin were prepared for all-ceramic crowns with different occlusal convergence angles. Four abutments were obtained with angles of 0^0, 5^0, 15^0 and 25^0

Then, with the help of a laboratory scanner (D700, 3Shape) the abutments were scanned, thus obtaining the reference model. The same preparations were scanned using an intraoral scanner (PlanScan, Planmeca, Finland) being in turn saved in 'STL' format (intraoral group). The next step was to make conventional impressions with polyvinyl siloxane (PVS), obtaining three models for each reference abutment. This resulted in a total of 15 impressions.

For each impression, working models were made. All cast models (n = 15) were scanned and saved in 'STL'- format (PVS Group). Using Geomagic Studio 2013 software, a comparative analysis of the differences in the geometry of the analyzed abutments was performed.

The results of this study are presented in Figure 2, and the following conclusions can be drawn:

1. Both investigated groups showed an increase in accuracy at the occlusal convergence of the abutment of 15^0.
2. At occlusal convergence close to 0^0, both groups showed similar values of accuracy.
3. For both groups investigated, the mean trueness values indicated that the PlanScan group had the lowest deviation from the reference model.

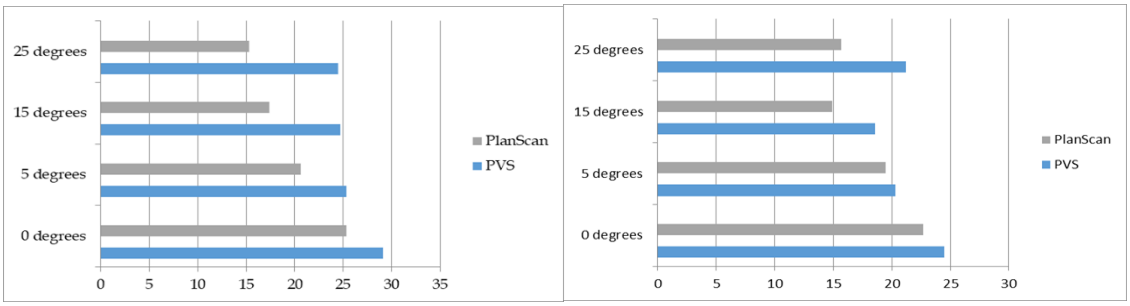

Fig. 2. Mean trueness(left) and precision(right) values(μm)

2. CLINICAL FACTORS INFLUENCE THE TRUENESS OF INTRA-ORAL SCANNING

The second study investigated the influence of adjacent teeth over the trueness of intraoral scanning. The null hypothesis is that interproximal areas are more difficult to reach by the light radiation from the scanning tip. A typodont right upper first premolar was prepared for an all-ceramic crown The prepared premolar, fixed in a typodont, was scanned with a high precision scanner (D 700 Trios, 3 shape), with a dimensional accuracy of 20 μm. Three different clinical situations were simulated: one with no adjacent teeth to the prepared premolar, one with one adjacent tooth, the second premolar, and one with both the canine and the second premolar present on the arch. The resulting STL files were used later as the reference digital models. Next, the same procedures were repeated, this time using an intraoral scanner from Planscan (Planmeca) (Fig. 25). Each situation was scanned by three different operators: a prosthodontic specialist, a prosthodontic resident and a dentistry student. Each operator scanned four times all the simulated situations, that led to 36 different scanned images (Figure 3).

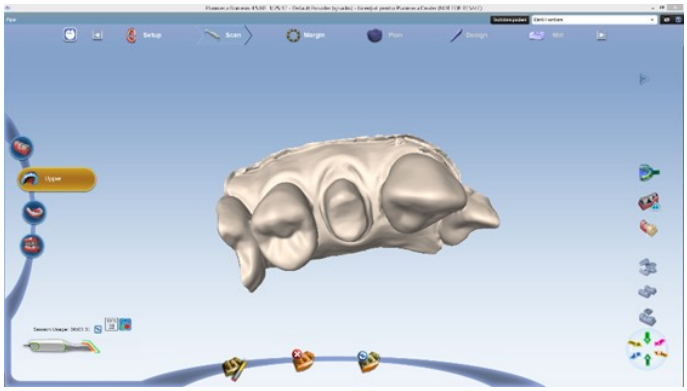

Figure 3. Digital model

The presence of adjacent teeth influenced the trueness of the scans and was significant for the overall trueness of the scans with a p value lower than 0.05. Poorest overall trueness was shown in the situation with two adjacent teeth for all the operators, followed by one tooth adjacent tooth and last with no teeth in relation with the abutment (Fig. 4). The difference in scanning trueness between operators was present, but by small margins, and with no significance, p values higher than 0.05.

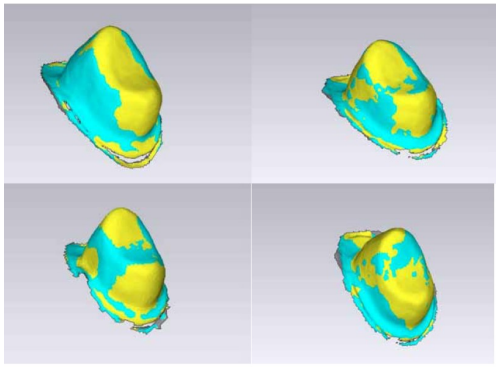

Figure 4. Visual representation of deviation values

3. TRUENESS AND PRECISION OF TWO INTRAORAL SCANNERS: A COMPARATIVE IN VITRO STUDY

The aim of this study was to compare the accuracy (trueness and precision) of two intraoral scanners on an onlay preparation and to assess if there are any major discrepancies between the qualities of the final digital impressions (). Two intraoral scanners Planmeca PlanScan (E4D Technologies, LLC, Richardson, TX, USA) and CEREC Omnicam (Sirona, Bensheim, Germany) and a high-resolution desktop scanner D700 (3Shape, Copenhagen, Denmark) were used in this study. A standard resin upper first molar was prepared for a ceramic onlay. Next, the model was digitized using a desktop scanner (D700, 3Shape) in order to obtain a reference model. The same prepared molar was scanned ten times using two high-end intraoral scanners and all the meshes were superimposed on the reference scan (Fig. 5).

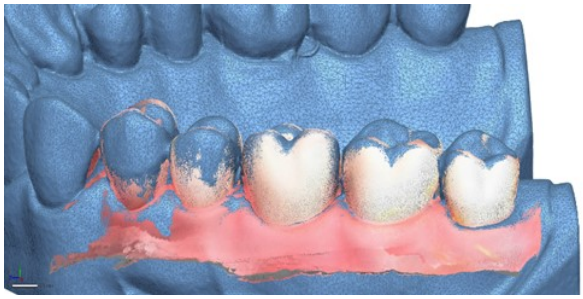

Figure 5. Alignment process of the meshes

The results of this study revealed a mean trueness value of 48,6 ± 4,39 µm that showed that the PlanScan scans had the best overall results. Regarding the precision of the two intraoral scanners, PlanScan also showed better results with a mean value of 24,86 ± 2,91 µm. The p values for both trueness and precision were >0.05, indicating that there was no difference between the scanners.
Considering the results of all these studies performed in the Department of Prosthodontics, Faculty of Dentistry, Victor Babes University of Medicine and Pharmacy Timisoara, in accordance with the scientific literature, it can be concluded that all the advantages offered by this technology will lead to switching soon from conventional to digital impression in a larger scale among dental practitioners.

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PAINFUL POST TAUMATIC TRIGEMINAL NEUROPATHY- CHALLENGING AND FRUSTRATING CONDITION LEADING THROUGH UNNECESSARY DENTAL PROCEDURES

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Abstract:
Painful post-traumatic trigeminal neuropathy (PTTN) has been defined as trigeminal pain caused by major or minor trauma, chemical or thermal aggression. The trigeminal nerve and its branches are at risk of damage during multiple dental and maxillofacial procedures. In the event of damage to these nerve branches, there is a high risk of developing a neuropathic pain that is considered very disabling for patients and that interferes with daily activities (eating, drinking, speaking, kissing, etc.). Moreover, there are few medication or surgical techniques available to eliminate neuropathy or reduce the symptoms. The clinical characteristics of PTTN vary considerably, most likely due to a combination of environmental, psychosocial and genetic factors. For intraoral PTTN, early stages are often misdiagnosed as odontogenic pain.

Key words: *Painful post-traumatic trigeminal neuropathy, trigeminal pain, odontogenic pain*

Introduction:
The aim of this article is to review the clinical, pathophysiological, and therapeutic aspects of traumatically induced trigeminal nerve pain.
Painful post-traumatic trigeminal neuropathy (PPTN) has been defined in the current International Classification for Headache Disorders as trigeminal pain caused by major or minor trauma, chemical or thermal aggression, or radiation and is supported by a set of criteria that should be fulfilled to address this definition. (1)
Various related terms exist in the literature, including deafferentation pain, phantom tooth pain, atypical odontalgia, anesthesia dolorosa, and persistent idiopathic facial pain (atypical facial pain).
The trigeminal nerve and its branches are at risk of damage during multiple dental and maxillofacial procedures: endodontics, extractions, removal of wisdom teeth, implant placement, use of local anaesthesia, orthognatic surgery. (2)
In the event of damage to these nerve branches, there is a high risk of developing a neuropathic pain that is considered very disabling for patients and that interferes with daily activities (eating, drinking, speaking, kissing, etc.).
The incidence of nonpainful traumatic trigeminal neuropathy may be even higher as some patients may not attend for therapy if the defect is minor. Chronic neuropathic pain occurs in 3% to 13% of cases following conventional root canal. (3)

Clinical characteristics:
The clinical characteristics of PTTN vary considerably, most likely due to a combination of environmental, psychosocial and genetic factors Possibly the type and extent of injury may influence the incidence and characteristics of PTTN. However, it is a complicating matter that pain may also have been present before the invasive procedure leading to nerve damage. The pain site in intraoral PTTN is often well localized and can include any tooth or extraction site, but the pain may move from tooth to tooth following dental procedures.
The maxillary premolar and molar areas are most commonly affected but it not unusual for the pain to also involve the mandibular premolar and molar areas on the same side. It can be present in an area of a tooth extraction. The pain is initially unilateral but may cross the midlines of the mandible or maxilla, and may even spread to the face in later stages as a result of central sensitization. The pain is continuous or almost continuous and is present almost every day although there is no consistent time

pattern. There are no pain-free remission periods. The pain is usually described as dull and aching and may also have a burning or throbbing component. Sometimes, this pain is accompanied by occasional bouts of spontaneous sharp pain. The pain is of variable intensity ranging from mild to severe, but is not as excruciating as the pain of TN. Some patients may report a feeling of swelling in the area even when a clinical examination does not reveal any swelling. (4)

Pathophysiology:

The pathophysiology of traumatic neuropathies involves a cascade of events in nervous system function. Injury and inflammation, ectopic neuronal activity, phenotypic neuronal changes, sympathetic nervous system involvement, changes in the CNS and the roles of central glial cells and peripheral satellite glia. These events include alterations in functional, biochemical, and physical characteristics, collectively termed neuronal plasticity. The events occurring after nerve injury that may lead to chronic pain have been excellently reviewed. (5)

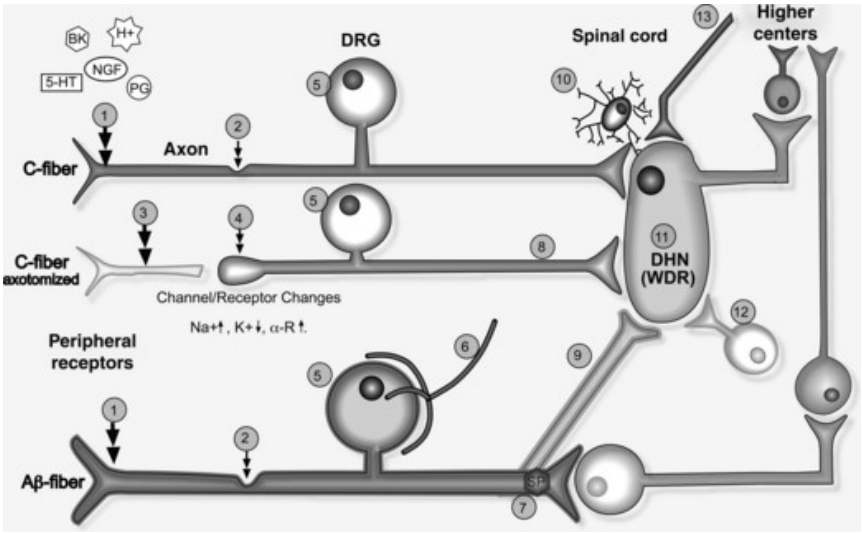

Fig. 1. Peripheral and central nervous system changes in chronic pain. Peripheral sensitization: Tissue damage (1) releases inflammatory mediators, for example, bradykinin (BK), nerve growth factor (NGF), serotonin (5-HT), prostaglandins (PG), and protons (H+). This 'inflammatory soup' of bioactive molecules induces increased sensitivity of peripheral nociceptors leading to allodynia and hyperalgesia. Axonal injury (2), for example, transection, crush or chronic pressure and inflammation induce increases in sodium (Na+) and α-adrenoreceptors (α-R), initiating ectopic activity and increased sensitivity. Axotomy results in death of the distal part of the nerve (3) and if the proximal section survives, there is healing with neuroma formation (4). Some of the neurons will, however, die. This activity leads to altered gene expression in the neuronal cell bodies located in the ganglia [dorsal root ganglion (DRG)] (5). Nerve injury may lead to sympathetic nerve fiber sprouting (6), particularly around the larger DRG cells. The modulating effects of satellite glial cells in DRGs have recently been demonstrated. Aβ fibers undergo a phenotypic change (7) and express neurotransmitters associated with nociceptors, for example, substance P (SP). Injury-induced C-fiber degeneration (8) may result allowing Aβ fibers to sprout from deep to superficial dorsal horn layers (9) augmenting allodynia. Primary afferents and dorsal horn neurons (DHN) activate glial cells in the dorsal horn (10), and these compromise opioid analgesia, enhance dorsal horn neuron and primary afferent activity and excitability. Persistent nociceptive input results in the sensitization of wide dynamic range (WDR) DHN, (11), excitation of adjacent neurons (central sensitization), and activation of glial cells. Glutamate-induced excitotoxicity reduces the number of inhibitory interneurons, augmenting excitation (12). Persistent pain initiates descending modulation, which in pathological states tends toward facilitation (13) From **Benoliel *et al*, 2008b** (6)

Differential Diagnosis:

Odontogenic toothache Myofascial trigger point pain Trigeminal neuralgia Neurovascular toothache (facial or midface migraine, cluster headache) Maxillary sinusitis. PTTN is a tooth-related problem or

occurs at a site where a tooth was extracted and several pain conditions may mimic this disorder. A thorough history is a key component in arriving at a diagnosis and most patients have a lengthy history of several failed dental interventions. After reviewing the history, the next step in diagnosis is to eliminate any odontogenic cause for the pain using clinical examination, imaging and, most importantly, diagnostic anesthetic blocks which can be extremely valuable in determining the source of the pain,

Treatment:
Pharmacotherapy is the treatment of choice for PTTN. Since both peripheral and central mechanisms may be involved, the use of a topical medication in combination with systemic medications may allow lower doses of a systemic medication to be used possibly avoiding serious side effects. For most patients, a course of systemic medications such as Triciclic antidepressants (TCAs) or gabapentinoids is indicated initially especially when central mechanisms are thought to play a significant role. But if local anesthesia produces a significant reduction in pain, a combination of topical medications under a neurosensory shield should be used first before starting on a course of systemic medications. Of the TCAs, amitriptyline is the most studied and is frequently prescribed for PTTN starting at 10 mg 2 hours before bedtime and slowly escalated to a tolerable level that affords the patient an acceptable level of pain relief For most patients, the therapeutic dose ranges from 50 to 75 mg. When gabapentin is used as the primary medication for PTTN, the usual dose is 900-1800 mg/day, but some clinicians have prescribed up to 2400 mg/day in selected cases. (7)

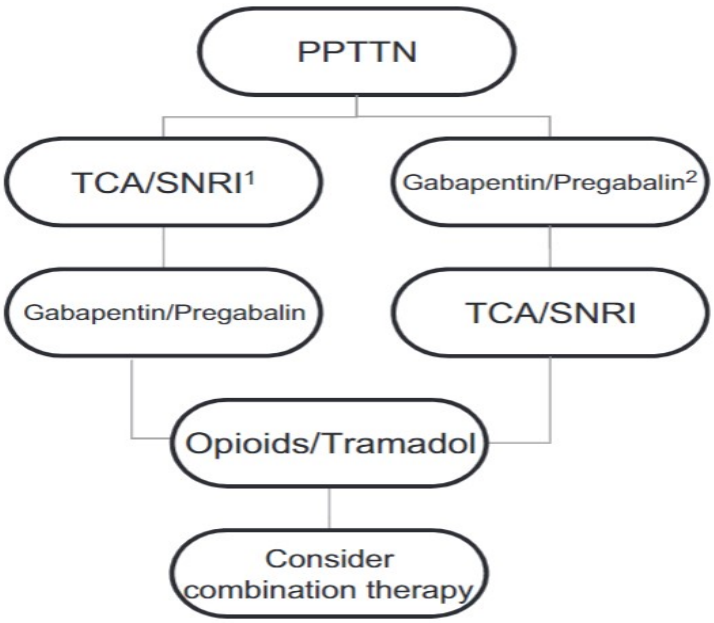

Fig.2. Treatment Algorithm for Peripheral Neuropathic Pain. The choice between tricyclic antidepressants (TCAs) or selective noradrenaline reuptake inhibitors (SNRI) and the use of gabapentin (GBP) or pregabalin (PGB) is based on the medical profile and other patient-based variables (profession, comorbidities). TCAs are more effective than GBP/PGB but have significantly more side effects. Superscript 1: SNRIs have not been as extensively tested as TCAs but seem less effective for neuropathic pain. Superscript 2: Patients initiated on GBP or PGB but are not responding to treatment may not be medically suitable for second-line therapy with TCAs/SNRIs. In these cases, the patient is transferred directly to opioids singly or together with GBP (based on the studies by **Finnerup *et al*, 2010**; **Dworkin *et al*, 2010** (7,8)

Conclusion:
PTTN is rare and commonly misdiagnosed, challenging, and frustrating condition. Dentist should be familiar with clinical characteristic of PTTN and never start any dental treatment without clear clinical and radiological sign of dental pathology.

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INFLUENCE OF THE POSITION OF POSTERIOR ARTIFICIAL ACRYLIC TEETH ON VOWEL PRONUNCIATION IN PATIENT REHABILITATED WITH COMPLETE DENTURES

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***Abstract**: When fitting a patient with complete dentures, it is necessary to establish both functional and aesthetic rehabilitation of the orofacial system, as the presence of removable partial denture and complete denture inevitably influences the speech of an edentulous patient. The aim of this study was to investigate the influence of the position of posterior artificial acrylic teeth on the vowel pronunciation in edentulous patients. As a part of this investigation, six different positions of artificial acrylic teeth in the posterior region, one control position and existing dentures were assessed. Patients' pronunciation of all vowels was analyzed using the Dr Speech software. Our findings revealed that, by moving the mandibular posterior teeth in the buccal direction, the articulatory movements of the vocal tract are reduced. Correct placement of artificial acrylic teeth, in accordance with all professional rules and guidelines, contributes to the correct and comprehensible speech in patients rehabilitated with complete dentures.*

***Key words:** complete denture; artificial teeth; vowel pronunciation; vowel traingle;*

Introduction

Complete dentures should establish a functional and aesthetic rehabilitation of the orofacial system of edentulous patients [1]. Yet, despite their many benefits, their presence inevitably impacts on the speech in these individuals. Therefore, the shape and position of artificial teeth incorporated into complete dentures should be adjusted to meet the chewing and articulation needs, as well as provide support to the orofacial muscles and contribute to the stability of complete dentures across the full range of movements and positions of the lower jaw [2]. The position of the front teeth (incisors, canines) primarily affects the pronunciation of consonants, and to a much lesser extent the pronunciation of vowels. Thus far, the influence of lateral teeth (premolars, molars) on the pronunciation of individual phonemes has not been examined [3].
In order to prevent potential articulation difficulties and speech alterations, it is necessary to establish an adequate treatment plan and respect all the principles of good clinical practice in the design and production of complete dentures [4]. Artificial teeth must be placed according to a precisely determined protocol, respecting the principles and boundaries of neutral space. Once patients receive complete dentures, they must undergo a period of adaptation. By following all the instructions for easier and simpler speech adaptation, patients successfully overcome the initial changes in speech production that are almost always transient. However, in practice, gross speech disorders may arise, and are typically due to improper placement of artificial teeth as well as inadequate retention and stability of complete dentures [5].
Vowels play an important role in speech analysis. These sounds are most frequently analyzed, as they feature prominently in speech, are not problematic for pronunciation, are indicative of the vocal cord functioning and the position of the articulator, and carry a considerable amount of speech energy [6].
The vowelsof the Serbian language have five acoustic energy clusters, but the first three are important for correct and accurate perception. The formant with the lowest frequency is denoted as F1, and

those with progressively higher frequencies are labelled as F2 and F3. F1 and F2 determine vowel quality with respect to the open/closed and the front/back dimension (which are typically, but not completely justifiably, associated with the position of the tongue in the oral cavity). The third formant F3 is useful in identifying different speech contrasts, such as vowel rotation and whispering. For the vowel *a* (which is an open vowel) the first formant F1 has a higher frequency, and for vowels *u* or *i* (closed vowels) it has a lower frequency. The second formant F2 has a lower frequency for the back vowels and a higher frequency for the front vowels [7].

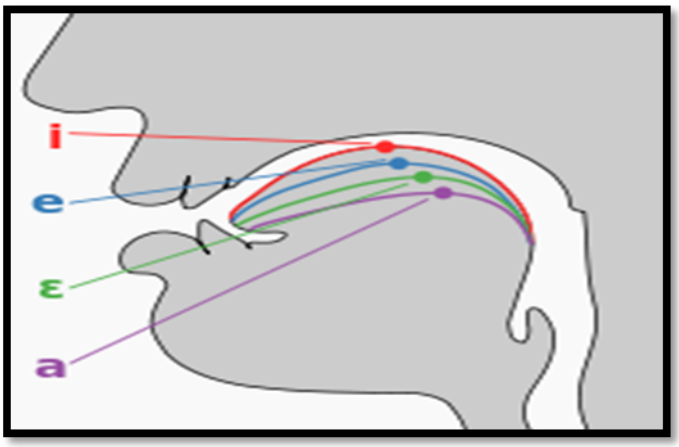


Figure 1. Tongue position in the articulation of certain vowels.

Tongue plays the main role in the formation of the Serbian language phonemes, and changes its position and form in the pronunciation of consonants and vowels. Depending on the position of the tongue in the oral cavity, vowels can be divided into high I and U, central E and O, and low A (Figure 1). Vowels that are articulated by placing the tongue at an extreme position in the oral cavity are called cardinal or "corner" vowels. In English, Slovenian and Serbian language, these are the vowels A, I and U. The position of the tongue in the oral cavity when pronouncing vowels can be schematically representedas a triangle, known as the "vowel triangle" (Figure 2) [8].

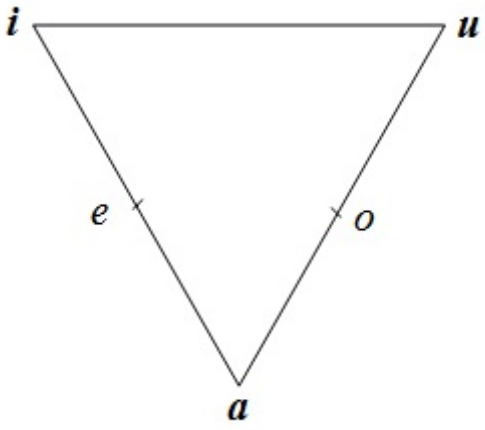


Figure 2. Vowel triangle.

A large vowel triangle indicates a more significant phonological difference between the cardinal vowels. Therefore, reduction in its size is expected when there is a restriction of articulatory space due to small and similar movements when pronouncing different vowels [9].
In a pilot study conducted in collaboration between the Department of Dental Medicine and the Phoniatrics Department of the Ear, Throat and Nose Clinic of the Medical Faculty of the University of Novi Sad, the influence of six different positions of lower and upper lateral teeth incomplete dentures

was examined. The vowel formant analysis was conducted using the *Dr Speech* computer software (Figure 3). During the formant analysis, participants were placed in a soundproof room and were instructed to articulate vowels with the usual height and intensity of the speaking voice while sitting comfortably. Their utterances were recorded by placing a microphone (model Behringer ultravoice XM 8500) at a 5 cm distance from the mouth.

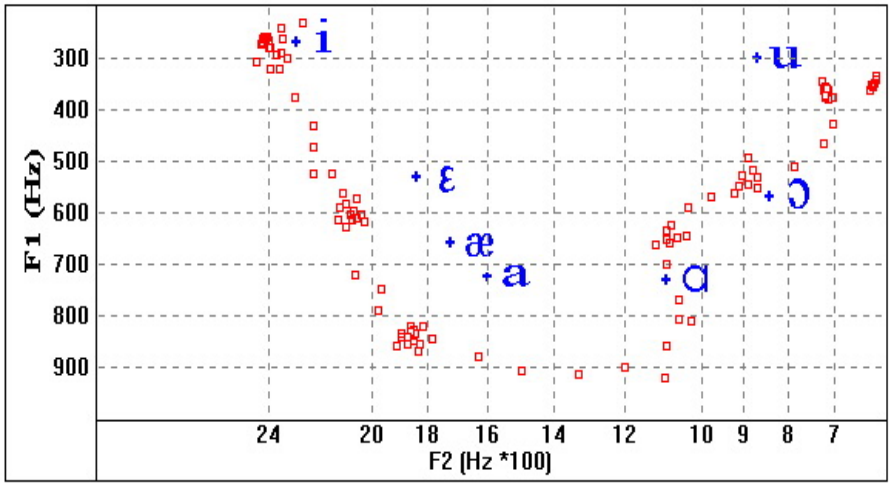
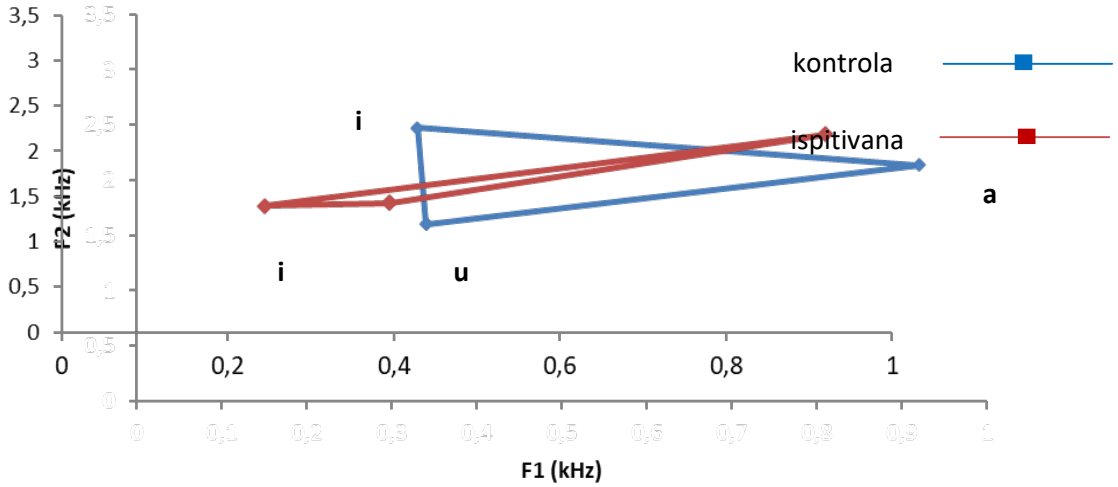


Figure 3. Acoustic analysis of formant vowel frequencies.

The study results were presented graphically in the form of a cardinal vowel triangle for each examined position. An example of one such triangle of cardinal vowels can be seen in Graph 1, where the graphical representation of the correct placement of lateral artificial teeth is marked in blue whereas the red-colored triangle was obtained when the lateral teeth occupied a more buccal and/or lingual position.



Graph 1. A cardinal vowel triangle generated by buccally shifting the posterior teeth relative to correctly placed upper and lower posterior teeth.

The analysis revealed a reduction in the vowel triangle when the upper posterior teeth were moved lingually, as well as when both upper and lower posterior teeth were moved lingually. A particularly significant reduction in the vowel triangle area was noted when the lower lateral teeth were shifted buccally. On the other hand, moving the lower posterior teeth lingually, the upper posterior teeth buccally, and both upper and lower posterior teeth buccally resulted in a negligible reduction in the vowel triangle area.

Conclusion

Placement of artificial acrylic teeth comprising complete dentures in the lateral region according to the pertinent rules and guidelines results in the largest articulation triangle, and thus leads to the most favorable speech and articulation outcomes. If the lower artificial teeth in the lateral region are placed more buccally into the complete dentures, this causes a reduction in the vowel triangle area and compromises patient's ability tocorrectly articulate all phonemes and produce intelligible speech. The acoustic analysis of formant vowel frequencies conducted as a part of this study also showed that lingually shifting the lower posterior teeth results in the smallest reduction in the vowel triangle area and thus does not interfere with normal speech and articulation.

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INTRAORAL AND LABORATORY SCANNERS – CLINICAL ASPECTS OF APPLICATION

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Abstract: *The development of 3D technology and digitization has enabled the development of dental scanners and the introduction of digital impressions in various fields of dentistry. Dental scanners are an integral part of CAD/CAM systems. Dental scanners are divided into intraoral scanners which are used in-office and laboratory scanners which are used extraorally for scanning the impression or the dental working cast model. Three basic principles for the work of intraoral scanners are triangulation, active wavefront sampling and parallel confocal laser scanning.*

Keywords: *digital impression; intraoral scanner; laboratory scanner*

Introduction

Taking dental impressions is an inevitable procedure in almost all branches of dentistry. Technological discoveries and their implementation lead to constant progress in all branches of dentistry. The development of three-dimensional (3D) technology enabled the introduction of dental scanners and digital impressions into dentistry in the mid-1980s (1). The conventional way of taking impressions is with a tray onto which various impression materials are applied. When performing this procedure, there are many stages where there is a possibility of stealing various errors, that can affect the subsequent accuracy of the replacement. Digitization reduces the number of work phases and thus the possibility of errors (2). The advantages of digitization conventional techniques include relatively short scanning time, control of preparation, marking of the preparation margin, scanning in the patient's mouth, data transfer via Internet, archiving capability, and, most importantly, much greater comfort for the patient (3). Digital impressions can be considered a step forward in dental prosthodontics. It and can be said that digitalization and digital workflow are becoming more and more important and will play a central role in all areas of dentistry in the future (4). The dental scanner is one of the three main components of a computer-aided design system (CAD) and a computer-aided manufacturing system (CAM). The other components consist of other software and a milling machine. The scanning unit captures the geometric data of the tooth and converts it into digital information that the computer can process. The software processes the data and virtually designs and displays the future replacement. The milling machine manufactures a replacement (5) from factory-prepared material blocks based on the given information. The available CAD / CAM systems (6) can be divided into three groups based on their production methods: in-office system, in-lab system and centralised production.

Comparison of conventional and digital impressions

The most frequently mentioned difference between conventional and digital impressions taking is the duration of the procedure. The duration of the procedure in the conventional method of taking impressions depends on the technique. Impressions can be taken in pre-made trays using two addition silicones - one of thick putty-like consistency and the other of rare consistency. However, the best impressions in prosthodontics are those taken in individual trays using polyether. Another impression taken previously taken previously with alginate is needed to make individual trays. In addition, with a conventional impression, there are other steps to consider, such as tray selection and testing, material preparation and curing, disinfection and storage. All of these stages are eliminated with digital impressions. Taking digital impressions takes an average of 4 minutes and therefore takes precedence

over conventional impression taking, which takes an average of 10 minutes (3). It is also necessary to take into account the impression of the opposing jaw and the registration of the intermaxillary relationships, which takes an average of 14 seconds for dental scanners and about 100 seconds for the opposing jaw. The same procedure takes up to 3 minutes for the intermaxillary register, or about 230 seconds for the opposing jaw with the conventional technique (13). Prosthetic works fabricated with the CAD / CAM system can be fabricated in one session. In addition, highly aesthetic temporary works can be fabricated from polymethyl methacrylate, which fully correspond to the final work in terms of shape, size and design. The provisional work is used for communication with the patient and as a template for the patient to get used to the future final work. When the patient is satisfied with the provisional work, the data is saved for the fabrication of the final prosthetic work, which ultimately facilitates the fabrication of the work. The patient may also have some objections that can be modified in consultation with the clinician before the final cementation or final delivery of the prosthetic work (3). (Table 1)

Table 1. advantages and disadvantages of conventional and digital impressions

CONVENTIONAL TECHNIQUES	• possibility of making larger prosthetic works that require a model • possibility of printing deeper subgingival preparations • economy	• the accuracy of the impression depends on the quality of the impression (selection of the material) , the transport and the quality of the plaster • the impression process includes several steps (selection of the tray, adhesive, application of the impression material, insertion of the tray into the mouth, hardening of the material) • the human factor • relatively unpleasant for the patient
DIGITAL TECHNIQUES	• scanning time relatively short • preparation control • marking the edge of the preparation • scanning intraoral • data transmission via Internet • current laboratory control • accuracy, precision • patient comfort • possibility of archiving • better communication with patients and the dental technician • simplified clinical procedures	• cost of purchasing and maintaining the device • deep preparations • moisture and blood significantly affects the accuracy of the impression • impossibility of making working model (if you don't have 3D printer) • additional education

Intraoral scanner

To obtain a good intraoral optical impression a well-prepared tooth is required. A camera with a scanner that emits infrared rays is placed over the occlusal surface of the prepared tooth. The rays pass through the lens and the inner grid, which consists of parallel lines, and fall on the tooth. The lines fall in a lighter and darker pattern, are reflected back and reach the photoreceptor, which is also located on the camera. The intensity of the reflected light is registered as voltage, which is later converted into a digital form. The darker parts of the prepared tooth have a higher voltage, the lighter

parts a lower voltage. Information about the depth of the cavity is obtained by distorting parallel lines, and the distortion itself depends on the depth of the preparation. The basis for the design of the replacement is a three-dimensional representation of the data obtained by scanning, i.e. an optical footprint that obtains the size and value of the phase (voltage) for each scanned point (pixel). This value is directly related to the depth of the scanned void point. Lighter areas indicate elevated areas and darker areas, which are gray, indicate deeper, undermined areas. The obtained data are used for three-dimensional shaping. They can be given in several planes denoting the ground, the equator, and the occlusal plane (19). The most common are the three principles on which the work of intraoral scanners is based today: Triangulation, active scanning of the wavefront and parallel confocal laser scanning (12). All methods measure the distance from the top of the sensor to the target position using different technologies to convert optical data into 3D models.

Conclusion

Digital impressions has many advantages but also disadvantages compared to conventional impressions. The main advantages are the speed of impression taking, comfort for the patient, reduction of the number of working phases and better communication between the patient and the doctor. Digital impressions showed at least the same accuracy of fit, but also more successfully met clinical requirements for single crown fabrication than conventionally made impressions.
The lack of optical impressions means a high purchase price and additional training. Intraoral scanners are still unable to register subgingival preparations, and impression registration is hindered by unfavorable intraoral conditions such as moisture and blood, which then affect the subsequent quality of the impression. Laboratory scanners, on the other hand, use classically taken impressions, and this is associated with errors in the application of conventional techniques.
Dental scanners now have a wide range of indications covering different areas of dentistry, and their development and digitization will only expand their range. However, for more complex dental works with more than five members, the use of conventional methods is still recommended today, although analysis has shown that newer intraoral scanners have the capability and precision to reproduce clinically acceptable impressions even in these cases. The digital workflow is increasingly replacing conventional techniques and can be predicted to play a central role in all areas of dentistry in the future.

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INJECTABLE SYNTHETIC BIOMATERIALS - ADVANTAGES AND DISADVANTAGES

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Abstract: *Following tooth extraction, the alveolar ridge undergoes dimensional changes. Various biomaterials are used to reduce alveolar ridge volume loss by stimulating new bone formation. The aim of this paper is to systematically review the literature on the effect of injectable synthetic biomaterials and their advantages and disadvantages for new bone formation in the maxilla and mandible in animal and human studies. Animal and human studies have shown heterogeneity in terms of animal models, follow-up time, composition of the injectable biomaterial, and different outcome variables such as newly formed bone, connective tissue, residual bone graft and radiographic bone density.*
Key words: *bone regeneration, allograft, dental implantology*

Introduction

In cases of atrophy of the alveolar ridge or localized bone defects, the peri-implant hard and soft tissues are disturbed in the long term. Alveolar resorption following tooth extraction occurs within the first year. Previous human studies have described a horizontal bone loss of 29-63% and a vertical bone loss of 11-22% in the first 6 months after tooth extraction. When the height of the alveolar ridge is more than 5 mm, procedures such as augmentation and implant placement can be performed simultaneously, as opposed to cases where the height of the residual ridge is less than 5 mm and time is needed for bone healing after biomaterial placement and final implant placement. Nowadays, many different biomaterials are used for bone regeneration such as allografts, xenografts, autogenous bone, and synthetic biomaterials to reduce dimensional changes of the alveolar ridge and stimulate bone regeneration [1-3]. The following flowchart shows the different biomaterials used in dentistry for bone regeneration (Figure 1).

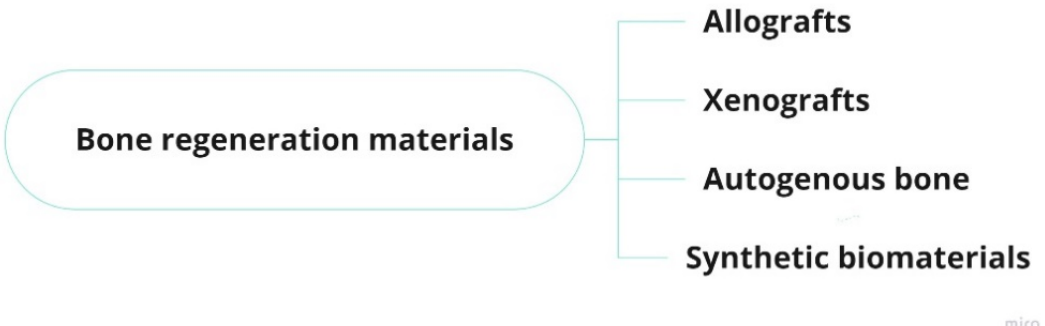

Fig 1. Different bone regeneration materials in dental medicine

Allografts

The source of an allogeneic bone graft is an individual (i.e., a living donor or a cadaver) of the same species but of a different genotype. The advantages of this biomaterial are the avoidance of a secondary surgical site and a shortened procedure time. Disadvantages of allogeneic grafts include infection, nerve damage at the donor site, and limited bone availability [4].

Xenografts

Xenografts are bone substitutes derived from animals such as cattle, pigs, and horses. Before use, such bone must undergo a mechanical and chemical purification process to remove organic components and eventually yield hydroxyapatite granules that closely resemble human bone. Xenografts are biocompatible and hydrophilic and have osteoconductive properties. Theoretically, bovine xenografts have the risk of transmitting prion infections to the recipient, which is one of the disadvantages of this biomaterial. Research has shown that the risk of disease transmission is negligible, but suspicion still exists. Xenografts are available in the form of bone blocks or granules (grafts made of small or large particles). Another disadvantage is that a xenogeneic bone block may fracture during fixation, compromising the surgical procedure and bone healing. Xenografts are used in the following cases: Cavity preservation, augmentation of the sinus floor, and guided bone regeneration. In addition, due to their advantages in terms of mechanical properties and resorption resistance, they are often combined with autogenous bone to achieve volume stability [5-8].

Autogenous Bone

Autogenous bone is considered the gold standard for clinical bone augmentation. The material is completely biocompatible because the donor is the patient himself. For this reason, an additional surgical site is required from which the replacement is taken; this site can be intraoral or extraoral. One of the main problems with autogenous bone graft is resorption. The graft tends to lose volume (40%) during healing and remodeling. Other shortcomings such as a different surgical site, limited availability, morbidity, bleeding risk, edema, and postoperative pain have led to the development of new biomaterials [7,9-15].

Synthetic biomaterials

Alloplastic bone grafts, which belong to the group of synthetic biomaterials, are used as an alternative to the gold standard. The advantages of these bone graft substitutes are their biocompatibility, osteoconductive capabilities, and stability. In addition, no donor site is required, and there is no risk of transmission of infectious diseases [16-18]. Synthetic bone substitutes represent a large group of inorganic biomaterials with different physical, chemical, and structural properties. Synthetic bone substitutes are composed of calcium phosphate to be as similar as possible to natural bone, which is mainly composed of calcium phosphate hydroxyapatite [19].

Synthetic biomaterials must be such that they do not cause inflammation or an inflammatory response. A balance between scaffold resorption and new bone formation is important for successful bone remodeling [9]. In addition, biomaterial integration, degradation, and vascularization can be influenced by the amount of cytokines and secretion of invasive inflammatory cells. When the tissue is damaged and the biomaterial is incorporated into the defect, inflammatory mediators are released from the protein plasma and tissue to adhere to the biomaterial. Such a cell layer leads to the integration of inflammatory mediators, of which macrophages should be highlighted, which are involved in the degradation and/or phagocytosis of the inserted biomaterial [3].

There are various forms of CaP biomaterials on the market in the form of powders, blocks, and granules in many sizes that are difficult to handle, especially when the bone material is placed in three-dimensional cavities. These disadvantages have led to the development of materials in injectable form [16,20]. In addition, the increasing use of biomaterials in injectable form has become popular

due to their viscosity and ease of use. This may lead to a better clinical outcome and a reduction in surgical time [16,21)].

However, various clinical cases require the use of injectable bone substitutes (IBS) with certain additives. Most IBS are based on hydrophilic polymers such as collagen, hyaluronic acid (HY) and cellulose, in addition to calcium phosphate-based granules. In a study by Barbeck et al. it was shown that the addition of HY and methylcellulose to ß-TCP granules results in a biomaterial that plays an integrative role by inducing continuous cell growth from the periphery to the core, thus increasing vascularization around the implant [17].

CaP cements without any additives usually exhibit poor injectability due to liquid separation and a solid phase. In most cases, purely inorganic CaP pastes tend to disintegrate in the initial stages of contact with biological fluids (blood) due to poor cohesion. Finally, the release of calcium phosphate particles into the bloodstream can cause certain complications. Increased blood clotting can lead to disturbances in the cardiovascular system and cause pulmonary embolism, for example [22].

We can divide CaP cements into single-phase and two-phase cements. In general, single-phase CaP cements in injectable form are biocompatible and osteoconductive, but their degradation is generally slow [20]. Two-phase CaP cement showed better curing time and injectability compared to single-phase CaP cement. Further in vitro studies on this topic are needed to analyze the differences [23].

Thus, the main advantage of injectable CaP cements compared to CaP cements in other forms is that they can be placed in the bone cavity by themselves without mechanical processing. This feature is important in clinical applications with various wider or narrower bone defects, which favors the further development of minimally invasive surgical procedures. Alloplastic biomaterials and their design, i.e., use with syringes of various sizes, are therefore becoming increasingly popular and are an ideal substitute for other types of biomaterials with the ability to cover the margins of various defects in the oral cavity, and thus increased osteoconductive properties. Animal and human studies on these injectable biomaterials play an important role in the field of dentistry [21,22,24].

The aim of this article was to systematically review the literature on the effects of injectable synthetic biomaterials and their advantages and disadvantages for new bone formation in the maxilla and mandible in animals and humans.

Materials and methods

A literature search was performed through the National Medical Library, Washington, DC (MEDLINE PubMed), the Cohrane Central Register of Controlled Trials (Cohrane library), and a biomedical database (Embase) using the following terms: [dental biomaterials]. Terms such as (injectable) or (synthetic) or (alveolar bone regeneration) or (bone graft) or (sinus augmentation) or (extraction sockets) were added to exclude any off-topic research. A total of 501 articles were found.

The inclusion criteria were:

- human studies;
- animal studies;
- English language studies;
- case reports, clinical cases, experimental pilot studies, randomized clinical trials, and preliminary studies;
- studies limited to the application of synthetic biomaterials in dentistry;
- studies limited to the injectable form of application;
- studies that included biopsy (histomorphological) and radiographic analysis; and
- studies that observed specific outcomes.

The exclusion criteria were:

- studies that were not in English;
- studies that were performed on other bones (orthopedic surgery);
- studies that did not use synthetic biomaterial in injectable form; and
- in vitro studies.

Of the 501 articles reviewed, 452 were excluded for insufficient subject matter. An abstract analysis was performed for 49 articles, resulting in 21 studies that met the inclusion criteria (13 animal and 8 human studies).

Results

The animal studies show heterogeneity in terms of animal models, specific outcomes, follow-up time, and composition of injectable biomaterial used. A detailed analysis of the individual studies revealed that most studies were conducted in dogs (seven), followed by studies in rats and sheep (two each), and mice and rabbits (one each). Different outcome variables were observed depending on the study: Bone-Implant Contact (BIC), newly formed bone, and peri-implant bone density. The follow-up period also varied in these studies and usually ranged from 3 to 6 months after implantation of the biomaterial. The biomaterials used were in injectable form and consisted of calcium phosphate cement (CPC) alone or with organic or inorganic additives.

Heterogeneity was also demonstrated in human studies on maxillae and mandibles. In these studies, the following outcomes were observed: newly formed bone, connective tissue, residual injectable bone substitute, radiographic density, and residual bone height. Time points varied from 2 months to 3 years after implantation of the biomaterials. The biomaterials used were similar in composition to those used in the animal studies, i.e. they consisted of calcium phosphate cement with organic or inorganic additives.

Conclusion

The conclusions that can be drawn suggest that bone augmentation with injectable biomaterials increases bone volume and allows adequate implant placement in the atrophic maxilla and mandible. The injectable form of biomaterial offers a modern way of delivery into the defect. More specifically, it can be fitted into three-dimensional defects immediately after implantation and thus fits precisely into the defects, unlike other forms, which are usually in the form of a block and must be specifically adapted to each individual defect before insertion. Based on animal and human studies discussed in this paper, the advantages of the injectable form of biomaterials include better handling and application to smaller defects in terms of insertion into hard-to-reach sites, reduced surgical time, compressive strength, favorable tissue response, rapid resorption associated with the use of smaller particles with the formation of new bone, and the ability to mix the biomaterial with various additives that increase cell interaction.

However, disadvantages of injectable forms of biomaterials include the inability to use them in geometrically challenging large cavities that require the use of solid biomaterials due to larger granules, increased viscosity due to higher fluid content, and consequently more difficult injection and leakage. Due to all these points, further studies, especially in humans, based on histological and histomorphological analyses of biomaterials with a better understanding of the biomechanical properties of the injectable form delivery, are needed to draw more concrete conclusions that will contribute to a better understanding of the performance of this type of biomaterials and their role in alveolar bone regeneration.

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ADVANCED APPROACH OF YOUNG SUBJECTS WITH PERIODONTAL DISEASE

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Abstract: *This was a cross-sectional comparative study of 3 clinical groups of young medically healthy subjects from the western region of Romania. Forty subjects were recruited: 10 with aggressive periodontitis, 20 with chronic mild-moderate periodontitis and 10 with no signs of periodontitis. General and neurological health status was determined, salivary inflammatory cytokines, as well as the measurement of targeted metabolomics. Our findings had showed that young subjects with periodontal disease had lower cognition and that salivary metabolites levels are distinct among groups.*

Key words: *Periodontal disease, cognition, inflammatory cytokines, salivary metabolites*

Introduction:

Periodontal disease (PD), represents both an infectious and an inflammatory condition and its worldwide prevalence confers to the Global Burden of Disease Study from 2016 as the 11th uttermost prevailing condition, ranging from 20- 50% and increases with age from adolescence to adult to mature society.(1)

On the other hand, according to the World Health Organization (WHO), it has been shown that approximately 50 million people are suffering from dementia, of which 60 -70% are diagnosed with Alzheimer's Disease, and it is estimated that the case will double in the next ten years.(2) Taking into consideration that AD-specific pathology begins decades before the onset of dementia, suggesting that this pathology may be influenced by inflammatory conditions present early in life.(3) Periodontitis, in its chronic or aggressive form, can affect the young population. With the increasing rate of PD, it was enthralling to explore whether there is a high risk among young subjects seeking treatment at the Prosthodontics Department, University of Medicine and Pharmacy "Victor Babes" Timisoara, Faculty of Dental Medicine.

The inflammatory hypothesis is commonly accepted to be a significant etiologic or contributory factor in which there is a reaction between senile plaques with antibodies in contrast to the glial cell production of proinflammatory cytokine (TNF-α, Il-1ß, Il-6) and C-reactive protein (CRP). (4, 5) When taking into consideration the infectious hypothesis, microbiota can be the result of a disrupted homeostatic balance and a predictor of immune system decline. In addition, itcan affect antimicrobial resistance and stimulate further bacterial colonization.(6, 7) In addition, the autoimmune mechanism is present both in healthy as well as individuals with PD, but in the second, more vulnerable group, it can result in tissue damage and alteration on the systemic level. Since the long-term goal of this study is to investigate the contribution of these inflammatory conditions to AD pathology, the first step was to explore the occurrence of aggressive periodontitis in our population and characterize it. While it is not known what the decisive factors in the pathogenesis of Alzheimer's disease are, it is assumed that inflammation and infection are involved, the nature and mechanism of these relationships are currently being studied. Another essential factor for this research is establishing whether oral inflammation and dysbiosis could predict Alzheimer's Disease Development.

Material and methods

The first study direction was focused on screening young convenience samples for PD prevalence. The study population consisted of patients presenting consecutively to the Prosthodontics Department of the Faculty of Dental Medicine, "Victor Babeş" University of Medicine and Pharmacy, Timisoara. These subjects were enrolled in the period from 2013 to 2016, consented to our study, and fulfilled our research criteria. The study design was approved by the University Ethics Committee. In general, patients seeking prosthodontic treatment were referrals from other school departments (approximately 80%) or were self-referred. Annually, approximately 800–900 patients of all ages are seen at the Prosthodontics Department. Subjects were included in the study if they were age ≤ 42 and were not edentulous. Subjects were excluded if they had a history of uncontrolled hypertension, diabetes, radiation, and/or drug use. The diagnosis and classification of the periodontal conditions, as well as dental pathologies and conditions, were based on panoramic radiographs. The radiographs were visually evaluated by two calibrated periodontists (AK, RG) and examiners (AK, SH). The radiographs were rated as optimal quality since the information provided was sufficient to obtain diagnostic information.(8)

The second study focus was on neuropsychological screening for a group of subjects from the previous sample and a biological sample collection for pro-inflammatory cytokine tests. The subjects were recruited from a pool of 149 subjects that participated in a previous study. This study was approved by the University Ethics Committee. Informed consent was reviewed and signed with all subjects. (No27/2017). Forty subjects were recruited: 10 with aggressive periodontitis (AGG_P), 20 with chronic mild-moderate periodontitis CrP, and 10 with no signs of periodontitis NL. In addition to fulfilling the inclusion and exclusion criteria described below, subjects were required to agree to a neuropsychological evaluation and saliva collection. Neuropsychological assessments were performed by a clinical psychologist using RAVLT, MOCA, MMSE, and Prague tests. Romanian translations of each test were used. The primary outcome measure was delayed recall tested with the Rey Auditory Verbal Learning Test (RAVLT). In addition, the Montreal Cognitive Assessment test (MOCA), Mini Mental State Examination (MMSE) and Prague tests were also used. The evaluation of the cognitive functions consisted of examining the short and long-term memory and the concentration capacity (PRAGA test). Also, the orientation abilities, praxis, language, and executive functions were evaluated for these aspects, using the following standardized tests: MMSE, MOCA, REY (Delayed recall test), Clinical Dementia Rating Scale, FAQ (Functional Activities Questionnaire), and CGI (Global Clinical Impression). Because depression can mimic the signs of cognitive dysfunction, in advanced cases, even dementia, the Hamilton test for dementia was applied (short variant - 17 items), the presence of depression being one of the exclusion criteria in this study. (9, 10)

Saliva collection and processing were done as published. Salivary Interleukin-1 (IL-1β) and tumor necrosis factor- α (TNF-α) levels were assessed using human IL-1β ELISA kit (Invitrogen, Thermo Fisher Scientific, CA, USA) and Human TNF-α Ultrasensitive ELISA kit (Invitrogen, Thermo Fisher Scientific, CA, USA) using the manufacturer's protocol. (9, 11)

Results and discussions:

The findings in this extended research raise the possibility that in young subjects with periodontal disease abnormal memory dysfunction is present, signs of brain abnormalities may exist, and increased risk of AD later in life is possible.

The first study showed that the prevalence of periodontal disease in young subjects presenting to a prosthodontics department at a university in Western Romania was high. Among the 149 patients seeking prosthodontic rehabilitation, only 34.2 % were periodontal disease free while 65.8% had periodontal disease. Among those with periodontal disease, 82.7% had radiographic diagnosed chronic periodontitis and 17.3% had aggressive periodontitis.

In the second study, the findings raise the possibility that in young subjects with periodontal disease abnormal memory dysfunction is present, signs of brain abnormalities may exist, and increased risk of

AD later in life is possible. The episodic memory is thought to be the first memory domain to be impaired in AD. Studies showed that in addition to delayed recall, learning curves are also impaired in those with MCI compared to those with normal cognition. These tests are early predictors of AD and can differentiate between cognitively normal and patients with MCI. The difference in cognitive tests between NL and those with AgP is consistent across multiple cognitive tests. These results are not surprising as AgP is highly destructive and associates with more severe immune response compared to CrP. The microbial load is also higher and characterized by many pathogenic bacteria. The difference between those with CrP and NL is not as consistent. This may be due to less severe periodontal disease, less aggressive immune response, or less microbial burden. An additional reason could be the limited sample size. The cognitive tests for CrP were slightly lower than those of NL and therefore a larger number could result in significance (Figure 1,2)

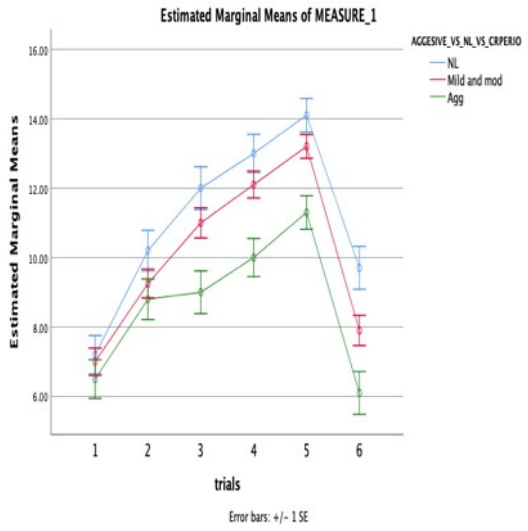

Figure 1. Learning performance among groups

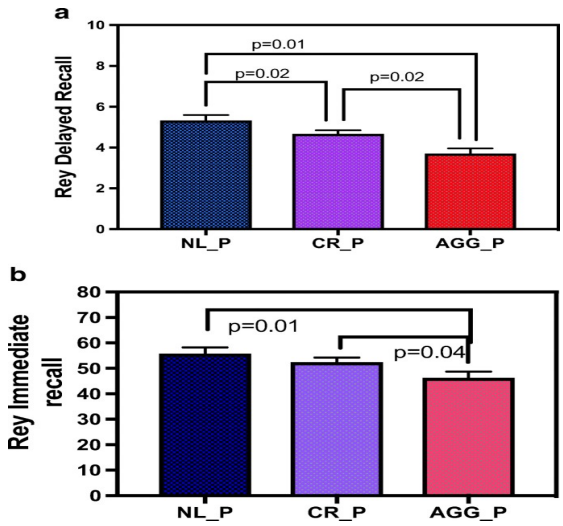

Figure 2. RAVLT Delayed Recall among groups

Conclusions:

In this contemporary era of digital dentistry, it is paramount to have a periodontally healthy patient for prosthodontic treatment, especially when planning for a long-term esthetic and functional outcome. Identifying modifiable risk factors, together with monitoring and treatment of PD, could reduce or postpone the AD diagnosis. The potential long-term impact of this project is substantial towards understanding the early contributors to AD-pathology in the brain. Brain atrophy and cognitive decline may ultimately lead to the identification of additional AD biological markers, such as prevention, early diagnostic, and treatment protocols for AD.

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NON-PLAQUE-INDUCED GINGIVAL DISEASES

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Abstract: *Although most gingival diseases are caused by the dental plaque on the tooth surfaces, those not caused by plaque accumulation, while less common, can have adverse consequences for patient health. Such non-plaque-induced gingival lesions are often manifestations of systemic conditions, but may also signify pathological changes in the gingival tissues. Current classification, based on the lesion etiology, includes genetic/developmental disorders; specific infections; inflammatory and immune conditions and lesions; reactive processes; neoplasms; endocrine, nutritional and metabolic diseases; traumatic lesions; and gingival pigmentation, which should serve as a guideline for dentists and periodontists when establishing diagnoses, formulating treatment plans, or referring such patients for treatment.*

Key words: *classification, gingival diseases, periodontal disease*

Introduction

Human gingiva may exhibit several non-plaque-induced pathological lesions, which are often manifestations of systemic conditions, but may also signify pathological changes in the gingival tissues. Although these lesions are not directly caused by plaque, their clinical course may be affected by plaque accumulation and subsequent gingival inflammation [1].

The understanding of etiology and pathogenesis of oral diseases has considerably increased in recent years due to the scientific advances. A review of non-plaque-induced gingival lesions was presented at the 1999 International Workshop for a Classification of Periodontal Diseases and Conditions [1]. This classification was subsequently revised, whereby in the latest generally accepted version from 2017 (Table 1.) some non-plaque-induced gingival diseases and conditions that were not covered by the previous systematization are described (Table 2.) [1,2].

Table 1. Classification of periodontal diseases and conditions 2017

PERIODONTAL HEALTH, GINGIVAL DISEASES AND CONDITIONS	PERIODONTITIS	OTHER CONDITIONS AFFECTING THE PERIODONTIUM
Periodontal health and Gingival health Gingivitis: Dental plaque-induced Gingival diseases: Non-plaque-induced	Necrotizing periodontal diseases Periodontitis Periodontitis as a manifestation of systemic diseases	Systemic diseases or conditions affecting the periodontal tissues Periodontal abscesses and endodontic-periodontal lesions Mucogingival deformities and conditions Traumatic occlusal forces Tooth and prosthesis related factors

Table 2. Non–plaque–induced gingival diseases and conditions

1.Genetic/developmental disorders
1.1.Hereditary gingival fibromatosis (HGF)
2.Specific infections
2.1.Bacterial origin
2.2.Viral origin
2.3.Fungal
3.Inflammatory and immune conditions and lesions
3.1. Hypersensitivity reactions
3.2 Autoimmune diseases of skin and mucous membranes
3.3 Granulomatous inflammatory conditions
4.Reactive processes
4.1.Epulides
5.Neoplasms
5.1.Premalignant
5.2.Malignant
6.Endocrine, nutritional and metabolic diseases
6.1.Vitamin deficiencies
7.Traumatic lesions
7.1.Physical/mechanical insults
7.2.Chemical (toxic) insults
7.3.Thermal insults
8.Gingival pigmentation
8.1. Gingival pigmentation/melanoplakia
8.2. Smoker's melanosis
8.3. Drug-induced pigmentation
8.4. Amalgam tattoo

1. GENETIC/DEVELOPMENTAL ABNORMALITIES

1.1. Hereditary gingival fibromatosis (HGF)

Hereditary gingival fibromatosis (HGF) is an autosomal dominant inheritance pattern characterized by fibrous gingival overgrowth that can cover the teeth completely or partially, preventing eruption in many cases [3].

2. SPECIFIC INFECTIONS

2.1. Infections with bacterial origin

Necrotizing periodontal disease

Necrotizing gingivitis (NG), ***necrotizing periodontitis*** (NP), and ***necrotizing stomatitis*** (NS) are severe inflammatory periodontal diseases caused by bacterial infection (*Treponema spp.*, *Selenomonas spp.*, *Fusobacterium spp.*, *Prevotella intermedia* and others) in patients with specific underlying risk factors, such as poor oral hygiene, smoking, stress, inadequate nutrition or compromised immune status. The term “gingivitis” is used for lesions involving gingival tissue only, without loss of periodontal attachment. Central necrosis of the papillae may result in considerable tissue destruction that would lead to crater formation. If loss of attachment is established, the diagnosis is NP. NS is diagnosed when lesions with ulceration extending >1.0 cm from the gingival margin, including tissue beyond the mucogingival junction, is present [4].

2.2. Viral origin

Coxsackie virus

Coxsackie viruses may cause herpangina and hand–foot–and–mouth disease. While herpangina does not involve gingiva, hand–foot–and–mouth disease is a common contagious vesicular viral disease affecting skin and oral mucosa, including gingiva. The lesions, which present as small vesicles that leave fibrinous coated ulcers upon rupture, are primarily seen in children [5].

HSV-1 and HSV-2

HSV-1 usually causes oral manifestations, whereas HSV-2 primarily leads to anogenital infections and only occasionally oral infections [6].

Primary herpetic infection (Herpetic gingivostomatitis**)** occurs mostly in infants and manifests as the formation of few or many vesicles, which rupture, coalesce, and leave fibrin-coated ulcers, often of irregular extension. The gingiva is erythematous and swollen. After the primary infection, the latent virus can be reactivated in 20–30% of patients, usually in adulthood. Recurrent intraoral herpes simplex lesions typically occur on keratinized mucosa of hard palate and attached gingiva [6].

Varicella-zoster virus

Primary varicella–zoster virus infection causes varicella (chicken pox), mainly in children. When the virus is reactivated in adulthood, it causes herpes zoster which manifests as unilateral lesions on the skin or oral mucosa following the distribution of an infected nerve. If the second or third branch of the trigeminal nerve is involved, skin lesions may be associated with intraoral lesions (including gingival lesions) or intraoral lesions may occur alone. Emergence of lesions may be preceded by pain and paresthesia. When lesions initially appear, they are in form of vesicles, which soon rupture and leave fibrin-coated small ulcers, often coalescing to irregular forms up to the midline [7].

Human papilloma virus (HPV)

More than 100 types of HPV have been identified, and at least 25 types have been detected in oral lesions. Benign oral lesions associated with HPV infection include squamous cell papilloma, condyloma acuminatum, verruca vulgaris, and focal epithelial hyperplasia. These lesions are mostly asymptomatic, exophytic papillomatosis, verrucous or flat lesions. Histopathology of removed lesions is required for a definitive diagnosis [1].

2.3. Fungal origin

Candidiasis

Candidiasis is the most common fungal infection of the oral mucosa and is mainly caused by *C. albicans*. Less common species include *C. glabrata*, *C. krusei*, *C. tropicalis*, *C. parapsilosis*, *C. guillermondii* and *C. dubliniensis*. Candidiasis can be acute or chronic, with pseudomembranous, erythematous and hyperplastic (plaque-like/nodular) clinical presentations [8]. While candidal infection can affect any part of the oral mucosa, gingival lesions are rare in otherwise healthy individuals. Gingival candidal infection typically manifests as redness of the attached gingiva, often with a granular surface. Pseudomembranous candidiasis is characterized by whitish creamy plaques resembling milk curds which can be wiped away, leaving behind an erythematous mucosal surface that is prone to bleeding. Nodular gingival lesions are uncommon and present as slightly elevated nodules of a white or reddish color. “Linear gingival erythema” described in the 1999 International Workshop, associated with HIV infection, is now generally regarded as gingival candidiasis and has therefore been removed from this classification [1].

3. Inflammatory and immune conditions and lesions

3.1. Hypersensitivity reactions

Contact allergy

Oral mucosal manifestations of hypersensitivity may be caused by dental restorative materials, dentifrices, mouthwashes, and certain foods, and are typically classed as Type IV hypersensitivity reactions (contact allergy) involving redness and sometimes lichenoid lesions [1].

Plasma cell gingivitis

Plasma cell gingivitis is a relatively rare condition that usually occurs on the anterior maxillary and mandibular gingiva. It manifests as extreme redness, swelling, and gum tissue enlargement with propensity for bleeding (Picture 1.). While the disease etiology remains unclear, its presentation is mostly attributed to nonspecific inflammatory reaction to certain foodstuffs or ingredients in oral hygiene products [9].

Picture 1. Plasma cell gingivitis

Erythema multiforme (EM)

EM is an acute immune-inflammatory disorder of the oral mucosa with unknown etiology in most cases. However, it is posited to be an immunologic hypersensitivity reaction mediated by T-lymphocytes. It can be triggered by infections, particularly those of herpetic type, and some drugs. EM symptoms vary, from mild erythema and erosion to painful ulcerations, and typically extend to the anterior part of the mouth and lips [7].

3.2. Autoimmune diseases of skin and mucous membranes

Pemphigus vulgaris

PV is an autoimmune vesiculobullous disease of skin and mucous membranes often involving the oral mucosa and initially presenting as oral lesions in 60% of these cases. It results in the formation of intraepithelial bullae on otherwise normal skin or mucosa due to autoantibodies directed against desmosome-associated protein antigens. Gingival localization of PV usually manifests as desquamative gingivitis and/or as vesiculobullous lesions of the free and attached gingiva which, after bullae rapidly rupture, leave erosions [7].

Pemphigoid

Pemphigoid is a group of mucocutaneous disorders caused by autoantibodies toward antigens of the basement membrane, resulting in detachment of the epithelium from the connective tissue. If only mucous membranes are affected, it is denoted as mucous membrane pemphigoid (MMP). The subepithelial lesions of MMP most frequently involve the oral mucosa and typically manifests as desquamative lesions of the gingiva presenting as intensely erythematous areas. Lesions may present as intact vesicles of the gingival or other mucosal surfaces, but more frequently they appear as nonspecific-appearing erosions [7].

Lichen planus

Lichen planus is a common mucocutaneous disease frequently affecting the gingiva and manifesting as an inflammatory reaction toward an unidentified antigen in the basal epithelial layer/basement membrane zone. Six types of clinical manifestation have been described—reticular, papular, ulcerative, bullous, plaque, and erythematous type. The lesions are usually bilateral, often involve the gingiva, and present as desquamative gingivitis, causing pain and discomfort during eating and toothbrushing. Because lichen planus has been shown to exhibit premalignant potential, it is important to diagnose, treat, and follow the affected patients through regular oral examinations [7]. In a recent randomized controlled trial, a tailored plaque-control regime was shown to be beneficial in reducing symptoms of gingival lichen planus and improving patients' overall quality of life [10].

Lupus erythematosus (LE)

LE is a group of autoimmune disorders that result in the production of a great variety of autoantibodies, particularly antinuclear antibodies. Two major forms are described in extant literature—discoid LE (DLE) and systemic LE (SLE). Approximately 20% of the patients with LE develop oral lesions. DLE is a mild chronic form, which involves skin and mucous membranes, sometimes including the gingiva as well as other parts of the oral mucosa. A typical lesion presents as a central atrophic area with small white dots surrounded by irradiating fine white striae. It is estimated that about 8% of patients with DLE will develop SLE, and this progression is usually diagnosed through the emergence of ulcerations [7].

3.3. *Granulomatous inflammatory conditions (orofacial granulomatosis)*

Various systemic conditions like tuberculosis, Crohn's disease (CD), sarcoidosis and Melkersson–Rosenthal syndrome can result in persistent enlargement of the soft tissues in the oral cavity and the facial region. In recognition of this fact, in 1985, Wiesenfeld introduced the term orofacial granulomatosis (OFG) to make a distinction between these manifestations and granulomas that occur in the absence of any recognized systemic condition. Although OFG etiology is still unknown, several causes have been suggested, including infection, genetic predisposition, and allergy. The clinical symptoms include labial enlargement, cobblestone appearance of the oral mucosa, linear ulceration, and gingival overgrowth. There is still no consensus on whether OFG is a distinct clinical disorder, or an initial presentation of CD or sarcoidosis, or even an allergic reaction [11, 12].

4. Reactive processes

4.1. Epulides

Epulis is a term often applied to exophytic processes originating from the gingiva. Usually patients do not present with any symptoms, although the reactive processes are thought to cause an

exaggerated tissue response to limited local irritation or trauma, and are classified according to the histological findings. True epulides include Fibrous epulis, Calcifying fibroblastic granuloma, Pyogenic granuloma (Picture 2.) and Peripheral giant cell granuloma (or central). In a recent study involving 2,068 cases of reactive lesions of the oral cavity, the attached gingiva (with 1,331 cases, or 64.36% of the total sample) was found to be the most frequently affected location [13].

Picture 2. Pyogenic granuloma

5. Neoplasms

5.1. Premalignant

Leukoplakia

Oral leukoplakia is defined as a predominantly white lesion of the oral mucosa that cannot be attributed to any other definable type. The exact cause of leukoplakia is unknown, but heavy smoking and alcohol use are the main risk factors [7]. Lesions are generally asymptomatic with smooth, corrugated, or verrucous surface. They cannot be rubbed off and occur most frequently on the buccal mucosa, mandibular gingiva, tongue, and mouth floor. Leukoplakia can be of homogeneous or non-homogenous subtype. The prevalence of malignant transformation in leukoplakia ranges from 0.13% to 34%. Larger lesions and those of non-homogenous type are associated with a greater risk of malignant transformation than homogenous leukoplakia [14].

5.2. Malignant

Squamous cell carcinoma

Squamous cell carcinoma of the gingiva represents about 20% of intraoral carcinomas and occurs most frequently in the mandibular premolar and molar regions. The resulting lesions often present as painless exophytic masses, red and white speckled patches, or non-healing ulcerations involving the keratinized gingiva. Although lesions typically occur in edentulous areas, they may also be present at sites around dentition. Mobility of adjacent teeth is common, and invasion of the underlying alveolar bone occurs in approximately 50% of cases [15].

Leukemia

Leukemia results from the proliferation of a clone of abnormal hematopoietic cells. It is classified based on clinical behavior (acute or chronic) and the primary hematopoietic cell line affected (myeloid or lymphoid). Oral lesions occur in both acute and chronic leukemia but are more

common in the acute form. The signs and symptoms are diverse and include pallor of the oral mucosa, pain, petechiae and ecchymosis, gingival bleeding, and gingival swelling due to leukemic cell infiltration. Deep punched-out ulcerations and necrosis on gingiva and tooth mobility can also be present [7].

Lymphoma

Lymphoma is an umbrella term for describing tumors of the lymphoid system and may originate from B–lymphocyte and T–lymphocyte cell lines. Its main two types are Hodgkin lymphoma and non-Hodgkin lymphoma. Non-specific gingival swelling may be the first manifestation of non-Hodgkin lymphoma, mimicking a periodontal abscess or pyogenic granuloma. In contrast, oral manifestations of Hodgkin lymphoma are extremely rare [7].

6. Endocrine, nutritional, and metabolic diseases

6.1. Vitamin deficiencies

Vitamin C deficiency - scurvy

Ascorbic acid (vitamin C) is necessary for various metabolic processes, such as formation of collagen, which is a primary structural protein in the human body. As reduced plasma ascorbic acid concentration in scurvy causes changes in connective tissue metabolism, it results in gingival bleeding, swelling and ulceration, as well as a compromised immune response [11].

7. Traumatic lesions

7.1. Physical/mechanical insults

Frictional keratosis, Toothbrushing-induced gingival ulceration, Factitious injury (self-harm)

Inappropriate toothbrushing can be injurious to the gingival tissues. Limited physical trauma from brushing may result in gingival hyperkeratosis, a white leukoplakia-like lesion referred to as frictional keratosis. In cases of more extensive toothbrushing damage, symptoms vary from superficial horizontal gingival lacerations to major loss of tissue resulting in gingival recession. A characteristic finding in these patients is extremely good oral hygiene and/or cervical tooth abrasion. Self-inflicted injury to the gingival tissue is more common in young patients, in whom lesions may present as unusual tissue damage with ulceration in areas that can easily be reached by fingers and instruments [16].

7.2. Chemical (toxic) insults

Toxic chemical products may result in surface sloughing or ulceration which can be related to the use of chlorhexidine, acetylsalicylic acid, cocaine, hydrogen peroxide, or dentifrice detergents. These lesions are reversible and resolve after removing the toxic influence. Injury to the gingival tissue may also be caused by incorrect use of endodontic materials that may be toxic to the gingiva, including paraformaldehyde or calcium hydroxide, which may give rise to inflammation, ulceration, and necrosis of the gingival tissue if the cavity sealing is insufficient [17].

7.3. Thermal insults

Thermal injuries are usually caused by consumption of hot fluids and may affect any part of the oral mucosa, including the gingiva. The lesion is erythematous with sloughing of a coagulated surface and may sometimes present as ulceration, petechiae, or erosions. Vesicles may also occur in some cases [6].

8. Gingival pigmentation

8.1. Gingival pigmentation/melanoplakia

Physiologic melanin pigmentation presents as brownish-to-black diffusely pigmented areas on the attached gingiva, most often in persons with a dark skin complexion. If there is a sudden or gradual onset of diffuse mucosal pigmentation in adulthood, other sources should be considered, such as endocrine disturbances (Addison's disease) or syndromes (Albright syndrome, Peutz-Jegher syndrome) [7].

8.2. Smoker's melanosis

Cigarette smoking is the primary etiological factor in melanocytic pigmentation of the oral mucosa. It typically presents as brownish areas on the mandibular anterior gingiva. Melanosis gradually improves or may completely resolve upon cessation of smoking [7].

8.3. Drug-induced pigmentation

Antimalarial agents, such as chloroquine diphosphate and hydroxychloroquine sulfate, that are used for treating dermatologic and rheumatologic disorders can cause hyperpigmentation of the oral mucosa. These medications can stimulate melanin production by melanocytes and/or can cause hemosiderin deposition, potentially facilitating focal microscopic hemorrhage. Nevertheless, the exact mechanisms involved are not yet established. These alterations are generally reversible and improvements are typically noted as soon as the medication is discontinued [18].

Minocycline is a semisynthetic tetracycline and its black degradation product may be deposited in tissues. Long-term use of minocycline is associated with pigmentation of the alveolar bone and teeth. When changes in bone are viewed through relatively thin overlying mucosa, the gingiva may appear gray, especially in the maxillary anterior region. True minocycline-induced soft tissue pigmentation is much less common [19].

8.4. Amalgam tattoo

Pigmentation of the oral mucosa due to the use of amalgam fillings is frequently seen in patients affected by gingiva and alveolar mucosa. The lesion presents as a flat well-defined bluish or grayish discoloration. Introduction of amalgam particles into the gingival connective tissue through breaks in the epithelium can occur during tooth extraction or restorative procedures [11].

Conclusion

Non-plaque-induced gingival diseases cannot be resolved by dental plaque control. Current classification, based on the lesion etiology, should serve as a guideline for dentists and periodontists when establishing diagnoses, formulating treatment plans, or referring such patients for treatment.

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SYSTEMIC THERAPY OF APICAL PERIODONTITIS

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Abstract: *Enamel, dentin, and cement surround the tooth pulp, whose main role is a formative, nutritional, defensive, and neurosensory function. Damage of dental tissues by trauma, caries, or certain non-carious diseases can lead to the opening of the pulp and consequently its inflammation. Over time, under the influence of microorganisms, toxins, and metabolic products, as well as residues of necrotic pulp in the ducts, changes and resorption of bone around the apex occur. Apical periodontitis is one of the most common dental inflammatory conditions, however, to date, there is no available alternative therapy that would reduce periapical bone resorption.*

Key words*: apical periodontitis, endodontic infection, systemic therapy*

Introduction

Dental tissue damage and opening of the dental pulp with its exposure to oral conditions consequently leads to necrosis and disease in the periapical part [1, 2]. According to some research, more than half of adults worldwide have at least one tooth with apical periodontitis. It is more common in underdeveloped countries and on teeth that have already been treated i.e. in which the root canal is filled [3]. Chemomechanical treatment of the root canal is a golden standard in tooth endodontics and includes mechanical treatment that can be manual or machine and rinsing with disinfectants. The goal is to clean, shape, and fill the root canal to prevent or eliminate inflammation around the apex. Sodium hypochlorite (NaOCl) is used in the basic protocol for irrigation due to its antibacterial action and removal of necrotic and organic tissue. Ethylenediaminetetraacetic acid (EDTA) is used to remove the residual smear layer and inorganic components [4]. Despite advances in technology and the development of new instruments and techniques for root canal cleaning, research still shows a high rate of apical periodontitis after dental treatment and treatment failure [5, 6]. Poor instrumentation and non-follow-up of dental rinsing protocols are most often cited as the reason for this, however apical periodontitis is also found on well-treated teeth [7]. It can be divided as follows: one that occurs after treatment, e.g. due to the transfer of microorganisms by cleaning the canal, persisting if it remains despite therapy, and recurrent if it reappears on the tooth after healing [7, 8]. The main cause is a bacterial infection, either intraradicular or extraradicular, sometimes it may not be of microbial origin [7]. Radiolucency around the apex of the tooth, which occurs due to progressive bone resorption, is the main sign of apical periodontitis and occurs as a result of microbial infection and the host's response to it. The inflammatory response involves the activation of macrophages, polymorphonuclear leukocytes, endothelial cells, and osteoclasts and leads to rapid bone destruction. Interaction between osteoblasts, osteoclasts, their precursors, and immunoregulatory mechanisms is crucial in the destruction or formation of new bone [2, 9]. Options for further treatment include revision of the filling and re-endodontic treatment or periradicular surgery, however, there is certainly a need to develop less invasive therapies with a more predictable outcome [2, 7].

Antibiotic systemic therapy

Often, antibiotics are not justifiably included in therapy due to the persistence of symptoms and pain. Research has shown that many doctors of dental medicine are in doubt when they need to prescribe an antibiotic and often prescribe it even when it is not indicated [10]. However, due to the lack of blood flow, antibiotics do not reach the desired area and they are ineffective against microorganisms and the expected effect is absent [11]. It has also been shown that very often antibiotics are the first and only treatment choice [12]. This proves the uncritical use of antibiotics that are indicated only when there are signs and the possibility of systemic spread of infection and in medically compromised patients [13]. The use of antibiotics in this area is empirical, prescribed

without a previously proven causative agent, and with the assumption that the chosen drug will act on the most likely causative agent. The most widely are used penicillin group of antibiotics. Amoxicillin is often the first choice, in a dose of 500 mg three times a day or every eight hours, for three to seven days. The use of amoxicillin in combination with clavulanic acid, which has been shown to be effective in the treatment of endodontic infections, is particularly common, especially in immunocompromised patients. In the case of penicillin allergy, the drug of choice is clindamycin, which is usually prescribed in a dose of 300 mg four times a day or every six hours, for three to seven days. Other antibiotics used for penicillin allergies are clarithromycin 250 mg twice daily or every twelve hours and azithromycin 250 mg once daily. If there is no improvement in symptoms with the penicillin group of antibiotics, metronidazole may be included in therapy. The most commonly used antibiotics in endodontics and doses for adults are listed in Table 1. Other antibiotics less commonly used in the treatment of endodontic infections are erythromycin and cephalosporins [10, 14, 15].

Antibiotics systemic therapy is an important factor in the control of infectious diseases, and as such, it has extended the life expectancy and quality of life. Today we are facing the phenomenon of increasing microorganism's resistance to antibiotics, which has contributed by uncritical prescribing of antibiotics in situations where they can be avoided and are not indicated. This may return mankind to the pre-antibiotic period [16]. What further contributes to the increase in resistance is the already mentioned empirical prescribing of broad-spectrum antibiotics in the treatment of odontogenic infection, and the reason for this is its polymicrobial etiology. Uncritical prescribing of antibiotics not only leads to an increase in resistance but also increases the risk of potential allergic reactions, of which anaphylactic shock is the most dangerous and exposes patients to possible unnecessary side effects [15, 17].

Table 1. The most commonly used antibiotics in endodontics and doses for adults [references in the text]

Drug of choice	**The dose applied in adults**
Penicillin VK	500 mg every 6-8 hours
Amoxicillin	500 mg every 8 hours
Amoxicillin with clavulanic acid	1g every 12 hours
Metronidazole	500 mg every 6 hours
Clindamycin	300 mg every 6 hours
Azithromycin	250 mg every 24 hours
Clarithromycin	250 mg every 12 hours

Alternative systemic therapy

Apical periodontitis is characterized by bone destruction as an inflammatory response to a bacterial infection in the tooth root canal. Periapical bone resorption may be considered as an unappetizing side effect of the host protective response. It is the main clinical sign of apical periodontitis because the presence of radiolucency around the apex of the tooth indicates the presence of disease while the reduction of bone resorption speaks in favor of healing. The persistence of the lesion shows that the balance between bone resorption, which is mediated by the action of bone cells such as osteocytes, osteoclasts, and osteoblasts, and healing is still in favor of the disease state [18, 19]. Currently, the standard treatment procedure is the mechanical removal of infected root canal dentin assisted by a chemical rinse. However, to date, alternative therapies that could reduce bone resorption in apical periodontitis have not been in use.

Scientists are working to find a cure that will stop the inflammatory process, reduce bone destruction and encourage its recovery. Numerous preclinical studies support this [20-24]. Omega-3 fatty acids have been shown to be effective not only in stopping osteoclastogenesis but also in promoting osteoblastogenesis, as well as in reducing proinflammatory factors and enhancing antiinflammatory ones [20, 21]. Probiotics have also shown promising results in this field [22, 23]. Research has also included the use of hormones: melatonin was effective in reducing the area of bone

resorption and radiolucency in an experimental model of apical periodontitis [24]. Antimicrobial peptides have shown good results in local application in endodontics, so the expansion of peptide research as a possible systemic therapy of apical bone defect at the right dose should be considered, especially peptides that have already shown good results in bone healing [25-27].

Conclusion

As apical periodontitis affects a large number of people around the world and local therapy itself has a certain percentage of failures, finding alternative therapies that could help reduce apical bone defects and thus preserve the teeth, would be significant. Such therapy should certainly have anti-inflammatory and regenerative effects, suppress the osteoclastogenesis, be biocompatible, and possibly not have an antagonistic effect on antibiotic therapy if it is really needed.

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REMOVAL OF MATERIAL FROM ROOT CANAL DURING ENDODONTIC RETREATMENT

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Abstract: *An important step during retreatment is complete removal of the existing filling material, to gain access in all parts of the canal system. The type of core and sealer obturation material, use of different solvents and the possibility to use hand instruments or a variety of machine-driven instruments can influence the amount of residual material on canal walls. These factors can decrease the time needed for retreatment, however not necessarily have the same effect on the cleanliness of the canal walls. Methods and instruments that provide the most optimal results during retreatment procedures will be reviewed.*

Key words: *Endodontic retreatment, Material removal, Rotary instruments, Solvents*

Introduction

Nonsurgical endodontic retreatment is a procedure performed in a tooth that has already received a previous attempt of treatment and should be considered as the first choice of treatment whenever possible [1,2]. Orthograde endodontic retreatment involves removing the existing filling material with additional cleaning, disinfection and final obturation of the canal. An important step during retreatment is complete removal of the existing filling material, to gain access in all parts of the canal system. Removal as much material possible, followed by reinstrumentation and enlargement of the root canal provides better removal of necrotic tissues and microorganisms that may be responsible for the persistant periapical inflammation. However, complete root canal cleaning is almost impossible, regardless of the technique used for root canal preparation [3]. Also an important problem that should be addressed during retreatment is the apical extrusion of debris, root canal filling materials, dentin, microorganisms and irrigants through the apical foramen, regardless of the technique, instrument or material used [4]. This can cause periapical inflammation, flare-up and disruption of the healing process, that can be associated with the increasing amount of extruded debris [5]. There are a lot of studies in the literature that investigated retreatment and approached this issue from different perspectives.

Discussion

Different materials -generally a solid core material with an endodontic sealer-are usually used for root canal sytem obturation. Gutta-percha is the most commonly used core material for this purpose due to its stability and ability to be compacted [6]. Providing an adequate seal with gutta-percha is difficult due to the absence of bonding to root canal dentine and endodontic sealer. As an alternative, a synthetic polymer-based material, Resilon (Resilon Research LLC, Madison, WI), that shows thermoplastic ability similar to gutta-percha, has been introduced for use with methacrylate-based sealer to enable monoblock formation and to improve the bond to the root canal dentine. A polycaprolactone thermoplastic material with bioactive glass, bismuth, and barium salts as fillers has handling properties similar to gutta-percha. The material induces a chemical interaction that leads to the formation of a single resin block, which adheres to the root canal walls [7]. Some studies that evaluated the remaining filling material concluded that there was less material observed in teeth obturated with Resilon compared to gutta-percha and sealer. The study by Cunha et al. showed that Resilon/Real Seal system was removed in greater quantities from the canal walls compared with the gutta-percha cones and the AH Plus sealer [7]. However other studies showed no significant differences between different materials [8–10]. Also, some studies were conducted in order to test

whether the removal of Resilon material is harder, regarding the deeper penetration [11] and formation of monoblock inside the dentinal tubules and therefore measured the time needed for retreatment [12].

There are many different techniques for removal of root canal filling material: use of hand or rotary instruments, ultrasonics or heat-carrying instruments or a combination of these techniques. Rotary nickel-titanium (Ni-Ti) systems are preferred in endodontic retreatment because of their safety, efficiency and speed [13,14]. In order to improve the retreatment procedure, there are specially designed Ni-Ti instruments for the removal procedure itself, such as D-Race System (FKG Dentaire) and ProTaper Retreatment System (Dentsply, Maillefer, Switzerland) [10]. These systems are manufactured in a way to provide better efficiency but also safety during the removal procedure. Also, conventional Ni-Ti instruments that are produced for primary root canal preparation, could be used for the cause of material removal. However, the design of these instruments can be unfavorable and result in instrument separation or transportation of the canal. In studies conducted, instruments specially designed for retreatment were more efficient also in the amount of filling debris removed, compared to conventional rotary instruments. The use of machine-driven instrumentation is expected to be more efficient and time-saving compared to hand instruments. Also, the rotary instrumentation is proved to be safer compared to hand instruments concerning the amount of apically extruded debris [15].

Beside the rotary action, instruments that work with reciprocating action such as Reciproc (VDW, Munich, Germany) and single-file Ni-Ti system, such as OneShape (Micro-Mega, Cedex, France), that use only one file to prepare the entire canal, can also be used for retreatment. However the reciprocating instrument showed to produce more debris and extrusion compared to the rotary systems. The authors concluded that the advantage of the single-file system could be in regard to the working time needed for material removal [16].

The type of core and sealer obturation material and the use of different solvents during material removal can also influence the amount of residual material on canal walls. In clinical practice, different organic solvents, such as chloroform and xylol, have been used as auxiliaries to aid dissolving/softening during the removal of filling material [17]. Unlike chloroform, xylol is not considered a carcinogen and has superior solvency capacity than orange oil and eucalyptol [18,19]. Also, the use of solvents can facilitate the penetration of the instrument inside the filling material and aid the action of instruments, therefore decreasing the possibility for diversion and perforations [19,20]. However, the use of solvents alters the physical and chemical characteristics of the filling material and can reduce the effectiveness of the instrumentation [21]. The gutta-percha softened by the solvent action can result in forming a thin film that adheres to the surface of the root canal wall, which is more difficult to remove, even if enlargement of the canal is done by re-instrumentation [21,22]. In a study that investigated different solvents, the authors concluded that the use of a solvent specific to the sealer during retreatment decreased the amount of apically extruded debris [23].

As all the studies show, the materials from the root canal cannot be removed completely and remnants in different amount are always present on the canal walls, especially in the apical root third. The apical third of the root canal is the most complicated area in terms of complete smear layer and filling debris removal, regardless the type of filling materials [10] and instruments or other method used, during retreatment. Also, this finding shows that the absence of filling materials on the instruments, in the irrigating solution and the smoothness of root canal walls are not a valid criteria to demonstrate complete removal of filling material from the canal walls [24]. Rodig et al. [14] reported the need to complement biomechanical preparation with instruments of larger caliber. Studies [25,26] have demonstrated that the enlargement of the root canal reduces the amount of remaining filling material and provides enough space for the hydraulic effect of the irrigating solution to be efficient, while flushing out the debris [2]. Additional instrumentation can be done after initial material removal in order to improve the cleanliness of dentinal walls [27]. However apical instrumentation with No. 40 instrument is probably insufficient for the complete removal of the filling debris plugs present in all dentinal tubules [10]. The implementation of additional methods and aiding factors can decrease the time needed for retreatment, but not necessarily have the same effect on the cleanliness of the canal walls.

Conclusion

Obturation materials from the root canal cannot be removed completely and remnants in different amount are always present on the canal walls, especially in the apical root third. Implementation of different instruments, additional procedures, solvents and irrigation protocols can aid the removal of remaining material and improve canal cleanliness. However, these factors should be considered also in regard to the type of material and sealant to be removed and their extrusion through the apex. Approaches that provide the most optimal results in terms of canal cleanliness and effectiveness of the retreatment procedure should be employed in each individual retreatment case.

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FACIAL AESTHETICS - THE OPINION OF A PROSTHODONT

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Abstract:
Aesthetics is a philosophical discipline that often emphasizes that beauty is in the eye of the beholder. The problem of aesthetics is especially pronounced in dental medicine because the face is the only part of the human body that is never covered. If some part of the face deviates from the "gold standards", a "halo effect" occurs, i.e. people around get a bad impression of the individual based on one physical detail. It can be said that today in an aesthetically conscious society, a smile plays an important role, and globalization, to some extent, harmonized the standards of aesthetics. As dental aesthetics cannot be defined qualitatively, the aim of this lecture is to provide some guidelines in the rehabilitation of the mouth and teeth from the prosthodontic aspect.

Key words: *(face aesthetic, gold standards, visualization techniques, smile.)*

Introduction

According to the literature, the problem of aesthetics is particularly pronounced in dentistry because the face is the only part of the human body that is never covered. This means that it is constantly available for environmental assessment. Teeth, lips, chin and cheeks affect the overall aesthetic impression of an individual's face. If some of that deviates from the gold standards, a halo effect occurs, that is, we acquire a bad opinion of the individual based on one physical detail. Despite a wealth of literature on facial and smile attractiveness, their determinants and perceptions remain controversial. The human face, and the smile in particular, must be viewed holistically in order to understand the perception of the attractiveness of a smile. Dental aesthetics, however, cannot be defined qualitatively or quantitatively. Still, some guidelines exist and are divided into three groups: micro, mini and macro aesthetics.

Micro-aesthetics

Micro-aesthetics studies teeth, i.e. their color, shape and position in the dental arch, proportions and symmetry. Mathematical rules can be found in every book on dental aesthetics. In short, it can be said that the central incisors are the lightest and the canines are two shades darker. The shape of the teeth should be consistent with the shape of the face, body, palate and similar structures, depending on different theories. Then, the width of the tooth is about eighty percent of its height. The position of the teeth must be consistent according to the medial line and the prosthodontic plane. The vestibulo-oral inclination of the teeth and the symmetry of the left and right sides are also being studied.

Mini-aesthetics

The second segment of dental aesthetics is, according to some authors, mini-aesthetics. It studies the influence of the appearance and position of the lips and gingiva in relation to the teeth. Some still call it a red-and-white aesthetic. The pink, healthy gingiva, looking like orange peel is considered beautiful. The gingival zeniths, that is, the most vertical points of the marginal gingiva, are also observed. They are slightly more distal than the medial line of the tooth. Their merging creates a

gingival line that is parallel to the upper lip. The gingival zeniths of the central incisors and canines are at the same level, and the lateral incisors are one millimeter below. The presence and size of interdental papillae are also assessed, and the presence of black triangles, which is a common problem in implant prosthodontics. Depending on the height of the upper lip, it is assessed whether the patient has a low level of smile so that less than three quarters of the teeth are visible. Equally for the average level of smile when whole crown of the tooth and one to two millimeters of gingiva can be seen or a high line of smile where you can see most of the gingiva so-called gammy smile which is not considered aesthetic. This visibility is influenced by gender (women usually have a shorter upper lip), but also by age, because the drop in muscle tone, lowers the smile line.

Macro-aesthetics

Macro-aesthetics is more an area of interest for plastic surgeons. It deals with the proportions of the face in the vertical and horizontal planes, both in the enface and the profile. The harmonious face is divided into three parts, horizontally from the trichion to the mentum. The interpupillary line, which must be parallel to the prosthodontic line, is also assessed. The medial line must pass between the central incisors. In profile Rickett's line is the most viewed. It connects the pogonion and the tip of the nose. Thereby, the upper lip is 4 mm away and the lower 2 mm from it. In conclusion, it could be said that facial aesthetics studies all the proportions on the face and any deviation is considered unattractive.

Therapy sequence

The very beginning of therapy should be the achievement of good communication between the patient and the dental team. Functional and esthetic success of an oral rehabilitation depends on the understanding of the patients and on effective communication among the entire dental team. The team consists of a dentist, assistant and dental technician. The involvement of the dental technician since the beginning of the treatment plan is one of the keys for success. During the initial phase of therapy, the dentist should get to know the patient, that is, determine the patient's primary requirement and main expectations. At this stage dentist and the patient discuss the therapy equally, and photographs, plaster models and even fashion magazines can help. Once the patient has defined his or her desires, the dentist collects initial documentation, X-rays, conducts clinical examinations, study models, and photographs. First of all, in order to protect the dentist from potential lawsuits. After that, the dentist delivers information for the patient, that is in a language he understands, explaining his problems and possible therapeutic solutions. Finally, when therapy is selected, the patient is explained the price and duration of therapy and possible alternatives. The final phase follows, in which it is explained to the patient the possible limitations of the therapy.

Visualization technique

Today's patients are demanding, but often they cannot even perceive what their teeth will look like after a dental procedure. Precisely because of this, and in order to reduce the patient's extreme dissatisfaction, therapists show them what their teeth will look like in the end with different visualization techniques. A smile reflects the emotional state and personality of the patient, and the translation of this into a new smile design happens in different ways. This can be reported either by analog methods or digitally. Using visual language will help the dentist and dental technician create a personalized smile design. The fastest and simplest visualization technique is digital photography and various computer simulations. The new taken photos of the patient's face and mouth are used, which therapists then process with various software programs (photo shop, dental explorer, etc.) and show several suggestions to patients and receive suggestions from them. The method is economical and fast, but it has a big disadvantage, which is two-dimensionality. The patient cannot fully imagine what his lips, profile will look like. This is often a problem for patients who come with complete dentures

and want implant-prosthetic rehabilitation, but only fixed. With photographs, they do not get an insight into the fact that, for example, their struggles will intensify. Another visualization technique is wax-up i.e. waxing plaster models. This method, unfortunately, is not ideal for the patient because his eye is not trained to look at models and it is difficult for him to imagine the final look based on wax up. For this reason, we use this method more for the production of silicone keys for controlled grinding, the production of temporary replacements and for the production of masks for periodontal surgery. The next visualization technique is mock up, that is, making a trial run directly in the mouth. It can be made in the laboratory on the basis of wax up or directly in the mouth by reshaping the teeth with composites to the desired shape. This is the method most accepted by patients and they are actively involved in the design. If therapists make mock up before grinding tooth, and the patient is undecided, the tooth is not etched and no adhesives are used so there is no damage the tooth if the patient gives up the procedure. The advantage of this method is that it is easily modified, and the patient gets a realistic picture by looking in the mirror. Wax up and mock up technique combinations are also possible. The last method of visualization is both, the worst and the fastest. It is for informational purposes only. Therapists show the patient photos before and after other patients' procedures to at least get some idea of whether they want to enter therapy at all. If they agree then therapists are just going to the previously mentioned visualization techniques.

Conclusion

In an aesthetically conscious society, a smile plays an important role. And globalization somehow standardized standards. When a patient's smile is impaired by a dental disease, it often leads to a loss of self-esteem and impairment of the overall psychophysical health of the individuals. In their interactions people spend most of their time with their eyes. It is followed immediately by a smile in terms of expressing attractiveness, and then less by other facial features. Every human smile is special and unique. Today, there is a lot of talk in dentistry about aesthetics, but not only smiles but also faces. Dentists in their daily practice encounter the patient's ideas of beauty. At the same time, it must not be forgotten the function of the stomatognathic system, which is too often not important to patients.

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ADHESIVE CEMENTATION

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Abstract: *The development of composite materials and adhesive systems leads to the use of adhesive cementation. Adhesive cementation means composite cement and bonding system. For some adhesive cement, the bonding system is in the composite cement itself. Such cements are called "all in one cement". Unlike other adhesive cements where the bonding system is separated from the composite cement. When using adhesive ones in which the bonding system is separated from the composite cement, with additional treatment of the prepared tooth and the restoration, there is a stronger connection between the tooth and cement. Therefore, there is a greater possibility of a longer and more lasting restoration. Because adhesive cements have a wide range of applications, no single adhesive cement can be recommended for all clinical cases.*

Key words: *adhesive cementation, bonding system*

Introduction

Improvements in adhesive techniques and materials have extensively influenced modern restorative dentistry. At first adhesive techniques were used in restorative dentistry, mainly for fillings. Further advance of adhesive procedures was in prosthodontic, leads to the use of adhesive cementation. Principles of tooth preparation proposed by Black [1] in 1917 was shortly explained as 'extension for prevention' but that principle is no longer scientifically acceptable, due to adhesive techniques and development of bonding systems. Black's massive hard tooth tissue removal has been replaced by the concept of 'minimally-invasive dentistry'[2]. Restorations without mechanical retention relies on the bonding effectiveness of adhesive materials, which do not require the removal of sound dental structure for additional mechanical retention [3]. Development of composite materials and adhesive systems lead to the use in prosthodontics fore mostly in adhesive cementation. Adhesive cementation, when defining is composite cement with use of bonding system. For better retention of restoration additional procedures need to be applied. That means etching of the restoration on surfaces that are connected to the cement or primers (silane) [4]. Restorations manufactured from lithium disilicate ceramics either by CAD/CAM systems or thermos-pressing systems etching with Hydrofluoric acid are necessary. That will create micro retentions on ceramic surfaces. Also, etching of tooth tissues, especially enamel with orthophosphoric acid must be obtained. That procedure will also create micro retentions on tooth surfaces, and will multiply the surface for adhesion, which is achieved with bonding systems [5,6] . For some types of adhesive cements, the bonding system is in the composite cement itself [7]. Such cements are called "all in one cement". Use of such systems is not time consuming, and the procedure itself is simple and user friendly. On other types of adhesive cements the bonding system is separated from the composite cement. Procedure with those types of cement is more time consuming, with more steps during cementation. Also, there are multiple possibilities for introducing failures into procedure because of more steps required during the cementation. Every step has its own procedure, and every procedure and step must be followed "by the Book". When using adhesive cements with separated bonding system, with additional treatment (etching) of the prepared tooth and the restoration, there is a stronger bonding strength between the tooth and cement system.

Clinical report

A 35-year-old male, who has been missing maxillary central left incisor, came to the dental office. He had a temporary tooth made out of acrylic material which is connected to adjacent teeth by fibers glass in a composite - Figure 1.

Fig. 1. Temporary tooth 21

The maxillary central right incisors and lateral left incisor were intact. The patient had normal habitual occlusion with normal overjet and overbite of the anterior teeth. The different treatment options were discussed with the patient: implant, classical bridges and bridge with palatal partial veneers. The patient was scared of drilling therefore, didn't want implant in his mouth. The classical bridge was not an option because adjacent teeth were intact. The only option left was a bridge with palatal partial veneers. Precisely because the preparation will not be able to have good mechanical retention (partial veneers) we need the best bonding system and perfect occlusion, in static position and during protrusive and left and right laterotrusive movements. The material of choice was lithium disilicate glass ceramics, because of their mechanical and optical (esthetic) characteristics. Because of lack of retention of partial veneers there was need for maximum retentive strength of cement, or strong bonding strength of cement system. So adhesive cementation, composite cement with separate bonding system and adhesive cementation technique will be needed.
In the maxillary area of central right incisors and lateral left incisors anesthesia was applied. Condensation silicone impression of the frontal upper teeth was taken and will be used for provisional restoration direct procedure. A retraction cord was placed in the gingival sulcus on the central right incisor and lateral left incisor. Retraction cord was placed only on the opposing surface of left lateral incisor, and right central incisor. The central right incisor and lateral left incisor were prepared with straight diamond abrasive with rounded tip. The preparation of the teeth was minimally invasive, preserving tooth structure, but achieving enough space for restoration. Only a small part of palatal surface was prepared. There were no incisal reductions of the teeth. The proximal preparation of the distal part of the right incisor and mesial part of the lateral left incisor encompassed the entire vestibulo-palatal proximal surface. All internal line and angles were rounded, and all surfaces were finished with fine diamond burs – Figure 2, Figure 3.

Fig. 2. Preparation of vestibular surface

Fig. 3. Preparation of palatal surface

Additional retraction cord, soaked with retraction liquid, thicker than first one was placed over the first cord in gingival sulcus. That will make gingival preparation line clearly visible, and that line will be better outlined on impression. Custom made metal rim lock impression tray was selected. Double step impression technique with putty/wash (extra light body) materials was used. VPEES, additional silicone with polyether was used. Before double step (wash) material, second retraction cord was removed - Figure 4.

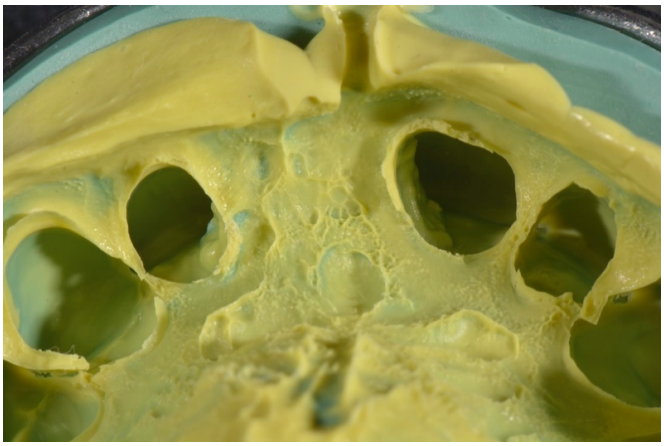

Fig. 4. Impression of the preparation

Impression of lower jaw was made out of silicone impression material by condensation type one step double impression technique.
Interocclusal position was obtained with silicone registration material – Figure 5.

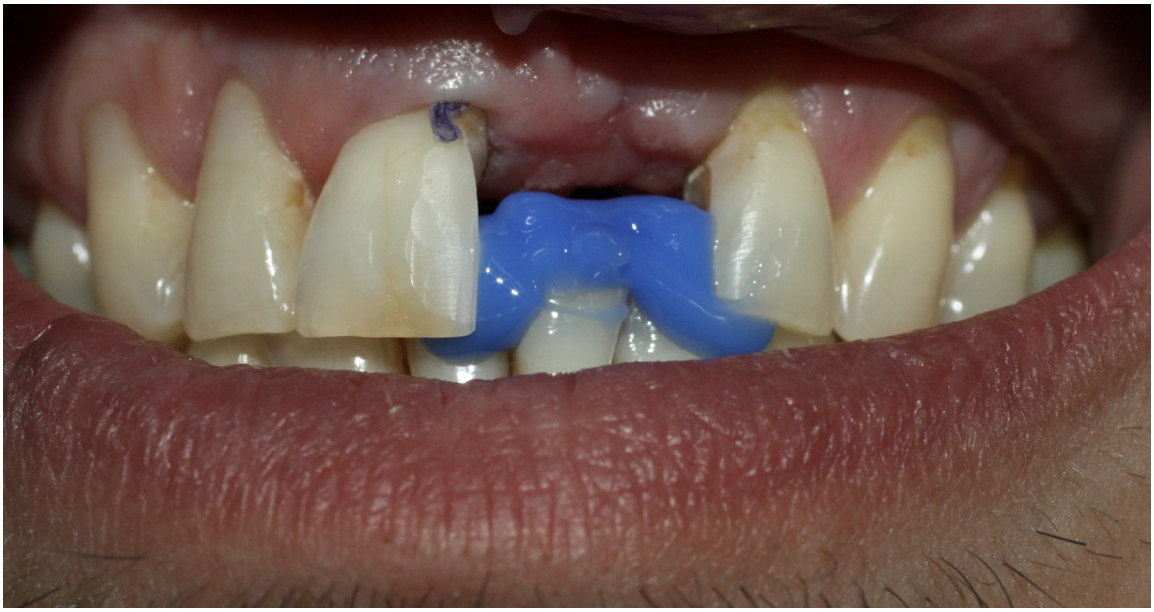

Fig. 5. Interocclusal registration

Provisional restoration was made out of acrylic material for crown and bridges manufacturing, using silicone impression taken before preparation of the teeth. Temporary cement, zinc oxide paste without eugenol was used, for provisional cementation of temporary restoration.

In dental laboratory, cast was poured from dental stone type IV. Preparation lines are clearly visible, and restoration was modeled in wax. Mainly from white modeling wax, because lost wax technique will be applied, and thermos-press procedure for all ceramic restoration. In such material use, no residual color from wax will affect final restoration. After pressing ceramic, object was relieved from excess, pouring canals, and was later trimmed to the wanted shape.
In dental office all ceramic restorations were checked for marginal fit, undercuts, overlaps and occlusal interferences.
Again, in dental lab final contours, characterizations and glaze were made.
Final check out in dental office, contained of appearance check out, occlusal control in maximal intercuspation, protrusive, left and right laterotrusive movements, patient approval and final look control.

Cementation of restoration has two steps. One step on the patient, and another step on restoration. Lithium disilicate all ceramic restoration that was etched with 9.5% Hydrofluoric acid for 1 minute. Also, etching of margins is essential - Figure 6.

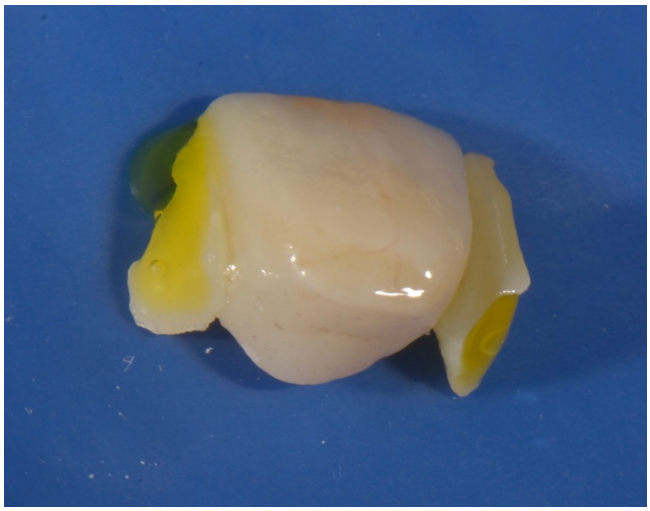

Fig. 6. Hydrofluoric acid 9,5%

After one minute of etching, acid is neutralized with ceramic powder. Ceramic powder must be rubbed into – Figure 7.

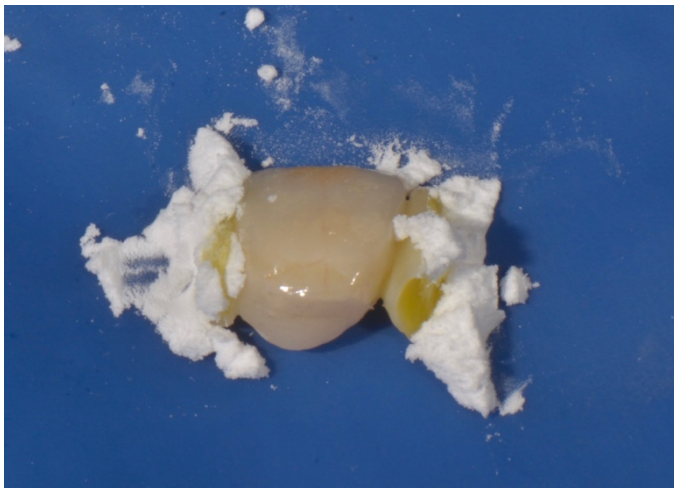

Fig. 7. Neutralization of Hydrofluoric acid with ceramic powder

After that, restoration was immersed into solution of water and the same ceramic powder used for initial deactivation of acid on all ceramic. All acid residua were rubbed down with small pellets usually used for bonding applications - Figure 8.

Fig 8. Removing Hydrofluoric acid with solution of water and ceramic powder

Then, restoration was washed under running water, while rubbing down all possible acid residue. Ceramic surfaces must be free of any yellow dots (residual acid), and dried out of any moisture - Figure 9.

Fig. 9. Washing restoration under running water

Additional etching with 37% Orthophosphoric acid through 60 seconds was applied. With additional etching, only loose particles of ceramic will be removed - Figure 10.

Fig.10. Orthophosphoric acid 37%

Acid must be removed under running water, also by rubbing with bonding appliers – Figure 11.

Fig.11. Removing Orthophosphoric acid under running water

Etched surfaces must be completely dry and should appear as matte. Layer of primer liquid was applied on etched surfaces, and was left to dry on air – Figure 12.

Fig. 12. Primer liquid

Dry operatory field is mandatory. So, rubber dam, whenever is possible must be used. In this case we use retraction cord in gingival sulcus, without the retraction liquid – Figure 13.

Fig. 13. Putting retraction cord in gingival sulcus

Meanwhile, teeth surface where contacts with restoration will be, need to be etched with 37% Orthophosphoric acid through 10 seconds – Figure 14.

Fig. 14. Etching enamel with 37% Orthophosphoric acid

Wash down any acid and completely dry with air. Tooth surface etched with acid must be matte and dim in sight. Bonding liquid, in this case with acid primer, mixed with dual cure activator, was then applied on prepared tooth surface. Bond must be 10 seconds on the tooth, without direct light on it - Figure 15.

Fig. 15. Applying bonding liquid with acid primer mixed with dual cure activator

Excess of bond must be dried out with maximal air pressure. Thin layer of dual cure cement, extruded from automix system is spread on etched and primed restoration surfaces. Additionally, thin layer of cement could be positioned on preparation margins of the teeth – Figures 16.

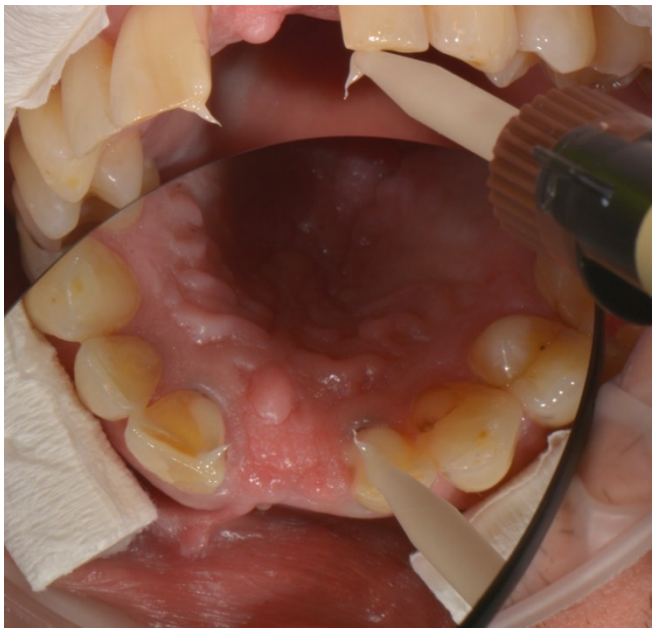

Fig. 16. Dual cure composite cement

Restoration is placed on the tooth, and excess of cement is brushed down with bonding appliers. Initial tac light cure, during two seconds was made. Possible excess of cement is removed with sharp instrument, scaler or similar one. After that light cure during 40 seconds on each surface of the restoration must be applied. After light curing, 5 minutes restoration must be in place without trimming or removing residual cement. After five minutes, retraction cord was removed, shaping, finishing and polishing it in an usual way for composite restorations to be done. During final shaping and polishing, additional occlusal checks must be performed – Figure 17, 18, 19.

Fig. 17. Final look

Fig. 18. Final look - lateral view

Fig.19. Final look - upper view

Conclusion

Using good planning, modern technology and following the sequence of clinical steps good functional and aesthetic result can be achieved. When using adhesive cements in which the bonding system is separated from the composite cement, with additional treatment of the prepared tooth and the restoration, there is a stronger connection made between the tooth and cement. Therefore, there is a greater possibility of a longer and more lasting restoration that benefits the patient. Since, adhesive cements have a wide range of applications, no single adhesive cement can be recommended for all clinical cases.

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DENTAL TREATMENT IN TRANSPLANT PATIENTS

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Abstract: *A better understanding of the immune system and development of immunosuppressive drugs has led to an increased number of successful transplants and, consequently, to an increase in the number of transplant patients in dental practices. Transplant patients should be approached as medically compromised because of oral complications that arise as a side effect of immunosuppressive therapy and weakened immune system. It is important for the doctor of dental medicine to be able to treat transplant patients after and before transplantation, to minimize the risk of complications. It is necessary to instruct the patient in proper oral hygiene, to heal the oral cavity before transplantation and to identify and treat complications if they occur after transplantation.*

Key words: *oral hygiene; oral manifestations; transplantation*

Introduction

The replacement of a dysfunctional kidney, liver, heart, or lung with a healthy organ transplant was one of the most important medical and scientific advances in the second half of the 20th century. This was made possible by a better understanding of the immune system and the development of immunosuppressive drugs that can prevent or delay organ rejection [1]. Hematopoietic stem cell transplantation is used to treat malignant hematologic diseases and autoimmune disorders [2,3]. Due to the frequency of transplants performed today, these patients are often found in dental offices [4]. However, patients who are preparing for transplantation or who have already undergone transplantation should be treated as medically compromised patients and therefore should be treated with special caution [1]. Patients with solid organ transplants receive strong immunosuppressive therapy, and some of them may also suffer from other systemic diseases, making their treatment challenging for any dentist [5].

The aim of this paper is to describe the most common oral complications in transplant patients and to summarize guidelines for dental treatment before and after transplantation.

Oral manifestations in transplanted patients

Oral manifestations in transplant patients occur as a result of immunosuppressive therapy and a weakened immune system in patients [6,7]. Complications of hematopoietic stem cell transplantation occur more frequently in allogeneic transplants than in autologous transplants [2,3,8]. The most common oral complications are infections, gingival hyperplasia as a side effect of medications, salivary gland dysfunction, and malignancies of the oral cavity [6,7]. Graft-versus-host disease, resulting from a immune response due to transplantation of immunocompetent cells from one individual to another immunodeficient individual [6], is also manifested by a number of oral manifestations belonging to a special group of complications [4,9].

Infections

Infections after transplantation can be of bacterial, viral and fungal origin. Signs of oral infection may go unnoticed due to a reduced inflammatory response or may be overemphasized, depending on the patient's level of immunosuppression and ability to establish an immune response [2,3,6,8]. Infections that occur after transplantation are categorized into three phases:

1. The first post-transplant month is characterized with fungal infections caused by *Candida spp.* and *herpes simplex* virus infections. The incidence of these infections was significantly reduced by prophylactic administration of antimicrobial drugs.
2. The period between the first and the sixth month after transplantation is characterized by the occurrence of new opportunistic infections such as *cytomegalovirus* infections, cryptococcosis, oral candidiasis, and recurrent herpetic stomatitis [6,8].
3. The third period occurs after the sixth month of transplantation. In this phase, the risk of infection varies depending on the course of the first two phases and the immunosuppressive status of the patient [6,10].

Herpes simplex virus (HSV) is the most common viral agent causing oral infections in transplant patients. Infections occur most frequently between the second and sixth week after transplantation [6]. In these patients, HSV causes a more severe clinical picture than in immunocompetent individuals [6,11]. Primary and recurrent oral HSV infections are characterized by multiple erythematous-based vesicles that rupture rapidly, leaving an ulcerated area [6,12]. Patients are recommended to take oral acyclovir prophylactically for one year. Treatment of active infection involves taking 400 mg of acyclovir three times daily. Foscarnet is prescribed for acyclovir-resistant virus and intravenous administration of acyclovir is prescribed for severe infections [6,8].

Epstein-Barr virus infection causes hairy leukoplakia in immunocompromised patients. It is described as a wrinkled white lesion that occurs most commonly on the lateral parts of the tongue but may affect other areas of the tongue as well. Treatment includes antiviral drugs and reduction of immunosuppression [6,13,14].

Cytomegalovirus (CMV) infection occurs in 30-75% of transplant recipients [6], although the incidence of the disease itself is lower, depending on the type of graft, immunosuppression, and CMV serostatus of both donor and recipient. Prophylactic intravenous administration of ganciclovir at a dose of 5 mg/kg once daily or oral administration of valacyclovir at a dose of 2 g 4 times daily is recommended [6,10].

The clinical forms of candidiasis described in transplant patients are erythematous candidiasis, angular cheilitis, and pseudomembranous candidiasis. *Candida albicans* has been proven to be the main cause of fungal infections in transplant patients [6]. Active infections are treated with fluconazole and itraconazole. Prophylactic use of fluconazole is recommended in patients with higher risk of fungal infection [6,10].

Gingival hyperplasia

Immunosuppressive drugs are used to prevent graft rejection. The most commonly used immunosuppressants are cyclosporine and tacrolimus, which can cause a number of side effects in addition to their primary function. The most common is gingival hyperplasia [3,6,7,15,16]. Cyclosporine affects gingival fibroblast proliferation and extracellular matrix accumulation [6,7,9,16]. The anterior areas of the maxilla and mandible, the interdental and marginal gingiva, are most affected [4,7,15]. Other side effects of cyclosporine include changes in renal and hepatic function, hypertension, slowed healing and severe bleeding [9]. Tacrolimus is given as a substitute for cyclosporine, although it also causes gingival hyperplasia, but to a lesser extent [4,7]. Side effects of tacrolimus mainly include oral ulceration, tingling and loss of sensation, especially in the oral cavity

[9]. Adequate oral hygiene may prevent or minimize gingival hyperplasia in some patients when it is not possible to change the immunosuppressant [4,6,7,9].

Salivary gland dysfunction

Salivary gland dysfunction can occur as a result of taking various medications, as a result of infection or fibrosis of the major and/or minor salivary glands [8,9]. Immunosuppressive and antimicrobial medications taken by transplant patients to prevent complications such as graft rejection and infection often result in hyposalivation [6]. Xerostomia also occurs as one of the symptoms of transplant disease, in which decreased glandular function leads to decreased salivary flow and production of viscous, mucous saliva that is poor in salivary immunoglobulins [4,6,8]. Such a condition promotes the development of caries and periodontal disease, but also affects the quality of life [1,8,17]. Therapy consists of fluid intake, artificial salivary preparations in the form of solutions, gels and sprays, as well as chewing sugar-free gums that promote salivary flow. In more severe cases, systemic therapy with sialogues may be prescribed. Pilocarpine at a dose of 5 mg, three times daily, is most commonly used [6,8].

Malignant disease of the oral cavity

Numerous studies have shown an increased risk of oral cavity malignancies after transplantation [4,17]. Epithelial dysplasia and lip cancer are the most common, but cases of squamous cell carcinoma, lymphoma, and Kaposi's sarcoma have also been reported [4]. The pathophysiologic processes contributing to the development of malignant lesions are thought to be multifactorial and may include suppression of the body's immune mechanisms against malignant cells and activation of oncogenic viruses [1].

Graft-versus-host disease

The "graft-versus-host" reaction is a multisystemic immune response following transplantation of immunocompetent donor cells into an immunodeficient host [6,18]. Depending on the clinical presentation, the reaction may be acute or chronic. In the acute phase, the most common oral manifestations are xerostomia, lichenoid reaction, erythema, atrophy and ulceration of the oral mucosa. Oral manifestations are more common in chronic graft-versus-host disease than in the acute phase [4,6,18]. Extensive erythema and ulceration, lichenoid reactions on the buccal mucosa and atrophic glossitis, as well as an increased incidence of oral cancer, are characteristic of the chronic reaction [4,18,19]. In addition, sclerosis of the perioral tissues, which leads to restricted mouth opening, making it difficult to eat [6,9,18,19].

Dental treatment – pre-transplantation period

Before treating a potential transplant recipient, a detailed medical and dental history should be taken, comprehensive noninvasive clinical examination should be performed and radiographs should be obtained. After the examination, it is advisable to consult with the patient's medical team regarding the current status of the immune system and general health [9]. The goal is to fully rehabilitate the oral cavity before transplantation, at least 3 days and ideally 14 days before transplantation [4,20]. The dental examination should focus on identifying and eliminating potential sources of infection, as their exacerbation could delay or jeopardize transplantation [1,3,20]. The main goals of dental treatment are to maintain good periodontal health, to eliminate caries in teeth with a favorable prognosis, including endodontic treatment, and to extract teeth with a poor prognosis. Teeth with a poor prognosis are any teeth with periodontal pockets larger than 5 mm, teeth with exposed furcations, or endoparodontal lesions. Teeth with existing periapical lesions and extensive deep caries

are considered to have an uncertain prognosis, so they must be extracted [4,5,17,21]. Partially erupted teeth with recurrent pericoronitis, such as third molars, should be extracted [22]. Orthodontic appliances should be removed before transplantation [5]. Treatment of peri-implantitis can be performed prior to transplantation if sufficient time is allowed for tissue healing. If this is not possible, treatment is postponed after transplantation until a stable phase [4]. Before proceeding with oral surgery, it is important to remember that these are patients in the terminal stages of organ failure who are likely to have weakened immune system and are taking various medications that could cause certain conditions in the oral cavity and interact with medications that the dentist might use during the procedure or prescribe for home use. The transplant team should be consulted regarding antibiotic prophylaxis, anticoagulant therapy, and other medications the patient is taking, as well as which antimicrobial medications should be prescribed in case of an active oral infection [5,9]. Antibiotic prophylaxis is recommended for all invasive dental procedures, such as tooth extractions or periodontal treatments, where there is a high risk of bacteremia. Although some authors advise against antibiotic prophylaxis in the period before transplantation, others recommend it when the leukocyte count is below 2000/mm3. It is recommended to take 2 grams of amoxicillin orally one hour before the procedure [20]. In case of penicillin allergy, 600 mg of clindamycin is recommended [5]. Patients receiving anticoagulant therapy before dental procedure should undergo laboratory testing of INR and PV and, depending on the results, decide in consultation with the physician whether the procedure can be performed or whether the anticoagulant therapy should be adjusted before procedure [5,9,23]. During the procedure patient should not be swallowing his or her own blood in order to avoid the risk of hepatic coma. Suturing techniques should be used to stabilize the clot [9,21]. Acetylsalicylic acid-based medications and other nonsteroid anti-inflammatory drugs should be avoided and the medication of choice for postoperative pain control should be acetaminophen [5,21]. In case of active oral infection, antimicrobial therapy should be started before surgery and continued after surgery to prevent systemic spread of infection. The oral infection must be completely eliminated before transplantation [9]. The patient's physician should be consulted regarding the choice of an antimicrobial drug because some of these drugs, such as azoles and tetracyclines, are excreted through the kidneys or liver [21-23]. It is crucial to inform and educate the patient about the importance of oral hygiene in order to minimize oral problems before, during, and after transplantation [5,21]. Proper oral hygiene includes brushing teeth with a soft brush two to three times daily and using interdental hygiene products [21]. Patients with poor oral hygiene or periodontal disease should use fluoride solutions or antiseptics such as chlorhexidine daily [5,21]. The patient should be advised to avoid alcohol-based mouthwashes as they dry out the mouth [21].

Dental treatment – post-transplantation period

The posttransplant period can be divided into an immediate phase, which is considered the first 6 months after transplantation, and a stable phase, which is a period after 6 months after transplantation in which there is no signs of organ rejection. The immediate phase is considered the most critical in the patient's life, as the risk of organ rejection and systemic complications is highest during this phase [4,5]. During this period, patients are exposed to the maximum dose of immunosuppressive therapy, which is why only emergency dental procedures should be performed exclusively in a hospital in consultation with a specialist [5]. Dental treatment in the office should be exclusively preventive and palliative, in order to prevent hyposalivation, xerostomia and infection [4,5]. Patients should be motivated and informed about oral hygiene and nutrition in the immediate period. In addition, orthodontic appliances should be removed and dentures should be adjusted [5,17]. Oral hygiene instructions are the same as in the pre-transplant period. Soft brushing, fluoride pastes and chlorhexidine-based rinses should be used [4]. The diet should be based on non-cariogenic, soft and not too spicy foods [4,5]. Some authors believe that a stable period after transplantation begins after the third month after organ transplantation [4,9], but still do not recommend dental procedures before the sixth month after transplantation [5,24]. During a stable period, all dental procedures can be performed, including root cleaning and polishing [24], restorative and endodontic treatments, and prosthetic treatments. Periodontal treatment should be performed in multiple sessions, treating a smaller number of teeth in each session [5]. Particular caution should be taken during invasive dental

procedures such as extraction or implant placement, where antibiotic prophylaxis should be administered as in the pre-transplant period [4,5], 2 g of amoxicillin or 600 mg of clindamycin in case of penicillin allergy [5,20]. It is necessary to perform hematologic laboratory tests before the procedure and apply hemostasis techniques, including suturing, during the procedure [4,5,23]. It should be borne in mind that transplant patients are still taking high doses of immunosuppressants. Therefore, they should be scheduled in the morning and try to keep the procedures as short as possible to avoid Addisonian crisis [5,22]. Local anesthesia can be used as in healthy individuals, but transplanted patients should rinse the oral cavity with chlorhexidine for one minute before each procedure. At each visit, the patient should be examined for oral lesions and malignancies associated with immunosuppressive therapy [5]. Non-steroidal anti-inflammatory drugs should be avoided, and acetaminophen should be recommended for pain control after surgery [21]. In case of organ rejection, only emergency dental procedures should be performed in a hospital with mandatory antibiotic prophylaxis [4,5,9].

Conclusion

The need for dental evaluation and treatment of patients prior to solid organ replacement or hematopoetic stem cells transplantation is likely to increase as transplant performance increases. Dental evaluation before transplantation should become mandatory in order to eliminate potential sources of infection and postoperative complications. Dental treatment of transplant patients should be significantly different from that of healthy patients, due to their severe, medically compromised health condition. The most serious complications are certainly uncontrolled infections and the risk of graft rejection. The guidelines for dental treatment of transplant patients should be strictly followed to identify and prevent complications in a timely manner.

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MYOFASCIAL PAIN DYSFUNCTIONS – CHALLENGES IN DIAGNOSTICS AND PROSTHODONTICS REHABILITATION

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***Abstract**: This pathology requires team work and a multidisciplinary approach, timely detection of causes and a meticulous selection of treatment procedures, particularly for management of orofacial pain, which can be very demanding in terms of differential diagnostics. In this article, a practical diagnostic of myofascial pain for use in everyday clinical practice is presented. The aim is to show the importance of the application of diagnostic protocols, which with auxiliary diagnostic methods represent a powerful tool in obtaining the correct diagnosis, and thus adequate therapy of these disorders. Using protocols in combination with diagnostic aids is the fastest way to make an accurate and timely diagnosis and minimize diagnostic errors. And the task of proper prosthetic rehabilitation is to remove potential sources which lead to functional imbalance in the area of masticatory muscles, trigger points and sources of stimulus for pain.*

***Key words:** myofascial pain, diagnostics, protocols, temporomandibular disorders*

Introduction

Myofascial pain dysfunctions (MPD) belong to a group of numerous, specific and complicated disorders that persist as isolated or associated within the syndrome with other painful conditions in the body. Myofascial pain (MFP) is one of the most common diagnoses related to chronic pain in the head and neck region, and therefore represents a specific and complicated challenge in everyday clinical practice. It represents a specific clinical manifestation of widespread forms of local muscle pain, which is characterized by the existence of trigger points (TP) and associated with numerous sensory, motor and autonomic phenomena [1]. TP are clearly demarcated local areas of strong and hypersensitive muscle fibers. They are a source of constant deep pain that can also cause a central excitatory effect. If TP centrally stimulates a group of convergent afferent interneurons, the most common consequence is the appearance of heterotopic pain in the form of tension headaches, but it can also be felt as ear pain, toothache or masticatory muscles pain. It happens very often that patients are not even aware of this because they mostly feel the pain projection. An experienced clinician should not be confused by that [2].

Therefore, qualitative and quantitative characteristics of pain, as the leading symptom (localization, moment of occurrence, duration, intensity, continuity, etc.) are essential for differential diagnosis and differentiation of MFP from other chronic pain conditions in the head and neck region. An incomplete understanding of the etiology of this condition is also a diagnostic challenge. However, some of the etiological factors are: systemic factors (increased muscle effort, fatigue, hypovitaminosis, poor psychophysical condition, viral infections ...), a source of ongoing deep pain, local factors affecting muscle activity, increased emotional stress and sleep disorders, as well as idiopathic mechanisms formation of TP [3].

Systematization of basic clinical diagnostic criteria would be that the pain is usually localized, unilateral and periodic, with the onset of heterotopic pain. The presence of pain in areas not affected by the disorder is the biggest problem for the patient, but also for the dentist who is trying to diagnose

the disorder. This is because during the anamnesis, the patient complains about secondary symptoms (headaches, etc.) and is often unaware of TP. In addition to pain, the central excitatory effect can be manifested as another symptom related to the nervous system: protective co-contraction, hypersensitivity of certain regions, vascular changes (paleness or redness of tissues), teary eyes or red conjunctiva. Since the fibers of the affected trigeminal nerve rarely cross the medial line, all symptoms are unilateral, which helps to make an accurate diagnosis. Pain is often felt on digital palpation of about 2 kg/cm² and intensifies while chewing. In our clinical practice, we usually notice a moderate restriction of mouth opening together with ipsilateral deflection, as well as tinnitus. The prevalence is in women aged 30 to 40 years, with often good prognoses [4]. Starting from TP in the surface layer m. massetera pain is transmitted to the upper and lower lateral teeth, jaw and face. This is where we often get anamnestic data on toothache. Differential diagnosis differs from real toothache because there is no suitable causative tooth, and the pain does not stop with the application of anesthesia. The deep part of this muscle projects pain to the ear and the preauricular region.

The most important differential diagnostic sign for distinguishing MFB from FM is the recognition and differentiation of TP and tender points pain. In the diagnosis of myofascial pain, active TP-s are localized, rarely symmetrical, in smaller numbers, in contrast to tender points in FM, which are symmetrical and distributed everywhere [5]. Also, the appearance of MFP in masticatory muscles occurs as part of temporomandibular disorders (TMD) [6]. In such case, we can talk about muscles dysfunctions, which are also the most common of all TMD.

Patients with diagnoses MFP need a comprehensive, multidisciplinary diagnostic evaluation. There has been continuous scientific development in this area in recent decades, which inevitably encourages the progress and improvement of clinical research protocols. Within numerous more or less successful diagnostic-classification systems, the most precise and comprehensive one is also the most frequently applied of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) protocol [7]. Inaccurate diagnosis, lack of a universally accepted classification system, and the use of different inclusive criteria to define similar subgroups in different taxonomic systems, result in confusion and inability to compare existing observations and research results. These are just some of the obstacles to dissemination of knowledge and insights about MFP.

The RDC/TMD protocol is designed as a dual diagnostic system, which is based on a complex interaction of physical symptoms and assessment of the psychological status of people with chronic pain. It is accepted as an instrument in scientific research and routine clinical practice. It is indisputable in the examination of disorders in which standardization of the diagnostic procedure is necessary. Today, there is a need for its dynamic development in various aspects [8]. That is why a multi-year reliability testing project has been launched, led by a group of eminent experts in this field. Their aim is to revise the original Dworkin protocol, i.e. to explore ways to fully understand MFP and TMD, to develop identical diagnostic systems for TMD, and finally, with the revision of this protocol, to enable its general implementation into routine clinical practice.

A review of the contemporary literature reveals data that indicate that occlusal parameters are small or almost insignificant factors in the etiology of MFP [9]. Differences in the results in relation to previous works, which considered this connection a golden rule, can be explained by the fact that pre-interocclusal contacts were registered only after the identification of some symptoms of dysfunction. However, the methods of diagnosing the symptoms were different, so it was almost impossible to compare the results correctly. Today, there are modern computer systems for the registration of occlusal contacts. People with MFP have a greater number of inadequate contacts than people without pain (healthy ones), so therapy is actually aimed at eliminating dysfunction and reducing pain. The future of diagnostics also lies in the application of biomarkers, which can be molecular, biomarkers for neuro-imaging and sensory biomarkers, as well as those that are closely specific to MFP [10].

Timely and correct diagnosis is essential for adequate therapy. The chellenges in diagnostics of such specific disorders are that doctors of various specializations have to work in a team in order to

determine the accurate therapy. Otherwise, a patient has to wander from one specialist to another asking for help. In addition to the need to improve unique and generally accepted diagnostic protocols, it is necessary to form expert teams. This would enable the improvement of diagnostic and therapeutic multidisciplinary cooperation, which is crucial for this type of pathophysiology, with special emphasis on the development of preventive measures in the field of orofacial MFP. The role of the specialist in prosthetics is extremely important, because he is often the one who diagnoses this disorder. Prosthetic rehabilitation should be performed within an individual therapeutic protocol. The therapy should combine symptomatic and etiological approach, primarily the elimination of pain and all factors which indicate, accelerate or worsen it. The application of irreversible splint therapy for various purposes, depending on the disorder, finds its place here. The use of pharmacological and physical therapy is also the right approach. And only then is the reconstruction of occlusal contacts approached and the establishment of functionally optimal occlusion. The development of new prosthetic restorations completes the rehabilitation of the orofacial system and the reconstruction of the intermaxillary relations. Due to the specifics of these disorders, behavioural or even psychological therapy is often necessary.

The aim is to show the importance of the application of identical diagnostic protocols, which with auxiliary diagnostic methods represent a powerful tool in obtaining the correct diagnosis, and thus adequate therapy of these disorders.

Case report:

A 50-year-old patient reported to the Dental Clinic of Vojvodina due to long-term and severe pain in the area of the right masseter muscle. The pain also increases with function, headaches and grinding of teeth are common. The patient states that her quality of life and ability to work are getting worse. A protocol for the diagnosis of chronic pain was applied. The patient had a comprehensive history of the disease and was treated for 2 years, mostly with pharmacotherapy. The further protocol included taking anamnesis, anamnesis of pain and clinical examination according to the principles of functional analysis of the orofacial system. On palpation, TT was observed on the body m. massetera. Pain values 8 were obtained with the VAS scale and verified by algometric measurement of 2.44 kg/cm² [11]. Evaluation of occlusal contacts by classical methods showed premature contacts during laterotrusive movements on the left side. She was diagnosed with MFP using the RDC/TMD protocol. Induction of a relaxation splint (relax masticatory muscles), removal of premature contacts, prevention of the consequences of bruxism, stabilise the position of the mandibule, elimination of stressful situations (relaxation techniques) and biopsychosocial therapy in combination with physiotherapy are indicated.

Conclusion

There are many challenges in diagnostics MFP. Using protocols in combination with diagnostic aids (algometry, VAS, etc.) is the fastest way to make an accurate and timely diagnosis and minimize diagnostic errors. And the task of proper prosthetic rehabilitation is to remove potential sources which lead to functional imbalance in the area of masticatory muscles, trigger points and sources of stimuli for pain.

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KNOWLEDGE AND BELIEFS REGARDING TEMPOROMANDIBULAR DISORDERS IN ORTHODONTIC PATIENTS: HAS ANYTHING CHANGED?

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Abstract: *Malocclusions have been widely investigated for presence of dysfunctional changes in the temporomandibular joint and masticatory muscles, known as temporomandibular disorders (TMD). The interest primarily originated in early belief that occlusal instability is the basis for the development of TMD. Thus, the treatment of dysfunction was oriented towards correction of the occlusion, including orthodontic treatment. The presentation will include discussion on whether patients with malocclusions are at higher risk of developing TMD, should orthodontic therapy be considered as a treatment modality or even risk factor for TMD, and what would be the treatment options for orthodontic patients regarding TMD.*

Keywords*: temporomandibular disorders, occlusion, orthodontic treatment*

Introduction: What are temporomandibular disorders and who gets them?

These complex functional disorders referred to as craniomandibular disorders (CMD) or temporomandibular disorders (TMD) include a number of clinical conditions which affect masticatory muscles, temporomandibular joint (TMJ) and surrounding structures. [1] Typically, TMD are characterized by the presence of two or more of the following signs and symptoms: pain or discomfort in the jaw area, limited jaw functions, and sounds in the TMJ. According to epidemiological studies, TMD affects about 15% of adults and 7% of adolescents. Despite the relatively high prevalence, only 3-7% of general population seeks treatment for TMD. Signs and symptoms of dysfunction increase across age and peak among 20 to 40-year olds. There are no gender differences in children, but among adults the sex ratio is approximately 2:1 (women: men) in general population, and 4:1 among TMD patients. [2]

TMDs are the most common non-odontogenic painful conditions of the orofacial region. Painful symptoms are the main reason why patients with TMD seek medical help. Temporomandibular pain was present in 5-6% of subjects in the general population and among 97% of patients referring to TMD treatment. The frequency of temporomandibular pain is higher in women than in men, and this difference increases in the reproductive age. Patients describe the presence of pain in the preauricular region, TMJ and / or masticatory muscles, which is usually enhanced by manipulation or function. [2] In a certain percentage of patients, temporomandibular pain becomes chronic through insufficiently elucidated mechanisms. Chronic pain is defined as pain that lasts longer than the time required for physiological healing, and is usually considered to be a period of three months. Chronic temporomandibular pain is a special health and social problem due to difficult therapy, and a proven impact on the psychological status, change of work activities and social life of patients.

Having in mind the variety of signs and symptoms of dysfunction, as well as the multifactorial etiology of these diseases, when diagnosing TMD, it is necessary to classify existing changes into appropriate diagnostic groups. In general, TMD are divided into articular, which include TMJ structures, and muscular, which involve masticatory and other muscles in the orofacial region. [1]

(Modern systematization of TMD classifies existing changes in relation to the signs, symptoms and etiology of dysfunction, and includes 4 groups of diseases, 13 basic subtypes and a total of 36 diagnoses. Studies conducted in recent years have been mainly based on the diagnostic tools that contain precise criteria for setting the several most common types of TMD: myofascial pain, disc dislocation, degenerative and inflammatory joint diseases, TMJ subluxation, and headache attributed to TMD.

TMD are acknowledged to be multifactorial in origin and factors that have been mentioned behind TMD are trauma to the masticatory system, metabolic conditions, genetics, psychosocial, and structural factors. [3]

TMD and malocclusions: Are patients with malocclusions at higher risk for TMD than controls?

Patients with malocclusions have been widely investigated for presence of dysfunctional changes in the TMJ and masticatory muscles. The interest primarily originated in early etiological concept according to which the onset of TMD had been associated with occlusal instability and skeletal discrepancy. Various mechanisms have been proposed, including the complex aspects of loading in the TMJ and muscle hyperactivity.

A number of extensive review papers and clinical studies have been published on the possible etiological role of various malocclusions (including excessive overbite or overjet, open bite, unilateral posterior crossbite, centric slides, etc) regarding TMD. Earlier findings were incosistent, as presence, absence of association, or only a weak relation was observed between certain malocclusions and TMD symptoms. [4,5] Data regarding prevalence of TMD among patients with malocclusions vary, with an average of about 20%. More recent studies report similar prevalence of malocclusion features in TMD and general population. The exeptions however, might be interferences during dynamic occlusion. Namely, mediotrusive interferences and slide between retruded contact position and intercuspal position (RCP-ICP) $\geq$2 mm were found to be more prevalent in TMD patients. It has been suggested that these dynamic interferences that are related to dental instability may potentialy lead to the instability in TMJ. [6]

In addition, there is no general agreement on the type of malocclusion considered to be causal in the etiology of TMD and no significant pattern of TMD symptoms for any specific malocclusion was reported. [6]. It could be concluded that presence of malocclusions does not necessarily lead to TMD and that occlusal factors present only a part of the total mosaic of multifactorial etiology in TMD.

Orthodontic therapy: should it be considered as a treatment modality for TMD?

With the assumption that instable occlusion presents the main cause of the TMJ and muscle dysfunction, the treatment of TMD was oriented towards reconstruction of the patients' occlusal stability. The proposed modalities of occlusal treatment included occlusal adjustment, prosthodontic reconstruction or orthodontics. Many generations of dentist have been taught that any aberration from the concept of ideal occlusion is detrimental and thus should be corrected. Therefore, correction of malocclusion has traditionally been recommended not only to improve facial esthetics but also to rehabilitate the function and possibly reduce TMD symptoms [6]. However, during orthodontic treatment various degrees of improvement, deterioration, or no change in TMD symptoms have been observed.

Malocclusions are common (60-90%), while prevalence of treatment demanding TMD is comparably low, about 10% in adult population. Therefore, there is a huge population of those with untreated malocclusions that are free from TMD symptoms. Besides, there is no evidence that support use of orthodontic treatment in prevention or treatment of TMD. [5] Based on these facts, orthodontic

treatment in adults should not be undertaken in order to prevent or to treat TMD, [3,5] but for esthetic, psychosocial [7], or dento-periodontal reasons. In addition, orthodontic therapy might be indicated to stabilize the occlusion after pain and dysfunction subside. [7]

Does orthodontic treatment increase the risk of TMD?

Of the known etiological factors of TMD, orthodontic typically affects occlusion. It has been reported that in some patients that were asymptomatic regarding TMD before, signs and symptoms of dysfunction developed during the orthodontic treatment. The transitional occlusal interferences, posterior condylar displacement, or lack of canine guidance have been suggested to have a role. [4] However, this has not been well documented in the literature. The interest of the dentist community for orthodontics-TMD relationship increased after a patient, claiming that orthodontic treatment caused her to suffer from TMD, won the lawsuit, so the specialty started to investigate this relationship. Although there was no clear evidence that orthodontic treatment might be a risk factor for the development of TMD, the relationship is not that simple. [8] According to current knowledge, various orthodontic treatments such those involving extractions, headgear, inter-arch elastics, chin cups, etc. do not necessarily cause the posterior positioning of the condyles nor do they necessarily predispose patients to TMD. [4] The importance of providing stable occlusion in harmony with stable joint position after orthodontic treatment in order to minimize a dental risk factor has been suggested [8] or denied. [4] It has been suggested that the patient's inability to adapt to change, poor-controlled orthodontic therapy, genetically determined pain susceptibility or presence of other TMD-related factors, may be responsible for development of TMD during orthodontic treatment. [5,8] Regarding the last, TMD among patients who underwent orthodontic treatment has been associated with psychosocial well-being as well as neuroticism and self-esteem measures. Signs and symptoms of TMD may also appear independently of the orthodontic treatment, as TMD normally fluctuate over time without predictable pattern. In conclusion, there are no data which supports association between active orthodontic intervention and presence of TMD, [5] so patients who have undergone orthodontic treatment have no higher risk to develop TMD.

What would be treatment protocol for orthodontic patients with TMD?

According to the British Orthodontic Society, every patient referring for orthodontic treatment should be assessed for presence of TMD signs and symptoms. [9] In case of positive findings or history, patient should be screened for the biopsychosocial characteristics (including pain intensity, pain-related disability, other pain disorders and psychosocial disturbances) and evaluated for the presence of oral parafunctional activities. [4] Patient should be informed about the etiology, nature and treatment of the dysfunction. [9]
If orthodontic treatment is recommended, the patient should be aware that this not to prevent or treat TMD, but to correct the malocclusion, and that TMD symptoms may improve, get worse or do not change at all, regardless of treatment. In case TMD symptoms develop during the orthodontic therapy, treatment should not be interrupted, but slowed or paused. [7] Spontaneous resolution might be possible, and various treatment modalities might be offered, starting with simple measures such as jaw rest, limited strain to the pain specialist referral. This may be problematic, as specialists are generally scarce. [9]

Conclusion

Presence of malocclusions does not necessarily lead to TMD. Orthodontic therapy should not be undertaken in order to prevent or to treat TMD. Also, patients who have undergone orthodontic treatment have no higher risk to develop TMD. Other factors, including micro-trauma, psychosocial, and genetic variables may play a role in the pathophysiology of TMD in these patients. Regarding

presence of TMD in orthodontic patients, therapist should adhere to the guidelines and refer patients to a pain/TMD specialist if necessary.

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SEALING ABILITY OF CONTEMPORARY ENDODONTIC CEMENTS

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Abstract: *The most common cause of failure of endodontic therapy is apical leakage, which most often allows the progression of microorganisms due to incomplete canal obturation. Endodontic sealers are responsible for filling imperfections in the prepared canals, eliminating the remaining bacteria, and sealing the canal system. Endodontic cements that have the ability to penetrate the dentinal tubules may have exhibit a potential antibacterial capacity and thus further affect the number of bacteria remaining. Currently, there is a large number of different endodontic sealers available. There is a huge dilemma present while deciding which endodontic cement and which obturation techniques to employ when treating patients clinically.*

Key words: *Endodontic sealers, Root Canal Therapy, Dental leakage*

Introduction

Difficulties in endodontic dental treatment and inaccessibility of this region represent a major issue in dental practice. The outcome of endodontic therapy is successful only if microorganisms are fully eliminated by thorough cleaning and shaping the canals. Additionally, the canals have to be obturated using biocompatible, impermeable and dimensionally stable materials so as to prevent any contact between oral cavity and periodontium.

In both restorative dentistry and endodontic treatments microleakage poses a serious problem. More than 50% of failed endodontic treatments occur because of the incomplete obturation of the root canal space. Various clinical studies dealing with the causes of unsuccessful treatments support the idea that inadequate obturation is indeed the leading reason behind the failed endodontic treatments. *In vitro* studies prove that inadequate obturation causes microleakage. [1-3]

Currently, there is a large number of different endodontic sealers available. With the intention of improving the characteristics of the sealer content, various features have been added, namely those to enhance fluidity or bond strength durability. However, it is necessary to state that endodontic cement alone is never sufficient in root canals obturation. Gutta-percha, with its properties and the applied root canal placement techniques, should be used in agreement with endodontic cement and its characteristics. There is a huge dilemma present while deciding which endodontic cement and which obturation techniques to employ when treating patients clinically. The unfilled void occurring inbetween obturation materials and dentine is the trigger for apical leakage in root canals. Together with different types of endodontic cement, root canal obturation techniques are crucially important, whether they are performed using cold gutta-percha or warmed gutta-percha.

The definition of microleakage is any flow of fluids, protein and bacteria from the root canal, which subsequently results in clinical markers of treatment failure, easily determined radiographically. Many research papers have dealt with comparing obturation materials and techniques, with the aim of discovering the ideal approach for sealing apical foramen. Diverse techniques have been studies, namely, using radioisotopes, bacterial penetration and colour penetration, so as to establish the integrity of apical zones fillers. These studies have concluded that researching apical leakage of various particles as well as the void between root canal fillings and root canal walls provide the suitable method for measuring the quality of obturation. .[4-6]

The aim of this research is to determine the quality of sealing properties, through the microbal microleakage test, while applying the following root canal system obturation techniques: single-cone obturation and Thermafill, combined with three types of sealers – calcium silicate based bioceramic cement, *Endosequence BC Sealer* (*Brasseler, Savannah,GA, USA*), the conventional endodontic cement, or epoxy bisphenol resin based *AH plus* (*DeTrey/Dentsply, Konstanz, Germany*), and, calcium hydroxide *Acroseal* (*Septodont, France*).

Materials and methods

For the purposes of this research, we have used vital human single-rooted teeth. The fair use of the above mentioned teeth for scientific experimental purposes has been officially approved by The Ethics Committee of Dentistry Clinic of Vojvodina and The Professional Ethics Board of Faculty of Medicine, University of Novi Sad.

Criteria for teeth selection

The teeth used were vital human single-rooted teeth, extracted due to orthodontic or paradonthologic reasons, fully formed human single-rooted teeth with a completely developed root. There were a total of 66 human single-rooted teeth used. Prior to the start of the experiment, samples were submerged in 5.25% sodium-hypochlorite (NaOCI) solution for the duration of 30 minutes, and then manually cleaned from any remaining soft tissues present on the surface. The following step was creating access opening with a high-speed dental drill with water cooling system working at 300000 rpm (W&H Dentalwerk, Burmos, Austria), a carbide round bur #4 and a cone fissure bur from the set EndoAccessKitt (DentsplySirona,Ballaigues,Switzerland).

Preparation and obturation

The working length was determined C+files #10 instrument by measuring its length to the very tip which reached the apical foramen and subtracting it by 0.5 ml . The root canals were further prepared by using the 'crown down' technique, with ProTaper instruments in full rotation, following the sequences X1, X2 and X3 (ProTaper Next,Dentsply Sirona, Ballaigues, Switzerland).

The root canals were readied by using endodontic motor and contra angle reduction handpiece (16:1) X-Smart Plus (Dentsply Sirona, Ballaigues, Switzerland) at the speed of 300 rpm and the rotation momentum control as recommended by the manufacturer. After the use of each individual instrument, canals were rinsed with 2 ml of 5.25% sodium hypochlorite (NaOCI) solution applied by a plastic syringe with an endodontic irrigation needle (Micro-top applicators,Cerkamed, Poland). Furthermore, Glyde (Dentsply Sirona, Ballaigues, Switzerland) was used as a lubricant.

Specimens was randomly divided into two groups on the basis of obturation techniques applied and also into three groups on the basis of the specific type of cement tested. Ultimately, the sample was composed of 6 groups each containing 10 teeth. The teeth with crowns intact (n=3) were the negative control group, whereas the samples obturated with gutta-percha only (n=3) were the positive control group.

In the course of the research, three different sealers were tested: AH Plus (Jet system, Dentsply DeTrey GmbH, Konstanz, Germany), Acroseal (Septodont, France) and BC sealer (Brasseler, Savanah, GA, USA).

Microbal microleakage test

In order to prove apical microleakage the two-chamber model was used, originally described by Torabinejad . With the aim of proving microleakage, E. faecalis ATCC 29212 bacterial strain was used. The samples were placed in 20-ml scintillation vials, in such a way that a coronal part of a tooth remains outside the bottle (in the upper chamber) and a root area stays

in aseptic broth culture – Tripticase Soy Broth, containing Streptomycin (in the lower chamber) that prevents the contamination of nutrient broth with other types of bacteria during the research. Teeth were individually placed in pre-prepared bottle caps, which were drilled with a high-speed handpiece to create a suitable circular opening. Following the placement of teeth, samples were secured using blue wax. Apical part of each tooth (3 millimeters) was submerged in growth medium, with hard dental tissue not touching the vial walls (Image 1).

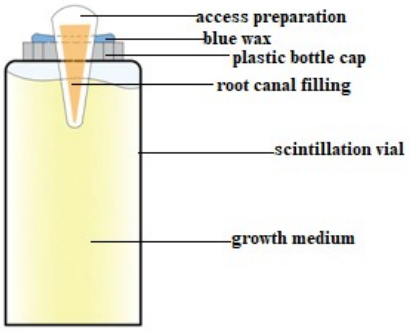

Fig. 1. – ***Schematic representation of two- chamber model***

Results

The positive result of microleakage was determined visually, since the turbidity of growth medium was visible to the naked eye.

In the positive control group, microleakage occurred within 24 hours from the start of the experiment. In contrast, in the negative control group, there was no microleakage until the end of the experiment. The research results show that, within the both groups tested, and regarding the obturation technique employed, nutrient broth became turbid. The microleakage was first noted on the 14th day since the onset of the experiment, with the two samples obturated using Single-cone technique and with the single sample in the group obturated using Thermafill technique. The greatest recorded number of growth medium turbidity happened on the 23rd day, with the four samples in Single-cone technique group and with the six samples in Thermafill technique group. In total, on the 23rd day, there were ten new turbid cases, that is, ten new clouding instances from the overall number .

Looking at the 10 samples obturated with the *BC sealer* cement and exposed to the Single-cone technique, 7 samples (70%) display microleakage. Furthermore, turbidity was registered in 6 samples (60%) of those treated with the Thermafill techique, which is insignificantly less that the previously described 7 samples.

The research results clearly show that *AH plus* cement has better sealing properties when it comes to the root canals, since out of 10 samples only 3 (30%) display microleakage in the Single-cone obturation technique group. By applying heated gutta-percha on rigid carrier technique, alongside the use of *AH plus* cement, the percentage of failure, that is microleakage, is 40%.

Out of 10 samples obturated with *Acroseal* cement used with the Single-cone technique 50%, or 5 samples, show signs of microleakage. When Thermafill technique is applied, that percentage is 60% of all samples.

The results collected testify that microleakage did happen in huge percentages, that is, in 31 samples or 51.66% of cases. Less than half of all the samples (29 samples) remain intact.

The experiment shows that the least number of microleakage instances occurs with the use of *AH plus* cement. Namely, it occurs in 11,66% of the total number of samples. Ranked on the basis of their sealing properties, the second most successful sealer is *Acroseal* cement with 11 (18.33%) failed obturations, and the worst sealer tested is *BC siler* with the rate of failure of 21%. Observing the results reached after the use of Thermafill obturation technique and different types of cements, it becomes clear that the application of *AH plus* cement leads to the lowest number of microleakage

instances (13.33%). In contrast, the application of *BC sealer* and *Acroseal* result in 20% of microleakage cases each.Regardless of the fact that *AH plus* cement provides the best result when combined with any of the obturations techniques employed, differences are minor and statistically irrelevant. As the P-value of χ^2 is 0.585 > 0.05(χ^2 = 1.071), there are no statistically significant differences in the turbidity of samples based on the Thermafill technique.

Discussion

This *in vitro* research was done with the purpose of analyzing the sealing properties of two obturation techniques and conventional, commonly found and widely used endodontic cements, as well as the latest sealers. The mission of our research study is to identify the best possible sealer and obturation technique pairing, thus guiding the clinicians and easing the endodontic therapy planning.

The experimental protocol used was developed in accordance with previously utilized research models, primarily those for testing sealing properties of endodontic sealers.

Studies on the issue list several methodologies suitable for performing microleakage tests: the apical dye penetration method, the bacterial microleakage test, the glucose penetration model, the protein microleakage test and the three-dimensional method. The great number of research studies which used the bacterial microleakage test show how efficient and precise it is. Furthermore, the bacterial microleakage test is clinically significant and biologically relevant, thus, it is the test utilized in this research. The microbal microleakage test using dual chambers system, employed in this research, was originally described by *Torabinejad* in 1990. [7]

Enterococcus faecalis is described as opportunistic pathogen bacteria which migrates from its typical habitat found in oral cavity to a tooth root canal, seizing the advantages gained by ecological changes in root canal area and beating other competitive microorganism that got eliminated by endodontic treatment. Bacteria *Enterococcus faecalis* is rarely present within primary infected root canals, however, in the cases of acute apical periodontitis, the presence of this bacteria varies from 20% up to 90%, according to various studies by multiple authors. *Enterococcus faecalis* is resistant to most intracanal medicaments. Due to its ability to regulate the internal pH values using its proton pump, it has been proven that this bacteria can survive pH value of 11.5, which renders any calcium hydroxide-based mixtures useless.[8]

The microleakage test was considered positive if there was turbidity present in the lower chamber. Also, a positive result was only a new instance of cloudiness. Taking into account that our research dealt only with presence or absence of cloudiness within the substrate, it belongs to qualitative research methods.

The most common root canal obturation technique is the Single-cone technique. It is a fast technique which can be performed easily, by applying gutta-percha cones which morphologically and dimensionally correspond to nickel-titanium rotary dental instruments, thus ensuring the precision and efficiency of treatment.

The research results presented in this paper show that there are no statistically significant differences in the microleakage test between the Single-cone technique and the Thermafill technique.

This study, which largely corresponds to ours, reinforces our results, that is, it confirms that there are no statistically relevant differences between the Single-cone technique and Thermafill obturation technique when *AH plus* sealer is used.

The combination of Single-cone technique and *AH plus* sealert research by *daSilva* statistically displays significantly better sealing properties than the other cements tested. Similarly, our results show that the Single-cone technique combined with *AH plus* sealer guarantees the least percentage of microleakage. This paper shows that *AH plus* sealer performed better in root canals sealing since, in the Single-cone obturation technique group, only 3 out of 10 samples (30%) displayed microleakage.[]

Conclusion

In conclusion, upon analyzing all the presented results, it is clear that different obturation tachniques give similar results regarding microleakage. The appearance of microleakage is unavoidable regardless of the obturation technique applied.

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BURNING MOUTH SYNDROME- ALTERNATIVE THERAPEUTIC APPROACHES

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Abstract

Despite the numerous investigations, burning mouth syndrome (BMS) is still enigmatic condition which frustrates both clinicians and patients and is characterized by burning in the oral cavity, mostly on the tongue. Burning mouth syndrome is thaught to be caused by peripheral and/or central neuropathic disturbances. As seen in other neuropathic conditions within oral cavity, so far available therapeutic possibilities are not sufficient in some patients with BMS, therefore need for alternative therapies is searched.

Keywords: *burning mouth syndrome, stomatopyrosis, stomatodynia, therapeutic approach*

HABITS RELATED TO ORAL HEALTH OF REFUGEES AND MIGRANTS IN SERBIA

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Abstract: *The effects of the migratory process can be noticed as changes in social determinants of health. Having in mind that refugees and migrants face great challenges such as lack of access to medical and dental treatment, poor health education, economic difficulties and much more, public healthcare system should focus on refugees and migrants as an at risk population and make a specialized strategy for them. Providing information about oral health habits, attitudes and behavior towards oral health can indicate in which way public healthcare can contribute to oral health preservation and improvement among refugees and migrants in Serbia.*

Key words: *oral health, migrant crisis, public health, preventive dentistry*

Introduction

Since the peak of the migration crisis in 2015, like many European countries, Serbia was struck with hundreds of thousands of refugees and migrants traveling through European borders. [1] The United Nations High Commissioner for Refugees (UNHCR) stated that there were 30,216 newly arrived asylum seekers and migrants in Serbia in the year 2019. The same year, the number of arrivals of unaccompanied/separated children was almost twice higher than the year before, with a total of 3777 children. Majority of the asylum seekers and migrants were men (76%), and much less women (18%) and children (6%). When talking about nationalities, 51% of them came from Afghanistan, 13% Syria, 7% Pakistan, 6% Bangladesh, 6% Iran, 6% Iraq and 11% other. [2]

The effects of the migratory process can be noticed as changes in social determinants of health, lack of access to healthcare, interrupted care, poor living conditions, or other. This means general health could be at jeopardy. Healthcare systems and healthcare providers are the ones put to the test when this happens. Knowing that oral health is one of the key indicators of general health, well-being and quality of life, we should thoroughly examine the impact of oral health habits in order to preserve and improve oral health among migrants and refugees. [3] The aim of this paper is to provide information about oral health habits, attitudes and behavior towards oral health and indicate in which way public healthcare can contribute to oral health preservation and improvement among refugees and migrants in Serbia.

In the year 2019, 14 reception centers and 6 centers for asylum were at disposal for refugees and migrants across Serbia. Total capacity of all available migrant centers is approximately 5890. [4] European Union Agency for Fundamental Rights (FRA) report from May 2017 states that majority of refugees and migrants in European Union (EU) countries have only primary school degree. [5] UNHCR statistics show that 91% of the world's children attend primary school, whereas 61% of refugee children have the same chance. Serbia followed other European countries and provides children with primary school education. [6] Financial aspect is an ongoing issue when dental healthcare comes to mind. Serbian public dental clinics do not charge only for emergencies, such as trauma, swelling and dental complications directly impacting oral health. This means all other cases are obligated to pay for dental treatment. Not being able to afford dental treatment might lead to deterioration of oral health and later on to a state of a dental emergency. This could all be avoided by

introducing adequate preventive measures. Various studies conclude that preventive measures are crucial when aiming to preserve good health among migrants and refugees. [7]

Drinking alcohol among refugees and migrants in Serbia is infrequent. Only 13.3% of migrants and refugees stated they do consume alcohol, whereas findings from a research from year 2006 show 31.6% of adults in Serbia consumed alcohol 30 days prior to participating in the research. [8] Alcohol consumption is uncommon among refugees and migrants in Belgrade. This can be explained by most of them originating from Muslim countries where alcohol consumption is forbidden. A study conducted in Germany found a strong correlation between alcohol consumption and maximal pocket depth. Furthermore, smoking and maximal periodontal pocket depth were significantly associated. [9] The data obtained in the year 2019. shows 48% of refugees and migrants consume tobacco. Unfortunately, research conducted by the Institute of Public Health of Serbia in 2016 affirms that many adults in Serbia share the same bad habit (38%). [10] Consuming tobacco, smoking especially, is known to increase the risk of: periodontal disease, bad breath, tooth discoloration, delayed healing of intraoral wounds, different types of oral carcinoma and many more. [11] People that consume tobacco are prone to having various oral health issues and should therefore be prioritized as at high risk. A public health strategy could be effective in educating and early screening of both tobacco and alcohol consumers.

Nutrition is a key factor of general health. Malnutrition and vitamin D deficiency especially, have been identified among migrant children in northern parts of the WHO European Region. [12] Findings obtained show that more than one third of the participants consume sweets on a daily basis (Table 1.). Various studies have shown side effects of sweetened juices on oral health. [13] Most common effect of a high consumption of added sugars on oral health is a greater prevalence of dental caries, but also of periodontal disease. Both dental caries and periodontal disease are a major public health problem globally and are a widespread non-communicable disease. Addressing these health issues and preventing them is of high importance. With a significance of male migrants and refugees drinking sweetened juices, the findings obtained in Serbia concur with a study from Udaipur. [14] Almost half of the migrants and refugees staying in migrant centers in Serbia stated they consume fruits daily. These results are higher than in a study conducted in Lithuania, but lower than the European Union average fruit intake. [15,16] Malnutrition can intensify the severity of oral infections and may lead to their evolution into life threatening diseases. [17] Public healthcare should address refugees and migrants suffering either from malnutrition and being overweight/obese, but also educate refugees and migrants on a balanced and healthy diet.

Table 1. Consumption of sweets, fruits and sweetened drinks/juices among refugees and migrants

	Consumption of sweets (%)	**Consumption of fruits (%)**	**Consumption of sweetened drinks (%)**
Daily	35	45.5	36.7
Several times per week	30.5	29.2	28.8
Several times per month	7.1	6.2	7.1
Rarely	18.6	12.4	15.9
Never	8.4	5.8	10.6
No answer	0.4	0.9	0.9

Research shows less than half of migrants in Serbia brush their teeth two or more time times per day. A study conducted in United Kingdom showed a higher percent (71.5%) of Pakistani/Bangladeshi brushing teeth twice a day. [18] Asylum seekers and immigrants that participated in a research in Finland had similar habit of brushing teeth. Women (75%) brush teeth more often than men (56%). The same study showed that 57,5% of the participants used toothpastes, whereas 79% of migrants and refugees in Serbia used some kind of fluoride supplements. [19] The findings show a large percent of children brushing teeth more than once a day (more than 80%). [20] Recognizing the need for early

dental treatment, providing migrants with adequate oral hygiene utensils and promoting good oral hygiene could highly impact oral and therefore general health.

Oral health affects general health by causing considerable pain and suffering and by changing what people eat, their speech and their quality of life and well-being. [21] This is why there is an undeniable connection between general health and oral health. A comparative study found approximately one third of refugees from the Middle East and Africa that participated in the study had regular oral pain. [22] Oral pain is the most common reason for a visit to the dentist. [18] Postponing dental treatment may lead to higher risk of complications occurring and more difficult treatment procedures. Public healthcare systems should strive to promote early dental treatment and emphasize the importance of prevention.

Some of the principles of healthcare in Serbia are based on solidarity, efficiency and protection of the rights of a patient. Free healthcare is provided to all children under 18 years of age and students till the age of 26 years, as well as people over 65 years of age and people with disabilities. Refugees and migrants in Serbia have the same rights and are included in the public healthcare system. The law concerning free dental treatment applies to trauma, swelling, etc. only at public dental clinics. [12] A low percentage of refugees and migrants going to the dentist in Serbia might as well be due to financial issues, language barriers, fear of the dentist and many more. Conclusions from other studies indicate that financial aspect and the lack of adequate dental insurance is one of the leading issues for not seeking dental treatment. [23,24] As for language barriers, it is mandatory that refugees and migrants are able to communicate whit healthcare workers. Specialized translators should be at disposal at all times when refugees and migrants seek medical treatment

Conclusion

Based on the findings of the study we can understand that in order to provide a safer and healthier environment, attempts should be made to educate and motivate refugees and migrants to maintain oral health. Public healthcare system should focus on refugees and migrants as an at risk population and make a specialized strategy for them. With a large number of refugees and migrants coming every day to Serbia and other European countries, this public health care issue should be prioritized and further analyzed. Early identification of oral health issues may mean less costly procedures which would be in the best interest of patients in need of dental treatment. Health care providers should have in mind the specifics of the migrant population and adjust procedures and treatment to their needs. The ultimate goal is to preserve and improve oral health among refugees and migrants in Serbia.

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FULL MOUTH REHABILITATION OF TOOTH WEAR USING DIGITAL AND CONVENTIONAL TECHNOLOGIES

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ABSTRACT

Dental wear is a common disease which raises multiple restoration issues. Both the factors that generates this disease and the consequences should be correlated with individual characteristics of the patient for a convenient treatment approach. From the diagnosis to the tooth wear treatment, digital dentistry stands as a useful partner for the clinician.

This case report describes a complete mouth rehabilitation of a senior female patient presenting tooth wear with edentation class I Kennedy at the maxilla and class III at mandible, using both digital and conventional tools.

Because minimally invasive approach is the high- expectation treatment whenever possible, for the present case the mandibular arch was an ideal situation to apply this principle as long as the patient rejected implants as a treatment plan to reestablish the upper arch. CAD/CAM technology was a useful partner beginning with the optical impression, design and milling, also the additive technique- 3 D printing was serving with the cast and the splint guide combining the free-hand technique.

Key words: *tooth wear, CAD/CAM technology, minimally invasive treatment.*

ORAL ALTERATIONS IN DIABETES MELLITUS

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***Abstract*:** *Diabetes mellitus has been defined as a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is a widespread chronic disease that continues to increase in number and significance. Hyperglycemia leads to widespread multisystem damage, which effects oral tissue. Various oral complications in diabetics might be dependent on the type, duration, and control of the disease. The present article summarizes current knowledge on the association between diabetes mellitus and oral health. An individual comprehensive approach should be the basis for the implementation of preventive and therapeutic measures in the management of diabetes mellitus and oral complications.*

Key words: *Diabetes Mellitus, Oral Disease, Oral Health*

Introduction

According to the American Diabetes Association, diabetes mellitus is defined as a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. Based on the disease etiology, current classification has been proposed [1]. Type 1 diabetes is characterized by the lack of insulin production resulting in severe hyperglycemia and ketoacidosis and includes immune mediated diabetes and idiopathic diabetes (5-10% of diabetic populations). Type 2 diabetes is characterized by insulin resistance mainly by altered insulin production but with certain capacity for insulin production without autoimmune destruction of β-cells (90-95% of diabetic population). Overweight, obesity and age are recognized as risk factors for this form of diabetes. Women with history of gestational diabetes mellitus and those with hypertension or dyslipidemia are more commonly affected. This type of diabetes commonly remains undiagnosed for a long time as hyperglycemia appears gradually and often without symptom, while ketoacidosis rarely occurs. Gestational diabetes mellitus refers to glucose intolerance of variable severity which is identified during pregnancy for the first time. It increases the risk for later development of type 2 diabetes mellitus. Other forms of diabetes mellitus are represented as genetic defects related to the β-cell or insulin action, exocrine pancreas diseases, diabetes secondary to autoimmune endocrinopathies, diabetes caused by drugs, chemicals, infections, rare forms of immune-mediated diabetes, and diabetes mellitus associated with genetic syndromes.

Prevalence and incidence of diabetes mellitus is increasing as a result of demographic changes such as population growth and aging, or lifestyle change related to urbanization, as well as to the extended lifespan due to generally improved health of diabetic patients. According to World Health Organization 171 million people had diabetes in 2000 and it is expected that by the 2030, 366 million [2] and 592 million by 2035 will be affected worldwide.

Diabetes mellitus related hyperglycemia affects multiple systems, particularly microvascular changes (microangiopathy) with thickening of the capillary basement membrane (includes retinopathy and nephropathy), macrovascular disease (macroangiopaty) with accelerated arteriosclerosis (includes coronary artery disease, cerebrovascular disease, and peripheral vascular disease), neuropathy affecting somatic and autonomic nervous system, and oral disease. In addition to beforementioned diabetes could cause acute complications such as hyperosmolar hyperglycemia, diabetes ketoacidosis, and acute infection.

Microvascular changes are hallmark of many diabetic complications. Sustained hyperglycemia induces production of advanced glycation end products (AGEs) from proteins and lipids and are considered to stand in the basis of a variety of diabetic complications. AGEs often form on collagen, and contribute to atherosclerotic changes (macrovascular complications) and to alterations in homeostatic membrane transport. AGEs formation and microvascular complications

have been associated with elevated level of vascular endothelial growth factor (VEGF). AGEs receptors (RAGE) have been found on the surfaces of smooth muscle cells, endothelial cells, fibroblasts, neurons, lymphocytes and monocytes/ macrophage. Hyperglycemia increases expression of RAGE while AGE-RAGE interaction and consequently increases the secretion of proinflammatory cytokines including interleukin-1β (IL-1β) and tumor necrosis factor-α (TNF-α), recognized as critical in the inflammatory process. AGE-RAGE interaction on endothelium enhances vascular permeability and thrombus formation. Vascular problems cause increased risk for infection, as well as its severity and duration. A common finding in diabetics is a change in collagen metabolism, that alters wound healing. Diabetes has a negative impact on bone healing by reducing the expression of genes responsible for differentiation of the osteoblasts and by decreasing growth factor and extracellular matrix production.

Oral complications in diabetes mellitus

Salivary findings

Xerostomia is defined as the subjective complaint of the oral dryness that implies change in the salivary composition and/or flow rate. It is more frequently observed in patients with type 1 and type 2 diabetes mellitus than healthy controls [3]. Symptoms of dry mouth in type 1 diabetic patients have been linked with peripheral neuropathy [3]. Estimated global prevalence of xerostomia among diabetic patiens ranges between 34%-51%. Higher rates of xerostomia were related to the female gender in type 2, but xerogenic medication, current use of cigarettes, and more frequent snacking behavior in type 1 diabetic patients [3]. Glycemic control level seems to generally influence the susceptibility of type 2 diabetics to xerostomia as well [4].

Salivary flow

Salivary flow rates data among patients with diabetes are conflicting . Some studies have shown lower resting and/or stimulated salivary flow in both type 1 and 2 diabetes mellitus [3,5], whereas other have found no differences between diabetic patients and controls. Dehydration linked to increased blood glucose may enhance osmotic gradients in gland and thus decrease salivary secretion [3]. Decreased salivary flow in type 1 or type 2 diabetes has also been associated with presence of peripheral neuropathy [9], xerogenic medication [3] poor control of diabetes [3,5] and obesity–insulin resistance. It has been hypothesized recently that dyslipidemia and hyperinsulinemia decrease salivary secretion as well, and give rise to oxidative stress, inflammation, sympathetic activity, and alter salivary gland insulin signaling, resulting eventually in gland degradation. Salivary gland hypofunction in type 2 diabetes patients might be associated with genetic polymorphisms of chromogranin A, secretory glycoprotein which is supposed to give contributions to the development of insulin resistance [5]. While duration of the disease, age, and gender do not affect salivary flow rates in patients with type 2 diabetes, impairment in salivary flow was observed with increasing age in type 1 diabetes [3]. Decreased salivary gland function has been associated with the increased risk of dental caries , the pathogenesis of candidiasis and periodontitis.

Sialosis

Patients with long history of diabetes may develop sialosis [6], bilateral, painless, non-inflammatory, non-neoplastic, but degenerative glandular enlargement, which usually affects parotid glands. It is related to an alteration in the neuroanatomic regulation of the gland due to demyelinization and consequent atrophy of the mioepithelial cells. It has been stated that the enlargement is accompanied by the salivary hypofunction, or that the salivary function is generally preserved.

Salivary composition

Certain changes in the composition of saliva have been observed in both type 1 and type 2 diabetics compared to the healthy controls. These changes include higher concentration of total sugars, glucose, α-amylase, urea, and acidic pH of resting saliva. Resting and stimulated concentrations of salivary proteins, calcium, magnesium, and potassium ions were found to be increased, while zinc ions were decreased. Certain salivary elements concentrations varied in diabetics and healthy individuals in relation to the gender. Microvascular changes and neuropathy may play a role in these changes. Higher susceptibility of diabetics to the dental caries were linked to higher levels of glucose and decreased pH in saliva, while more calcium and less zinc ions in the saliva may play a role in predisposition to the dental calculus formation and periodontitis in diabetic patients. A decrease in the secretion of immunoglobulin A was associated with diabetes mellitus and has been suspected to contribute affinity to infections among these patients [7].

Taste impairment

Diabetic patients tend to show altered taste sensations including hypogeusia for the primary tastes [8]. Taste impairment may interfere with the proper diet, favoring sugary and/or salty food. These changes are significantly associated with the complications and duration of diabetes and generally tolerated without complaint. Namely, consumption of the large amounts of sugar and sodium, may rapidly enhance blood glucose level and hypertension. A neuropathic mechanism, dryness of mucosa, decreased gustin production, zinc deficiency and coated tongue have been suggested to explain taste alteration. Moreover, changes in sweet taste perception might be related to low glucagon-like peptide 1 (GLP-1) secretion and enhanced glucose absorption.

Burning sensation

Diabetes mellitus, especially if uncontrolled, might be associated with oral mucosa burning sensation. Burning sensation in diabetic patients has been attributed to poor glycemic control, metabolic alterations in oral mucosa, angiopathy, candidiasis and regional neuropathy and diabetes control tend to results in the improvement of oral burning [9]. The neuropathic pain in diabetic patients has been reported as burning, tingling, or even as electric shock or stabbing sensation and has also been linked to the pain perception generated by a stimulus that does not usually provoke pain (allodynia) and increased response to painful stimuli (hyperalgesia). These sensations have a considerable impact on the physical and psychological functioning of the patients. Other oral diabetic neuropathy pain-related symptoms clinical conditions are trigeminal pain and temporomandibular joint disorder.

Orofacial Pain

Oral nerve pain might be related to diabetic polyradiculopathy as well. According to Arap et al. [10] results, in patients with extraoral complications of painful diabetic neuropathy the majority (55 %) of the patients reported the orofacial pain. Higher pain thresholds were observed in the facial areas innervated by the trigeminal nerve and they were positively correlated with the higher levels of glycated hemoglobin. Neuralgia in the orofacial region in conjunction with diabetes is rarely reported. However, in a diabetic woman, severe oral pain provoked by touch in the mandible area, tongue and gingival region have been observed, which led to the assumption of the involvement of the mandibular branch of the trigeminal nerve. Although the data are scarce, there are certain indicators that suggest there is an association between diabetes and temporomandibular disorders (TMD). While a study in Finnish population reported TMD in 27% of type 2 diabetic patients compared to 16% of controls, another study reported that the prevalence of TMD in the group of participants with diabetes mellitus type 2 was similar to the values reported in general population [10].

Periodontal disease

Diabetes, a risk factor for periodontal disease, may influence not only the prevalence but also severity and progression of periodontitis. Available evidence reported increasing periodontitis

prevalence with increasing levels of blood glucose in type 2 diabetes. Periodontal destruction was observed to be more severe in uncontrolled diabetics both type 1 and type 2, with greater mean bone loss, attachment loss and tooth loss [11]. The mechanisms by which diabetes adversely affects the periodontium are not entirely understood but involve aspects of inflammation, immune functioning, neutrophil activity and cytokine biology. The microbial composition of the subgingival biofilm between patients without diabetes and those with type 1 and type 2 diabetes shows subtle differences, but the clinical significance of this is unclear. Both type 1 and type 2 diabetes are associated with elevated levels of systemic markers of inflammation. Diabetes increases inflammation in periodontal tissues and people with type 2 diabetes have higher levels of inflammatory mediators. There is a possible role for type 2 diabetes in modulating the level of receptor activator of NF-kB ligand (RANKL)/(OPG) in chronic periodontitis. A limited number of studies have investigated the role of adipokines in periodontal disease and diabetes. While Kardesler et al.[12] found no effect of type 2 diabetes on serum leptin and adiponectin in chronic periodontitis, in another study [13] serum adiponectin was elevated in type 1 diabetes patients with chronic periodontitis. Pradeep et al. [14] showed a possible association between pre-B-cell colony enhancing factor (Visfatin) and type 2 diabetes in chronic periodontitis patients. Neutrophil function was reported to be altered in the diabetic patients. Oxidative stress in diabetes may activate periodontium pro-inflammatory mechanisms which could influence diabetes . On the other side, there is an evidence to support a negative impact of periodontal disease on diabetes. While diabetes significantly impacts the periodontium, there is also evidence that periodontitis may promote development of type 2 diabetes. Much emphasis has been given on the two-way relationship between these two diseases. Periodontal disease also adversely affects glycemic control. Due to predominance of gram-negative anaerobic bacteria in periodontal infection, ulcerated pocket epithelium could constitute a chronic source of systemic challenge for bacterial products and locally produced inflammatory mediators such as TNF-α, IL-6 and IL-1. Periodontal inflammation mediators are reported to antagonize insulin action. Increased insulin resistance and poor glycemic control may occur as a consequence of chronic gram-negative periodontal infections. Periodontitis increases the risk for diabetic complication as well. The prevalence and severity of nonoral diabetes related complications such as retinopathy, diabetic neuropathy, proteinuria and cardiovascular complications are reported to be correlated with the severity of periodontitis which supports the concept that periodontal disease may be the sixth complication of diabetes. Systematic review and meta-analysis evaluating the effect of periodontal therapy on the outcome of diabetes in patients with type 2 reported moderate reduction in HbA1c. Another review including patients with type 1 and type 2 diabetes showed that there is low evidence that the periodontal treatment by scaling and root planning improves glycemic control in people with diabetes, and the authors found no evidence showing that one periodontal treatment is more effective than another in improving glycemic control [15]. Therefore, larger, well conducted prospective studies are required to investigate the effect of periodontal treatment on glycemic control of the patients with diabetes.

Oral mucosa alterations

Several specific oral mucosa alterations have been associated with diabetes mellitus. There are reports of higher incidence of development conditions, such as coated and fissured tongue, benign migratory glossitis, melanin pigmentation and varices. Diabetic patients are more prone to fungal infection and potentially malignant disorders including leukoplakia, erythroplakia, and lichen planus. Susceptibility of diabetic patients to alteration and infection in oral cavity is still debated.

Conclusion

Diabetes causes multiple comorbidities and increases the risk of systemic and oral complications. Various oral complications in diabetics might be dependent on the type, duration, and control of the disease. Therefore, an individual comprehensive approach should be the basis for the implementation of preventive and therapeutic measures in the management of both diabetes mellitus and oral complications.

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IMPACT OF DENTAL IMPLANTS ON CIRCADIAN RHYTHM

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Abstract: *The circadian rhythm regulates many physiological human health and disease processes. The central circadian clock is located in the suprachiasmatic nucleus in the hypothalamus and controls many circadian clock genes. During bone remodeling, circadian rhythm gene expression was observed in osteoblasts and osteoclasts. Moreover, circadian rhythm genes were involved in the circadian network in the osseointegration of titanium implants. Also, the hormone melatonin produced depending on the circadian rhythm, affects bone homeostasis. Therefore, melatonin affects bone formation and could serve as a regenerative agent by increasing the process of osseointegration. This review highlights the impact of dental implants on circadian rhythm and osseointegration.*

Key words: *circadian rhythm, implants, melatonin, titanium*

Introduction

Osteointegration-based dental implants are generally accepted to treat complete and partial edentulism. Sound integration and maintenance of implants in the alveolar bone and the formation of new bone contribute to treatment success. However, genetic background related to bone quality, melatonin, and peripheral circadian rhythm as regulatory systems elemental for establishing and maintaining osseointegration is very complex [1]. The circadian rhythm regulates many physiological processes of human health and disease [2]. There is growing data that the circadian clock could influence tooth development, saliva production, and salivary and oral epithelial homeostasis. Circadian rhythm gene expression has been found in several epithelial craniofacial tissues, mainly in basal cells of the oral epithelium, including palatal and connective epithelium [3].
Central circadian clock components have an essential role during bone mineralization and remodeling, a mechanism that strengthens the outcome of dental implants and preimplantation procedures such as bone augmentation [4]. Circadian rhythm genes are expressed in osteoblasts. Also, the resorptive activity of osteoclasts shows circadian periodicity and is maintained by numerous endocrine hormones [4]. It has been suggested that the circadian rhythm could impact enamel formation as it stimulates amelogenin production. In addition to enamel, circadian rhythm is also essential in forming another hard tooth tissue, dentin [5]. During tooth development, the underlying circadian rhythm components are active in both ameloblasts and odontoblasts during the bell phase. Dentine development is marked by incremental lines for which a circadian motif has been noticed. Collagen production and secretion were detected in odontoblasts in a circadian manner, contributing to the periodicity of incremental lines in dentin. In addition, circadian rhythm gene polymorphisms could originate unique enamel morphology, thickness, and hardness [5]. Therefore, circadian rhythm genes could target further treatments with regenerative possibility for hard tooth tissue.

Molecular basis of circadian rhythm

The core clock genes are expressed in circadian rhythmicity in the suprachiasmatic nucleus (SCN), and light is one of the main drivers of the central clock. The molecular basis of the circadian rhythm includes transcriptional and translocation feedback loops. The circadian rhythm is driven by the brain and muscle ARNTL-like protein 1 (BMAL1 or ARNTL) and circadian locomotor output cycles kaput (CLOCK) transcription factors. In contrast, transcription repressors are cryptochrome (CRY) and period (PER) transcription factors. The central transcription factors that make up the activation and positive part of the molecular clock are BMAL1 and CLOCK. The heterodimer CLOCK:BMAL1

enters the nucleus, where it initiates transcription by binding to a specific sequence, the E-box, in promoters of the target genes (Figure 1). CLOCK's main downstream goals include *BMAL1* and its repressors, cryptochrome (*CRY1*, *CRY2*), period (*PER1*, *PER2*, and *PER3*), and multiple clock-controlled genes (CCG) [6]. CRYs and PERs accumulate during the positive loop in the cytoplasm. They are controlled by casein kinase 1 (CK1) ε and CK1δ [7,8]. CK1ε and CK1δ phosphorylate PERs for degradation. If CK1ε phosphorylates heterodimer PER:CRY, it enters the nucleus and suppresses the CLOCK:BMAL1 heterodimer. As a result, CRYs and PERs suppress their own expression [9]. Posttranslational phosphorylation of CRYs and PERs promotes their degradation, which triggers a new circadian cycle, with increased CLOCK:BMAL1 heterodimer binding to the E-box of CCG [10]. Due to sequence similarity, neuronal PAS domain protein 2 (NPAS2) is orthologous to the *CLOCK* gene. NPAS2 constitutes a heterodimer with BMAL1 and triggers transcription of target genes. The heterodimer CLOCK:BMAL1 is essential in preserving circadian rhythm, and NPAS2 is a redundant transcription factor that acts as a reserve plan for CLOCK in peripheral tissues. In the lack of CLOCK, NPAS2 is a replacement for forming heterodimer NPAS2:BMAL1 [11].
The second circadian clock regulatory loop includes the retinoic acid receptor-related orphan receptor (*ROR*) α and *RORγ,* and the *REV-ERBα* and *REV-ERBβ* genes. The CLOCK:BMAL1 heterodimer initiates their transcription by binding to the E-box elements of their promoters. RORs and REV-ERBs receptors bind to the ROR element (RORE). REV-ERBα and β inhibit transcription, while RORα and γ stimulate expression of target genes. RORs and REV-ERBs together create cyclic fluctuations in the expression of many CCG, including the regulation of *BMAL1* transcription [7]. REV-ERBα accumulates rapidly and prevents *BMAL1* transcription, while RORα accumulates more slowly and promotes *BMAL1* transcription. In this way, the stability and robustness of the rhythmicity of the internal clock system are enhanced [12]. All of these connected feedback loops create a circadian rhythm.

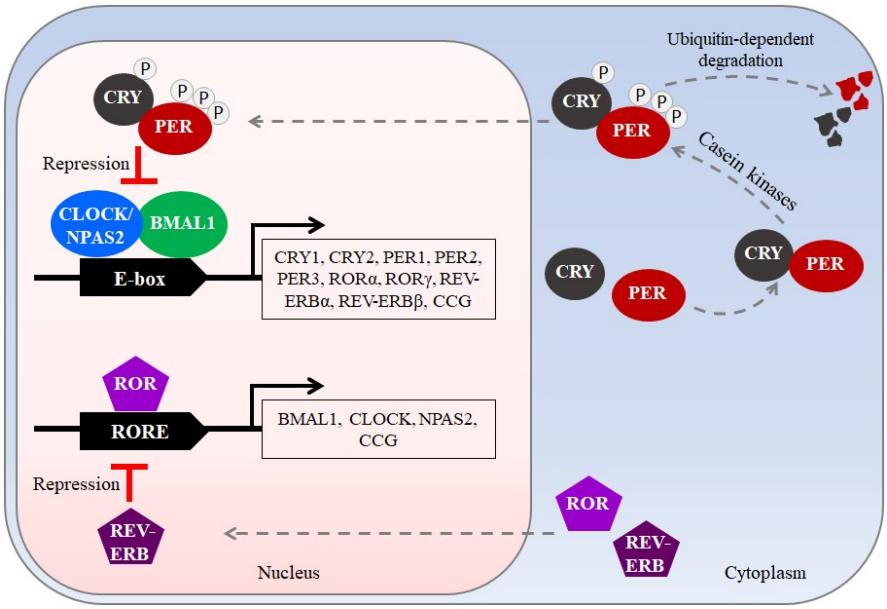

Figure 1. The core clock mechanism of the circadian rhythm. BMAL1 and CLOCK trigger transcription of CRY and PER, nuclear receptors (REV-ERBs and RORs), and other clock-controlled genes (CGG). PER and CRY heterodimerize and phosphorylate by casein kinases and translate into the nucleus, where they inhibit binding of the CLOCK(NPAS2):BMAL1 to the regulatory regions of target genes. In the second feedback loop, REV- ERBα inhibits the transcription of BMAL1 because it binds to the RORE element. In contrast, overnight, the same regulatory elements bind RORα and activate the transcription of BMAL1. Also, CLOCK(NPAS2):BMAL1 heterodimers induce the REV-ERBα and RORα expression.

Circadian rhythm in osseointegration

Titanium-containing biomaterials are often used in implantology for dental implants [5]. Dental implants consist of an endosseous anchoring piece and transmucosal support that sustains different

dentures. The benefit of a dental implant relies on the biological reactions to xenobiotic materials and the endosseous implant placement in the jawbone. Furthermore, in acquiring a sound bone-implant connection without clinical symptoms and signs of inflammation or infection, osseointegration plays a crucial role in permanent implant immobility[1].

The expression profile of genes associated with osteogenic mesenchymal stem cell differentiation shows that molecular circadian rhythm regulates mesenchymal stem cell differentiation. Circadian clock transcription factors control the expression of core clock genes and other CCGs. The positioning of titanium implants creates a distinct cellular condition that could increase the osteogenic differentiation of mesenchymal stem cells [11]. Thus, *PER1* gene expression is reduced in stromal bone marrow cells due to titanium-based biomaterials, essential for osseointegration [5]. Furthermore, mesenchymal stem cells that were susceptible to various titanium substances *in vitro* had improved osteogenic differentiation [11]. Almost 30% of genes show circadian oscillations [1,13]. Implant-induced microenvironmental change significantly affects *NPAS2* and *PER2* gene expression regulation or dysregulation in peri-implant tissue (Figure 2). It might contribute a new hint to understanding the process of osseointegration [1].

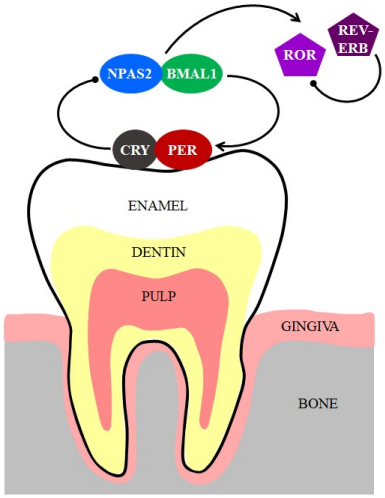

Figure 2. Association of circadian rhythm genes with dentistry. BMAL1, PER1, and PER2 are produced in ameloblasts. BMAL1 stimulates amelogenin production, and its overexpression is linked with enamel morphology, thickness, and hardness. NPAS2 is vital in bone peripheral circadian rhythm for osseointegration. PER1 and PER2 are produced during tooth development. PER1 is modulated by titanium in bone marrow stromal cells, while PER2 is produced in odontoblasts.

Successful dental implants require establishing an intimate connection with bone tissue [14]. Various studies have shown that the placement of titanium implants has the most significant effect on circadian rhythm gene expression. *NPAS2* and *BMAL1* gene expression increased, while *PER2* expression decreased. Biomaterials made of titanium with complex surfaces have a more significant effect on expressing distinctive circadian clock genes than untreated surfaces. Titanium implants with complex surfaces alter CCGs expression near the implant so that NPAS2 becomes a partner transcription factor with BMAL1 in the NPAS2:BMAL1 heterodimer. The CLOCK:BMAL1 heterodimer and NPAS2:BMAL1 heterodimer trigger various groups of genes [11]. The circadian rhythm regulates many CCGs, and the transition from CLOCK to NPAS2 after titanium biomaterial implantation modifies CCGs expression, including proteins that promote bone and implant binding [15].

The microenvironment produced by titanium biomaterials prefers the role of NPAS2, which can trigger the combined expression of CCGs that mediate bone and implant binding [11]. The role of NPAS2 determines the molecular mechanism of osseointegration. NPAS2 in peri-implant tissue is vital in establishing osseointegration [13] because it directly regulates collagen expression [1]. Peripheral circadian rhythm is required to establish osseointegration, which triggers the production of a specified group of cartilage matrix proteins that could integrate the implant surface and bone tissue [14]. Bone remodeling includes cytokines, growth factors, hormones, and other molecules, with

melatonin modulating bone formation and absorption [16]. Melatonin is a hormone produced in the pineal gland and positively regulates bone formation and homeostasis [16,17]. In the oral cavity, melatonin may play a role in maintaining and regenerating alveolar periodontal and peri-implant bone [17]. In addition, it has anti-inflammatory and antioxidant effects as it destroys reactive oxygen species [16,18]. Melatonin stimulates the differentiation of mesenchymal stem cells into osteoblasts and promotes bone formation [17,18]. Beneficial effects of melatonin in bone regeneration near titanium dental implants have been observed, whether applied topically to implant bearings, coated the implant, or injected near the implant at the time of positioning [16]. Bone repair consists of three phases (inflammatory, proliferative, and remodeling). Melatonin may have a role in these phases due to its regulatory effects on inflammation, antioxidant properties, bone cell regulation, and collagen synthesis. In addition, melatonin increases the number of blood vessels, a prerequisite for the supply of mineral elements and the migration of angiogenic and osteogenic cells [17]. The use of melatonin for osseointegration may be of interest because it promotes bone growth when used in combination with dental implants [17].

Conclusion

An increasing body of evidence demonstrates the importance of peripheral circadian rhythms in osseointegration. The most crucial change in peripheral circadian rhythm during osseointegration is NPAS2 which can be the basis for developing treatment approaches created to enhance osseointegration or re-establish the integration of implants and bone [15]. Melatonin plays a vital role in stimulating the production of new bone and increasing bone thickness near titanium dental implants. The topical application of melatonin at implant positioning may facilitate a more significant bone connection with the implant, thus promoting osteointegration [16]. This approach to osseointegration of titanium implants could help improve oral health.

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ORAL EXTRAINTESTINAL MANIFESTATIONS OF PEDIATRIC INFLAMMATORY BOWEL DISEASE- TEN YEARS OF EXPERIENCE OF ONE CENTER

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Abstract: *Inflammatory bowel disease (IBD) is a chronic, relapsing inflammation of any part of the digestive tract, and the name includes the two clinical entities, Crohn's disease and ulcerative colitis. Both diseases can be manifested not only by typical abdominal pain and bloody-mucous stools, but also by various extraintestinal manifestations. The aim of this study was to determine the frequency of extraintestinal manifestations in the oral cavity in children with IBD. Patients with IBD under the age of 18 are included in the Institute for Health Protection of Children and Youth of Vojvodina, which is the reference institution for the treatment of these patients in Vojvodina. Retrospectively, data from the medical histories of children treated in this institution from 1 January 2010 to 31 December 2020 were included. As many as 48% of pediatric IBD cases have manifestations in the oral cavity. The most common were diseases of the teeth and gums, but pathological changes were noted in almost every oral tissue, including soft tissues, tongue, lips and lymph nodes. Almost every other child with IBD has oral manifestations of this disease, which leads to impaired quality of life and difficulties with nutrition, and this leads to malnutrition and a significant increase in health care costs. It is necessary to create an algorithm for a systematic approach to the diagnosis and treatment of oral manifestations in pediatric IBD.*

Key words: *inflammatory bowel disease, child, oral health*

Introduction

Inflammatory bowel disease (IBD) is a chronic relapsing disease of any part of the digestive tract. The name includes 2 forms of the disease, Crohn's disease (Morbus Crohn, MC) and ulcerative colitis (Colitis ulcerosa, UC). Today, these diseases are constantly increasing in frequency (1). According to the latest reports, the prevalence of IBD is 400 to 600 cases per 100,000 inhabitants (2), and at least a quarter of them are children (3).

IBD impairs the quality of life of the patient, requires sophisticated medical equipment and educated medical staff for diagnosis, as well as the possibility of applying expensive therapeutic options, which significantly increases the cost of health care.

Although the disease is mostly manifested by gastrointestinal symptoms and signs, such as abdominal pain and diarrhea with blood impurities, this disease often affects other organ systems, when we talk about extraintestinal manifestations (EIM). IBD most commonly affects the musculoskeletal system (eg arthritis and enthesitis), skin (eg pyoderma gangrenous, nodular erythema), oral cavity (aphthous stomatitis), hepatobiliary tract (primary sclerosing cholangitis), and eyes (episcleritis, anterior uveitis and iritis), but any organ system can be affected (4).

Depending on what is considered EIM, the prevalence of these extraintestinal manifestations of IBD ranges from 6% to 47% in patients of all ages. EIM is more common in younger patients (5).

In the pediatric population with IBD, the incidence of EIM is 68% (6), that is, 50% of children with ulcerative colitis and 80% of children with Crohn's disease have EIM (7).

One patient may have several EIMs. Every fifth patient with IBD has 2 EIMs, and more than 10% have 3 or more EIMs. In 26% of patients, EIM is preceded by IBD, up to 2 years, but on average 5 months (4).

EIMs sometimes precede gastrointestinal symptoms and signs, and sometimes occurs in patients with IBD during relapse of the IBD or not related to relapse, as a consequence of the complicated course or side effects of the applied therapy.

The pathogenesis of EIM is unknown, most likely immune-mediated reactions in genetically predisposed individuals. It is possible that it is a cross-reactivity of the antigen on extraintestinal organs or a disorder of the intestinal microbiota that leads to dysregulation of the immune response and causes a chronic inflammatory process, both in the gastrointestinal tract and outside it. Genetic factors are involved in the pathogenesis of EIM in IBD. EIMs, like IBDs, have a familial predisposition with a high twin match rate. A link to genes in the HLA region has been established for some of the immune-mediated extraintestinal manifestations (ie uveitis / iritis, primary sclerosing cholangitis, ankylosing spondylitis). For example, patients with CD who have EIM are more likely to have HLA-A2, HLA-DR1, and HLA-DKv5, while patients with UC and EIM are more likely to have HLA-DR103, B27, and B58 phenotypes. Other factors, such as malabsorption, protein loss enteropathy, bowel resection, and fistulas, can lead to nutrient, protein, vitamin, and mineral deficiencies with corresponding clinical consequences. Treatments used to treat IBD can be associated with many non-intestinal side effects. Genetic factors play an important role in the development of EIM, it is known that EIM is more common in certain families and there is a high concordance among twins. It is known that patients with Crohn's disease have more frequent EIM if they are carriers of HLA-A2, HLA-DR1 and HLA-DQw5, and patients with ulcerative colitis if they have the phenotype HLA-DR103, B27, and B58 (8,9).

Sometimes EIM occurs as a consequence of complications of the IBD, when due to malnutrition, enteropathy with loss of protein, resection of the intestine, fistula and others, there is a deficiency of nutrients, vitamins, minerals that are clinically manifested outside the gastrointestinal tract. The IBD therapy itself, which involves the use of corticosteroids, immunomodulators and biologic therapy, carries the risk of developing side effects that may manifest as EIM (10).

In children, one of the most common EIMs are manifested in the oral cavity. Clinically manifested as cobblestone, erythema and / or ulceration on the lips, buccal mucosa and / or gums, but the clinical picture can be very diverse (11,12).

It is known that in the pediatric population with IBD, as many as 48–80% of patients have oral extraintestinal manifestations (oEIM), which may not be associated with gastrointestinal symptoms (13,14). The prevalence of aphthous stomatitis alone in children with IBD ranges from 5% to 50% (4). This is not surprising considering the structure of the oral cavity, which is the initial part of the gastrointestinal tract, and considering the systemic inflammatory character of the disease itself.

Oral EIM is sometimes not easy to detect. IBD-specific changes in the oral cavity, which contain specific granulomatous changes in the pathohistological findings, such as Cobblestoning and Mucogingivitis, are rarely seen. More often, these are completely non-specific pathological changes, such as aphthous stomatitis and angular cheilitis (15).

The aim of this study was to determine the frequency of extraintestinal manifestations in the oral cavity in children with IBD.

Methods

The study included newly diagnosed patients with IBD younger than 18 years. The paper presents a retrospective research from medical documentation. Patients included in the study were hospitalized at the Department of Gastroenterology, Hepatology and Nutrition, Institute for Health Protection of Children and Youth of Vojvodina, in the period from January 1, 2010 to December 31, 2020. The criteria for inclusion were: age of subjects under 18 years, diagnosis of IBD based on international guidelines of good clinical practice (16–18) and a dentist's report on the examination of the oral cavity. Criteria for non-inclusion in the study: subjects older than 18 years, if the diagnosis of IBD was made before or after the study period, and if there is no dentist's report on the examination of the oral cavity.

Analysis and statistical processing of data was performed in the program IBM SPSS Statistics v. 26, while Microsoft Excel 2019 v.16 was used for categorization and systematization, where the data was shown tabularly and graphically. During the analysis with descriptive statistics, the data was presented in the form of percentages, standard deviation, minimum and maximum value, ie as frequency and associated percentages. Gender and diagnostic differences were determined using the Chi-square test, while t-test of independent samples was used to compare age by sex. The level of statistical significance was estimated at $p < 0.05$. The results were presented in tables and graphs.

Results

The study included 118 subjects, with an average age of 13 years (X ± SD 13.07 ± 3.223). The youngest child was 4 years old.

The ratio of males and females was almost equal, ie 58 girls (49%) and 60 boys (51%) participated in the research ($p = 0.854$), (Figure 1).

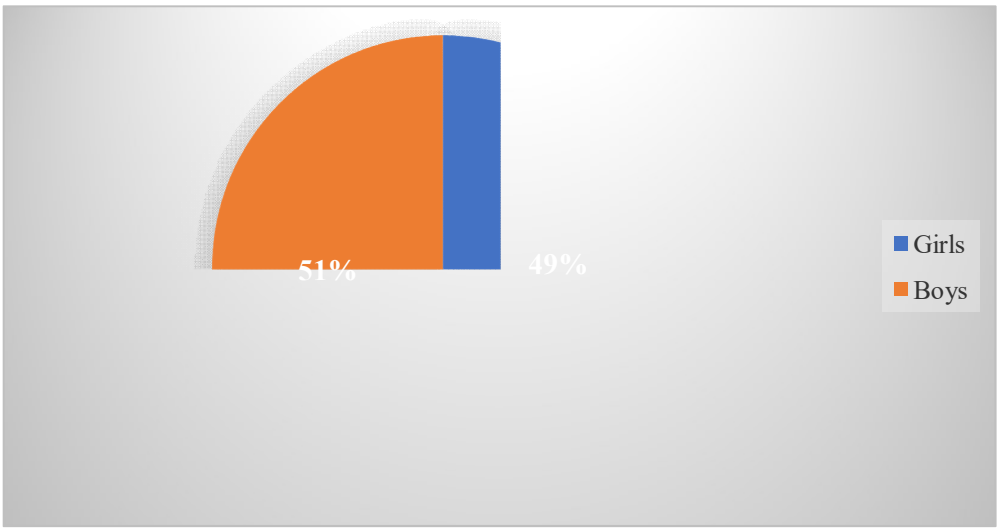

Fig. 1. **Distribution of subjects by gender**

Of the total sample, a significantly higher number of respondents, ie 80 (68%) have been diagnosed with Crohn's disease, and 38 (32%) have ulcerative colitis ($p = 0.002$), (Figure 2).

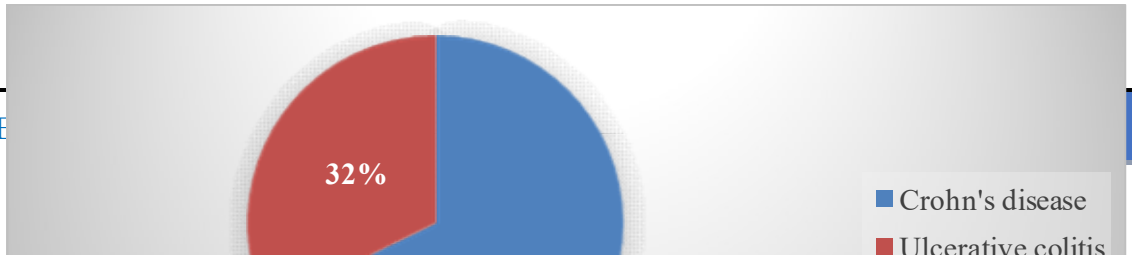

Fig. 2. Distribution of subjects by type of disease

Of the 118 subjects, 57 (48%) had oral extraintestinal manifestations of IBD, Table 1. Patients with oral EIM were on average one year younger than subjects with no change in the oral cavity, (12.63 ± 3.5 vs 13.48 ± 2.9; p = 0156), which graphically shows the distribution of subjects by age depending on the presence of oral EIM (Figure 3). No statistically significant difference in sex distribution was found between groups of patients with and without oral EIM (p = 0.142). Oral EIMs were statistically more common in patients with Crohn's disease (p = 0.047).

Table 1. Characteristics of subjects with oral EIM

	Number of subjects	Age (years)	Gender (%)	Type of IBD (%)		
	N	X±SD	Girls	Boys	Crohn's disease	Ulcerative colitis
oEIM -	61	13.48±2.9	26 (43)	35 (57)	40 (66)	21 (34)
oEIM +	57	12.63±3.5	32 (56)	25 (44)	36 (63)	21 (37)
Specific oral lesions	18	13.8±3.7	11 (61)	7 (39)	14 (78)	4 (22)
Cobblestoning	2	16±1.4	1 (50)	1 (50)	2 (100)	0 (0)
Mucogingivitis	8	12.5±4.2	5 (63)	3 (37)	6 (75)	2 (25)
Lip swelling with vertical fissures	4	17±0	3 (75)	1 (25)	3 (75)	1 (25)
Deep linear ulcerations	4	12±3.5	2 (50)	2 (50)	3 (75)	1 (25)
Non-specific oral lesions	49	12.4±3.4	26 (53)	23 (47)	29 (59)	20 (41)
Pyostomatitis vegetans	1	7±0	1 (100)	0 (0)	1 (100)	0 (0)
Angular cheilitis	24	12.6±3.7	9 (37)	15 (63)	14 (58)	10 (42)
Aphthous stomatitis	32	12.53±3.3	18 (56)	14 (44)	18 (56)	14 (44)
Total	118	13.07±3.2	58	60	90	38

Legend: N = number of subjects; X = mean; SD = standard deviation; oEIM- = oral extraintestinal manifestations are not present; oEIM+ = oral extraintestinal manifestations are present.

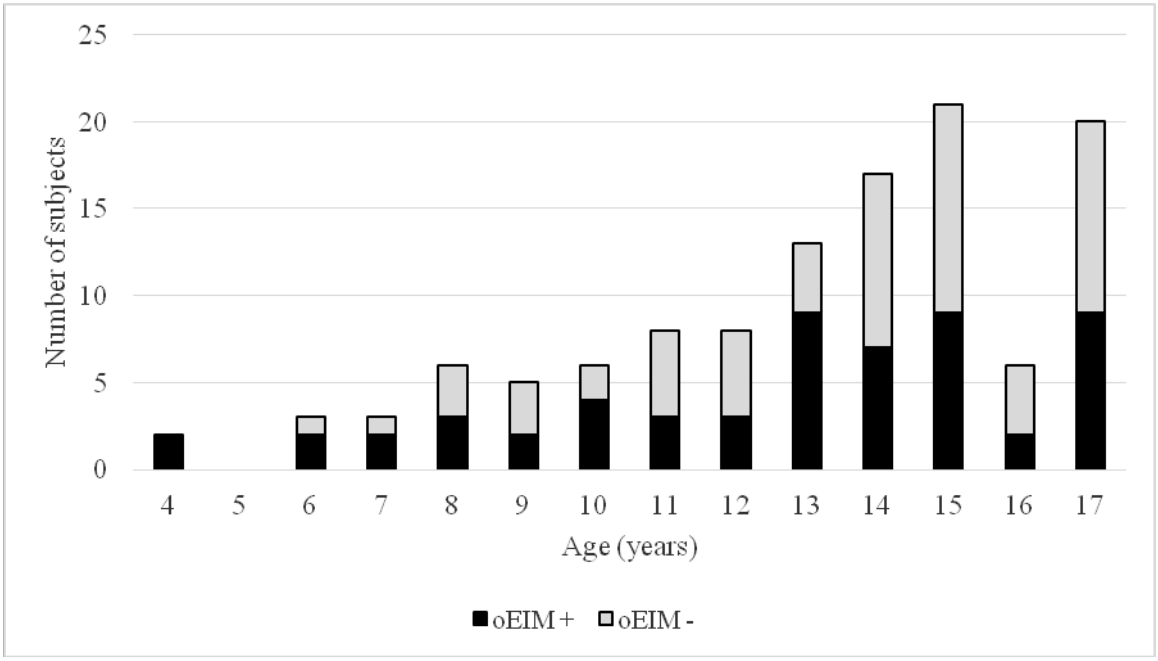

Fig. 3. **Distribution of subjects according to age and presence oEIM**

Of the subjects with changes in the oral cavity, 18 children (32%) had specific oral EIM and 49 children (86%) had nonspecific oral EIM. Furthermore, 16 (28%) children had two or more oral EIMs. Although changes were significantly more common in children with Crohn's disease, the distribution of pathological changes in the oral cavity were identical in both types of IBD, figure 4. In 9 children (16%) changes in the oral cavity occurred before the diagnosis of IBD, even more 2 children with cobblestone were referred to a pediatric gastroenterologist after pathohistological confirmation of biopsied lesions.

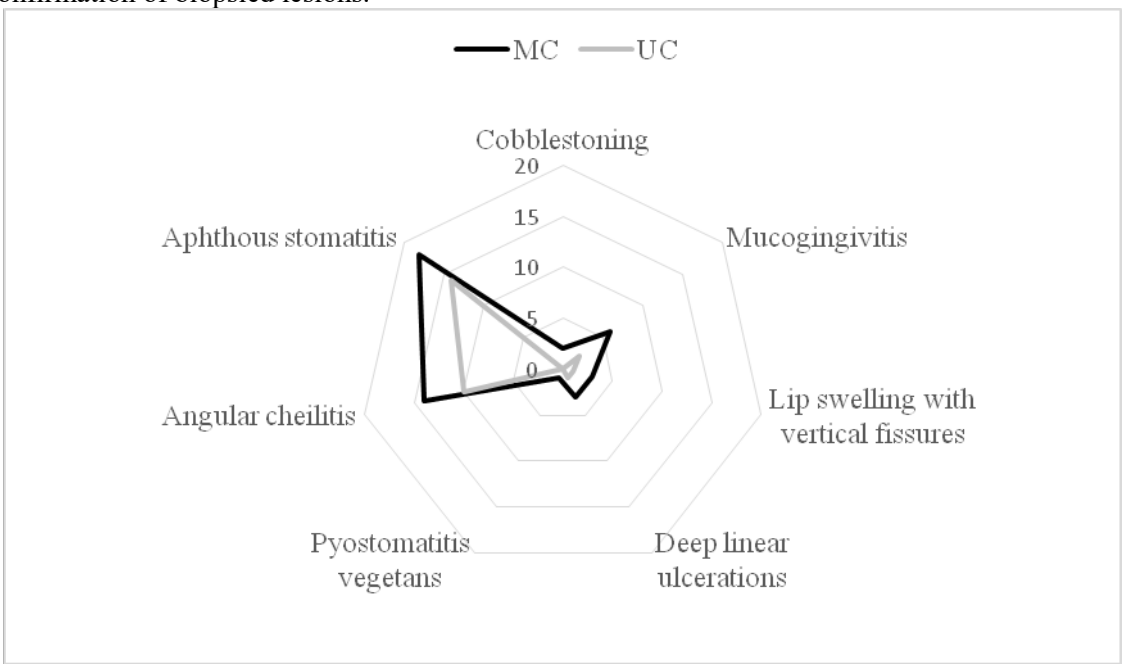

Fig. 4. **Distribution of subjects by type of oEIM and type of IBD**

There was no statistically significant difference in the distribution by sex and type of oral EIM, figure 5. The most common changes in the oral cavity in children with IBD were aphthous stomatitis and angular cheilitis.

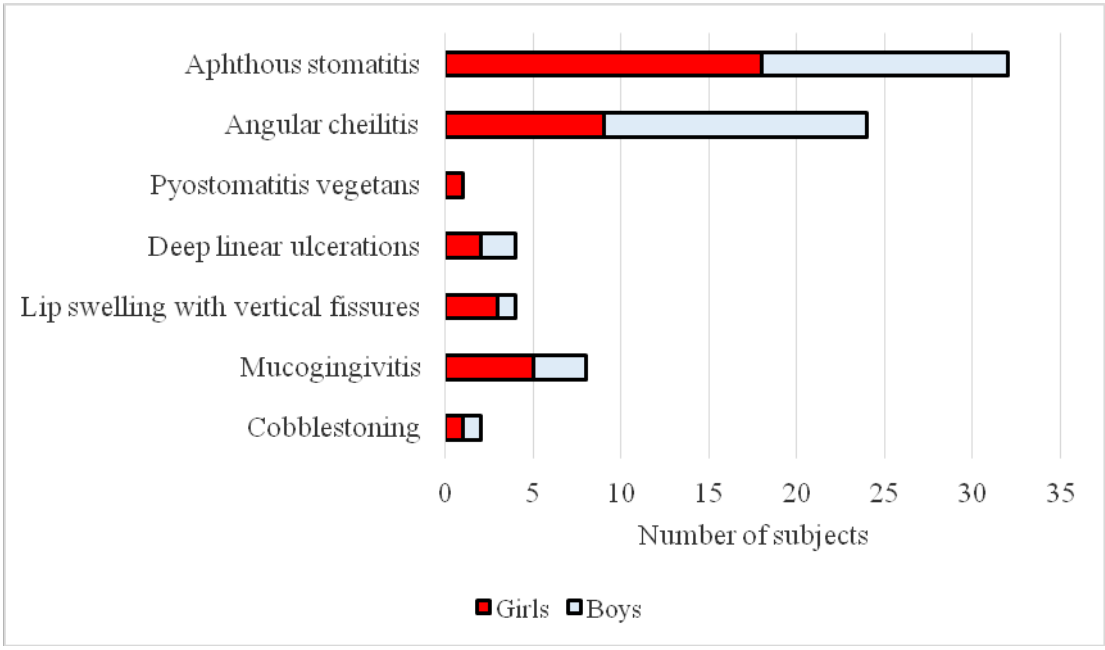

Fig. 5. **Distribution of subjects by sex and type oEIM**

Discussion

Extraintestinal manifestations of IBD can be classified in 3 major groups: the first one includes extraintestinal diseases caused by probably some immunogenic mechanisms, and these can be related to intestinal activity disease (i.e. peripheral arthritis, erythema nodosum, apthous ulcer) or independent to intestinal inflammation (i.e. ankylosing spondylitis, pyoderma gangrenosus, primary sclerosing cholangitis, uveitis); the second one includes inflammatory and metabolic complications of IBD (growth failure, osteoporosis and osteopenia, nephrolithiasis). The third EIM group consists of inflammatory and metabolic complications (growth failure, osteoporosis, osteopenia, nephrolithiasis, ureteral obstruction and fistulas, haematologic and thromboembolic complications, amyloidosis, pancreatitis), (10). Pathological changes in the oral cavity are most often triggered by the same immune mechanisms and follow the activity of the disease in the intestines.

It is known that oEIM occurs in about half of patients with IBD, more often in children and patients with Crohn's disease (5,19). This agrees with the data from the studied group of children with IBD, where the incidence of oEIM was 48%, and significantly more common in children with Crohn's disease compared to patients with ulcerative colitis.

Of the children with oEIM, as many as 28% had two or more different types of pathological changes in the oral cavity. A study of the Swiss cohort of patients with IBD showed that 25% of patients had two or more EIMs, and concluded that the development of one EIM appears to increase the susceptibility of developing another EIM (20).

IBD patients with smoking history, perianal MC, and colonic involvement are at an increased risk of developing EIMs (21).

Oral aphtous ulcers occur in 10%-30% of patients with IBD and may appear before the onset of intestinal symptoms of the IBD or may parallel the intestinal disease. The lesions rapidly resolve once remission is achieved (10). In this study, 9 (16%) children had oEIM before being diagnosed with the underlying disease.

The prognosis of oEIM depends on the type of oral changes and the course of the underlying disease. Oral aphthous ulcers have a parallel course with IBD and usually respond well to biological therapy (22). But deep ulcerations, pseudopolyps, and labial or buccal swelling is often associated with perineal disease and has a protracted course (23).

Aphthous stomatitis is the most common oEIM in IBD patients, as shown in this study (27%). According to other studies, the incidence is 4% -20%. However, this pathological change is not specific for IBD and occurs in 15% of healthy children. Differential diagnostics can be other pathological conditions: oral herpes simplex or coxsackievirus infection, Behçet's disease. Clinically, this cannot be distinguished, except for the fact that oral herpes simplex and coxsackievirus lesions begin as vesicles that later ulcerate. Aphthous stomatitis does not have a vesicular stage. It tends to recur, usually monitors the activity of the underlying disease and responds well to IBD therapy (21). Aphthous lesions are typically located on the labial and buccal mucosa but may also affect the tongue and oropharynx (22).

In this paper, data on the influence of therapy on the occurrence of pathological changes in the oral cavity are not processed. Although there is no official guide to the treatment of oEIM in children, all authors agree that a multidisciplinary approach is needed.

For proper treatment of oEIM, it is crucial to determine whether the pathological change in the oral cavity is a direct manifestation of the active IBD or is it a consequence of nutritional deficiency or an adverse effect of the applied treatment. Orofacial CD, oral aphthous ulcerations, and pyostomatitis vegetans are representatives of oEIM that are being driven by active IBD. Their treatment requires, above all, good control of the underlying disease. Side effects of IBD therapy are usually nonspecific changes in erythema, and ulcers, lichenoid reactions or more severe reactions such as erythema multiforme and Stevens-Johnson syndrome, which in mild cases do not require discontinuation of therapy. Chronic malnutrition or hypovitaminosis may manifest as oEIM. Deficiency of vitamins K, B6, B12, folic acid, zinc and iron is most common in children, may be present as cheilitis or angular cheilitis, glossitis, stomatitis, and aphthous ulcers. That is why nutritional screening of children with IBD is important, as well as compensating for deficient substances (25).

Conclusion

Almost every other child with IBD has oral manifestations of this disease, which leads to impaired quality of life and difficulties with nutrition, and this leads to malnutrition and a significant increase in health care costs. It is necessary to create an algorithm for a systematic approach to the diagnosis and treatment of oral manifestations of pediatric IBD.
Not enough significance is given to the examination of the oral cavity, although it is known that oEIM sometimes precedes the occurrence of gastroenterological manifestations of the IBD. Their timely recognition could lead to a faster diagnosis of IBD and thus improve the prognosis of the disease. Relapse of IBD is not infrequently accompanied by the emergence of new oEIM. The frequency of oral changes is higher in children than in adult patients with IBD, and in patients with Crohn's disease, than in ulcerative colitis. Therefore, our recommendation is that when diagnosing IBD and during each relapse of the disease, but also at least once a year during remission, pediatric IBD patients are referred for a dental examination. Dental examination provides a systematic approach to the examination of all structures in the oral cavity: lips, buccal mucosa, gingiva, palate, oropharynx, tongue (dorsal and ventral side) and teeth.
The role of a pediatric gastroenterologist who treats children with IBD is to recognize EIM, and their causal connection with inflammation in relapse of IBD, complications in terms of nutrient deficiencies, minerals or vitamins, as well as side effects of drugs used. Treatment of oral EIM in children with IBD requires a multidisciplinary approach for accurate diagnostic processing (pathohistological confirmation of specific changes in the oral cavity) and making a treatment plan (topical or systemic immunomodulatory therapy).

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Abbreviations:
IBD--Inflammatory bowel disease
EIM--Extraintestinal intestinal manifestations
oEIM--Oral extraintestinal manifestations
MC--Crohn's disease
UC--Ulcerative colitis

OCCLUSAL TRAUMA AND PERIODONTITIS

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Abstract: *Occlusal trauma—defined as structural and functional changes in the periodontal tissues caused by excessive occlusal forces—may occur in a healthy or inflamed periodontium due to periodontal disease. The role of occlusal trauma in the initiation and progression of periodontal disease has been extensively studied. Despite conflicting findings, there is a general consensus that trauma caused by occlusion does not initiate gingivitis or periodontitis or accelerate the progression of gingivitis to periodontitis. Rather, both animal and human studies indicated that occlusal forces could be a co-factor in the progression of periodontal disease by changing the pathway and spread of inflammation into the deeper periodontal tissues. Occlusal therapy is an integral part of periodontal therapy and may be performed in different treatment phases.*

Key words: *Periodontitis, Occlusal trauma, Occlusal adjustment, Periodontal therapy*

Introduction

As teeth and periodontium are constantly exposed to the occlusal forces generated by the orofacial system, periodontium can undergo physiological changes. Although periodontium can accommodate to the forces exerted on the tooth crown, its adaptive capacity varies among individuals, as well as across the lifespan of the same person [1].

Structural and functional changes in the periodontal tissues as a result of occlusal forces can lead to *occlusal trauma* [2] also known as traumatic occlusion, periodontal trauma, traumatogenic occlusion, trauma of occlusion, etc. [3].The extent of these changes depends on the magnitude, direction, duration, and frequency of traumatic occlusal forces, and can lead to either primary or secondary occlusal trauma. *Primary occlusal trauma* results from excessive occlusal force applied to tooth or teeth supported by healthy and non-inflamed periodontium [4]. It can arise due to high restorations, the drifting or extrusion of teeth into spaces created by unreplaced missing teeth, and the orthodontic movement of teeth into functionally unacceptable positions. Trauma is considered primary if it is deemed the sole etiologic factor in periodontal destruction and if the local alteration to which a tooth is subjected is attributed to occlusion only. Moreover, as shown in Figure 1, changes produced by primary trauma do not alter the level of connective tissue attachment and do not initiate pocket formation [1]. This type of occlusal trauma does not affect the marginal gingiva and does not lead to an increase in gingival crevicular fluid [3]. *Secondary occlusal trauma*, on the other hand, refers to changes induced by normal or excessive occlusal forces in the attachment apparatus of a tooth or teeth with inadequate or functionally compromised supporting tissues (Figure 1) [4].In these cases, periodontium becomes more vulnerable to injury, and previously well-tolerated occlusal forces become traumatic [1]. Although this type of trauma does not cause gingival inflammation or the formation of periodontal pockets, it may increase the risk of progression and severity of plaque-induced inflammation [5].

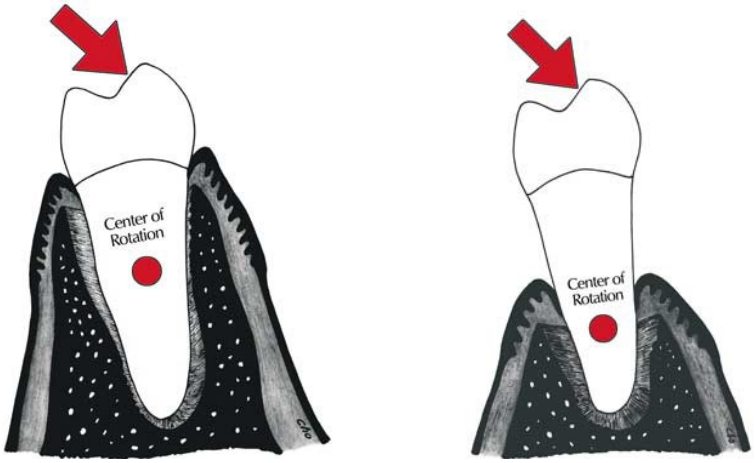

Figure 1. Primary and secondary occlusal trauma (Source: T.G. Wilson Jr. et al. Advances in periodontics, 1992).

Occlusal trauma can also be described as acute or chronic. *Acute occlusal trauma* occurs following an abrupt increase in occlusal load, such as that produced by biting too strongly on a hard object. It can also be induced by inappropriately designed restorations or prosthetic appliances, which would consequently interfere with or alter the direction of occlusal forces on the teeth. Acute trauma typically manifests as tooth pain, sensitivity to percussion, and increased tooth mobility. *Chronic occlusal trauma* occurs when abnormal occlusal forces are exerted on the tooth supporting structures for prolonged periods. As it is more common than acute trauma, it has greater clinical significance. If its causes are not eliminated, it can induce periodontal changes associated with gradual alteration in occlusion produced by tooth wear, movement, and extrusion, in combination with parafunctional habits (e.g., bruxism, clenching).

Occlusal trauma most commonly arises due to occlusal prematurity, whereby a particular tooth is inadequately aligned with the remaining dental arc, which prevents the harmonious closure of the jaw. This misbalance can result in damage to periodontium, masticatory muscles, and temporomandibular joint. Occlusal prematurity can be a direct result of missing teeth, caries or fracture, tooth abrasion, malposition, inadequate dental restoration, vertical dimension reduction and genetic factors. However, it can also be indirectly caused by apical periodontitis, periodontal diseases, tumors of the maxillofacial region, TMJ diseases and orthodontic tooth movement.

Effects of occlusal trauma on the initiation and progression of periodontitis

The relationship between occlusal trauma and periodontal disease has been a subject of extensive research, primarily involving animal experiments and clinical epidemiological studies. Stillman and other early investigators suggested that excessive occlusal force was the main cause of periodontitis [6,7,8], but this claim later proved to be controversial [5].

In the 1960s, Glickman described an alteration in the inflammation pathway as a result of occlusal trauma, positing that excessive occlusal forces could be a contributing factor in the progression of periodontal disease by allowing inflammation to progress into the deeper periodontal tissues, resulting in angular and crater-like bone loss [9, 10]. According to Glickman, the periodontal structures comprise of irritation and co-destruction zones. The zone of irritation includes the free gingiva (marginal and interdental gingival tissues), whereas the zone of co-destruction includes the periodontal ligament, root cementum, and alveolar bone. It is coronally demarcated by the transeptal and dentoalveolar collagen fibers of the gingival connective tissue. As shown in Figure 2, inflammatory lesion in the zone of irritation propagates into (1) periodontal ligament when teeth are subjected to trauma from occlusion and (2) alveolar bone when teeth are not subjected to occlusion

trauma. Glickman's pioneering work on this topic subsequently led to a series of animal experiments to investigate his findings.

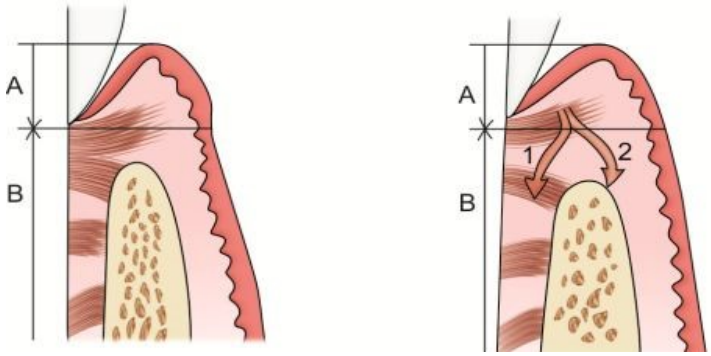

Figure 2. Glickman`s concept. A − zone of irritation, B − zone of co-destruction (Source: B. Shalu. Periodontics Revisited. 2011. 10.5005/jp/books/11320_28)

Owing to the animal studies conducted prior to the 1980s, subgingival biofilm was identified as the main risk factor for the development of periodontitis, the severity and progression of which was nonetheless still believed to be affected by occlusal trauma [11,12]. Human studies conducted in this period have also yielded conflicting findings. For example, a number of cross-sectional epidemiological studies failed to establish a relationship between premature tooth contact and increased probing depth or bone loss, while several authors reported an association of mobility and radiographic evidence of a widened periodontal ligament with increased pocket depth, attachment loss and bone loss [13]. For example, Nunn et al. noted that teeth with occlusal discrepancies had significantly deeper initial probing depths, greater mobility, and poorer prognoses than those without occlusal discrepancies [14]. These authors consequently concluded that occlusal discrepancy can be an independent risk factor contributing to periodontal disease. Based on their findings, Harrel et al. argued that multiple types of occlusal contacts—including premature contacts in centric relation, posterior protrusive contact, non-working contacts, combined working and non-working contacts—and the occlusal discrepancies between centric relation and centric occlusion were associated with significantly deeper probing depths and increased likelihood of unfavorable prognosis [15]. These authors further noted that, at 1-year follow-up, the chance of a deteriorating periodontal situation was 60% lower in teeth without premature contacts at initial examination, as well as in teeth where premature contacts had been eliminated. These findings are encouraging, as they indicate that occlusal treatment can be an important adjunct therapy in the comprehensive treatment of periodontal disease [16].

Although occlusion trauma is reversible, as the affected tissues undergo repair following the removal of traumatic force, its effects may not always be temporary and can have long-lasting clinical significance. The presence of inflammation in the periodontium as a result of plaque accumulation, in particular, may compromise adequate resolution of traumatic lesions.

Clinical and Radiographic Signs of Occlusal Trauma

Occlusal trauma primarily manifests as increased tooth mobility due to the destruction of the periodontal fibers and enlargement of the periodontal ligament space, which can be accompanied by tooth drifting, tooth abrasion, occlusal discrepancies, tooth fracture, fremitus, tooth migration (especially in frontal teeth), sensitivity to thermal stimuli, discomfort and pain, and gingival recessions [3]. Radiographic examination may further reveal increased periodontal ligament space width, radiolucency and condensation of alveolar bone, discontinuity and thickening of lamina dura, angular bony defects, and root resorption [13].

Occlusal adjustment

Occlusal therapy is an integral part of periodontal therapy and can hinder the progression of periodontal disease, thereby improving the overall prognosis. Its primary aim is to alleviate the etiological factors and ensure comfortable and functional dentition, which requires accomplishment of several therapeutic objectives:

1. Elimination or reduction of tooth mobility
2. Establishment or maintenance of a stable, reproducible intercuspal position
3. Ensuring freedom of movement to and from the intercuspal position, including movement in all directions regardless of the initial point of contact
4. Ensuring efficient masticatory function
5. Achieving comfortable occlusion
6. Establishing occlusion that would provide acceptable phonation and esthetics
7. Eliminating or modifying parafunctional habits [17]

Treatment considerations for patients with occlusal traumatism that have developed chronic periodontitis may include one or more of the following options:

1. Selective tooth grinding
2. Prosthetic therapy
3. Orthodontic tooth movement
4. Splinting
5. Extraction of selected teeth

Selective grinding (coronoplasty) involves precisely altering the occlusal surfaces of certain teeth to improve the overall contact pattern. Since this procedure is irreversible and involves the removal of tooth structure, it is of limited usefulness. Even when proper indications exist, coronoplasty should be performed only after inflammation surrounding the tooth has been adequately controlled, because tooth can be in supraocclusion as a consequence of inflammation. If coronoplasty is performed first, once inflammation has been treated, the affected tooth will be in infraocclusion. In general, selective grinding is appropriate only when the required alterations do not extend beyond the enamel structure. If this is not possible, and enamel has been penetrated by selective grinding, proper restorative procedures must be used. In patients with a large number of missing teeth, chewing forces are concentrated on the remaining teeth. In such cases, selective grinding is contraindicated and should be replaced by prosthetic therapy.

Occlusal therapy may also be performed as a part of orthodontic treatment, especially in different types of rough malocclusion. Tooth repositioning by applying appropriate orthodontic forces is one of the most widely used treatments following occlusion trauma. Still, this treatment modality is not without its drawbacks. For example, a periodontally compromised tooth with little bone support is not a good candidate for orthodontic tooth movement. Similarly, it is not advisable to move the tooth to a position which will further compromise its stability and long-term prognosis. In other words, the primary goal of orthodontic force application is tooth movement that will eliminate abnormal occlusal forces as well as improve long-term prognosis.

Periodontal splints can also be used to maintain and stabilize mobile teeth in their functional position and should be applied:
-To stabilize increasingly mobile teeth that have not responded to occlusal adjustment and periodontal treatment
-To prevent tipping or drifting and the over-eruption of unopposed teeth
-To stabilize teeth after orthodontic treatment
-To stabilize teeth following acute trauma

In rare cases, occlusal trauma may require tooth extraction, especially if the target tooth exhibits extensive periodontal involvement with poor prognosis, or when its removal would improve

the prognosis of the remaining teeth. Extraction of certain teeth may also be warranted to achieve more optimal position and alignment of the remaining teeth.

Occlusal therapy may be performed in different treatment phases, but is usually preceded by efforts to reduce or minimize inflammatory lesions. Evaluation of occlusal symptoms should continue throughout the course of therapy.

Conclusion

Available scientific evidence does not support the view that trauma from occlusion causes gingivitis or periodontitis, or accelerates the progression of gingivitis to periodontitis. Rather, extant research suggests that occlusal forces could contribute to the progression of periodontal disease by changing the pathway and spread of inflammation into the deeper periodontal tissues. Trauma from occlusion when combined with inflammation can produce infrabony pockets. However, its elimination should improve the clinical status of periodontitis.

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OVERVIEW OF 3D DIGITIZING AND DESIGNING METHODS USED FOR CUSTOM DENTAL MEDICAL MODELS

Sokac M., Eggbeer D., Santosi Z., Durakbasa N.M., Budak I.

Abstract: *The field of dental medicine has advanced greatly over the last decade. Three-Dimensional (3D) computer-aided methods are now routine in the fields of dental technology and dentistry, and are replacing physical production methods in many application areas. Computer-aided methods offer greater levels of precision and repeatability in complex patient-specific dentistry. This paper shows the overview of some of the methods and tools used for accurate acquisition of medical data and its transformation to digital form with the purpose of designing patient-specific medical models.*

Key words: *3D digitization, 3D design, medical models*

1. INTRODUCTION

The application of three-dimensional (3D) computer-aided design technologies in the medical field is accelerating, driven by reduced hardware and software prices and increased availability in parallel with increased recognition of the benefits. Complex reconstruction of bony anatomy following disease, trauma or congenital conditions is recognized to be safer using computer-aided technology [1]. Improved accuracy and speed of the custom device design and manufacture process compared to physical hand-crafted approaches are further-used to justify the transition to a computer-aided approach [2][3]. Dentistry [4], dental technology [5], maxillofacial [6] and craniofacial surgery [7] disciplines are among the leading adopters.

Clinical justification for adopting computer-aided technology is complemented by increasing commercial drivers and technology push. There are a growing range of commercially available systems for 3D digitization of anatomy, procedure planning, device design and production. with high accuracy and resolution. Today, there are many advanced software options capable of processing medical Computer Tomography (CT) scan data to a 3D computer model, ranging from industry-provided fully certified, regulatory compliant software to powerful freeware [8]. 3D surface scanning using laser, structured light or photogrammetry techniques have also become more accessible [9], [10]. Similarly, there is an increasing range of design software that can be used in complex anatomical reconstruction and design. The price of Additive Manufacturing (AM) equipment also continues to fall, which enables more people to fabricate complex, custom anatomical forms. Despite technological advances, the process of designing complex freeform anatomical geometries remains challenging. It also needs specialist software and hardware tools. Cooperation between engineering, dental/medical specialists remains paramount to achieve a safe outcome for patients and efficient processes for the healthcare providers. There are also other barriers to consider before more widespread adoption is possible, including the high costs associated with running some software and hardware [11], and the need for enhanced training to support newly required skills. Furthermore, evolving regulations around custom medical devices present challenges to both hospital-based and industry organizations using computer-aided technologies.

It is therefore important to reflect on current 3D computer-aided techniques to determine their potential value, limitations and the necessary developments required to enable more widespread adoption. This paper reviews 3D computer-aided methods used in dentistry and specific related areas of maxillofacial surgery. It focusses on direct and indirect custom device production.

2. METHODS AND MATERIALS

The workflow for obtaining patient-specific dental 3D models comprises of several key steps which can be divided into following (Figure 1).

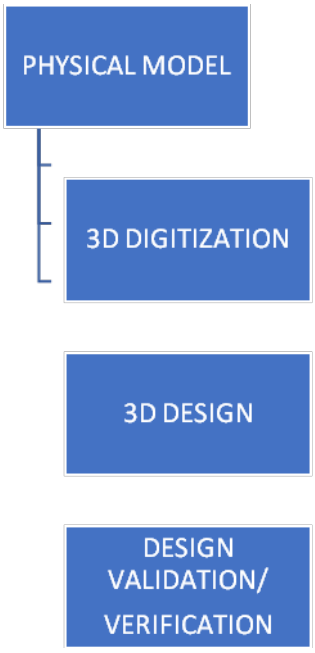
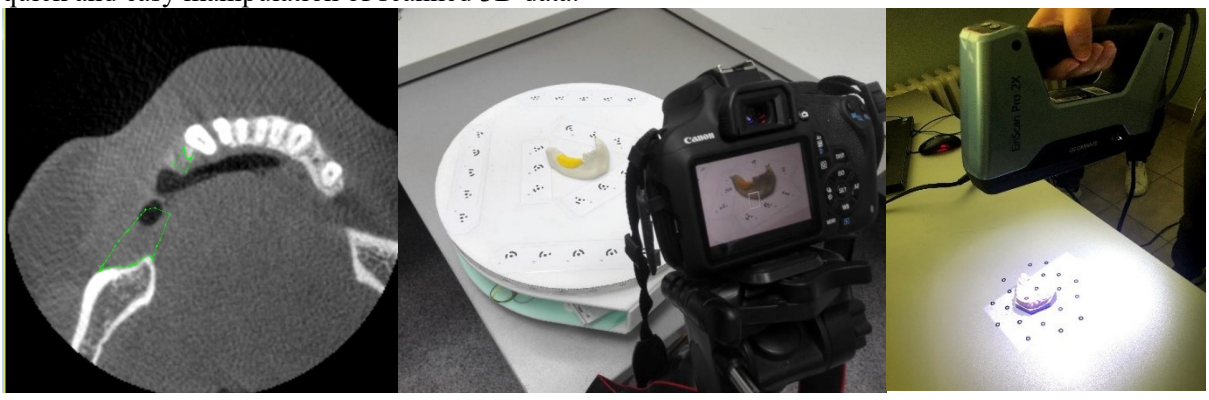


Fig. 1. Key steps defined for obtaining patient-specific dental model

2.1 3D digitization

Dental and maxillofacial custom device design workflows begin with acquiring 3D information of the patient. The type of 3D information will be dictated by the nature of the device being designed and whether it is surgically invasive, or intraoral. There are two primary options: Computed Tomography – CT (Fig. 2a) or Cone Beam Computer Tomography (CBCT) and; surface topography scanning methods, such as photogrammetry (Fig. 2b) and structured light 3D scanning (Fig. 2c).

Acquired 3D geometry is usually stored in *.stl* file format, which presents a standard format for quick and easy manipulation of scanned 3D data.

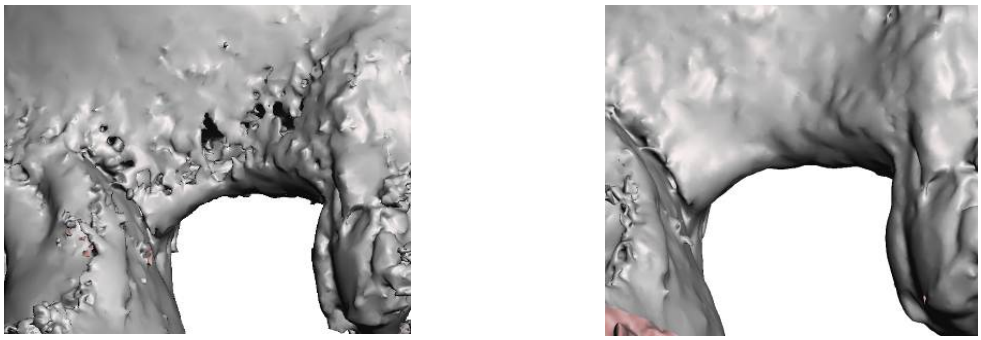


a) b) c)

Fig. 2. 3D digitization of physical models using a) CT scanner, b) close-range photogrammetry [10] and c) structured light 3D scanner

Using CT, the result of acquisition is stored in DICOM (Digital Imaging and Communications in Medicine) images. On the basis of these DICOM images, functional 3D models are reconstructed so that further designing and analysis can be conducted.

After 3D digitizing using CT scanners occurs, there is usually a need for some pre-design cleanup which can involve some type of surface preparation for the designing process. One of those examples is shown below on Fig. 3a where there was such need prior to patient-specific bone graft design (Fig. 3b).



a) b)

Fig. 3. 3D model obtained using CT scanner for bone graft design showing site a) before and b) after mesh preparation [12]

For 3D digitization using external 3D scanners, the results can be obtained with better accuracy, and with less noise on the resulting 3D data. But it must be taken into account that these methods are used for 3D digitization of casts, so some level of diminishing accuracy can be present. Of course, today there are also different commercial solutions of intraoral 3D scanners which offer direct 3D scanning [9]. Figure 4 shows the results obtained using external 3D digitizing methods such as close-range photogrammetry (Fig. 4a) and structured light 3D scanner (Fig. 4b). Note that there is also a need for post-processing of these scan data, due to the presence of holes or some sort of mesh irregularities.

a) b)

Fig. 4. 3D models obtained using a) close-range photogrammetry and b) structured light 3D scanner

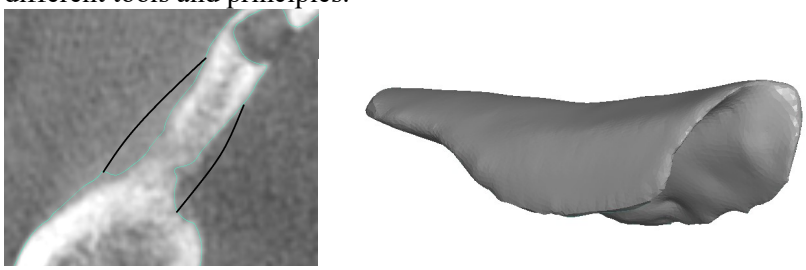
2.2 3D Design

The range of software available for complex anatomical form design is increasing. Options range from freeware (such as Meshmixer, Autodesk Inc.), through application-specific options (such as 3 Shape) to more open modelling software (such as Geomagic FreeForm, 3D-Systems Inc.). All this software provides a greater degree of flexibility and many advanced tools such as ability to combine complex organic shape creation with engineered geometry which are found in many custom medical devices. These 3D designing packages also allow designers to replicate the tools commonly used in laboratories using physical methods, but offer greater ability to undo mistakes, more geometric freedom and ability to analyze results prior to fabrication.

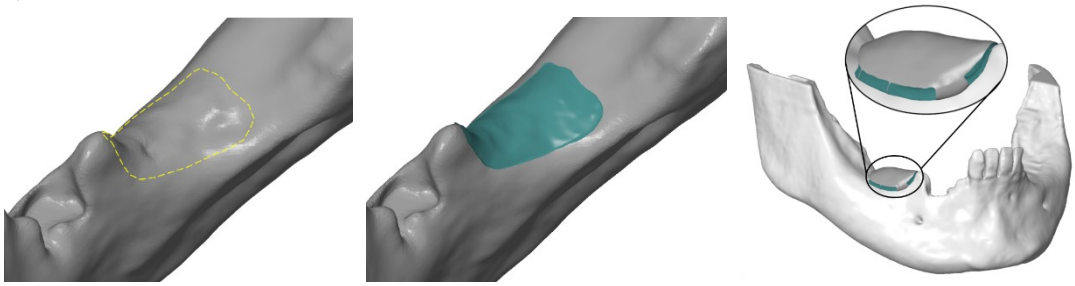
Depending on the input, which is in this case acquired digital geometry of the dental model, the design process can be achieved in a collaborative manner between designers and medical staff. It must be assured that the final design of the patient-specific 3D model will satisfy requirements from both sides, in regards to its design, mechanical, aesthetical and functional properties [5][13], [14]. This can only be achieved through the aforementioned collaboration between the two teams. One thing to note is that some of these equipment and software do require, to a certain extent, a training in order to be used appropriately.

Figure 5 illustrates several different approaches to designing a dental medical model which include

different tools and principles.

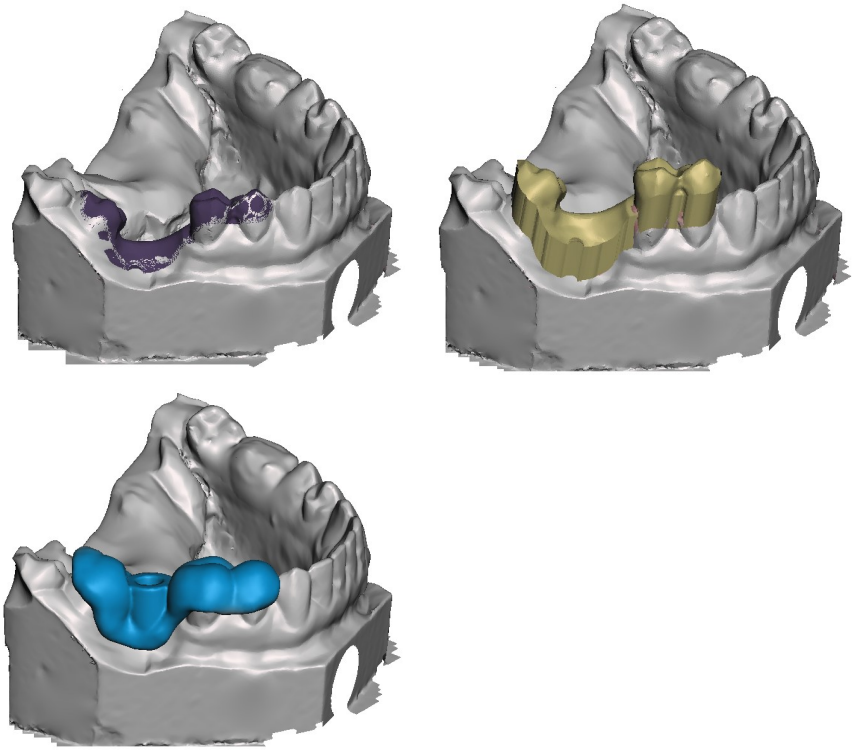


a)

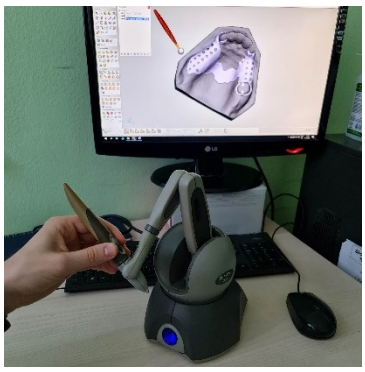
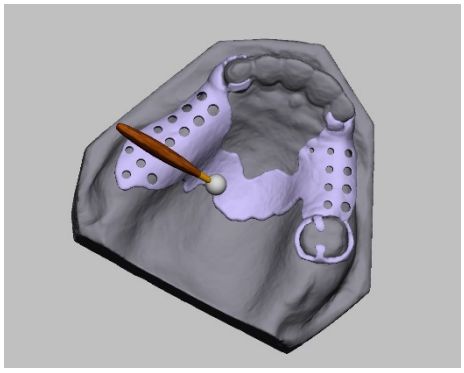


b)

c)



d)

e)

Fig. 5. Different designing principles for various dental models showing a) designing of bone graft directly from CT dataset, b) designing of bone graft from digital sketches [5], c) tracing design of removable partial denture (RPD) on 3D model obtained from close-range photogrammetry [15], d) design of surgical guide using *Offset* function and e) digital sculpting of RPD using haptic device with touch sensitive feedback

From Fig. 5a the presented approach consisted of designing a patient-specific bone graft directly from a CBCT dataset. The process included manual tracing of future 2D borders in the software (3D-DOCTOR, Able Software Corp.). However, this concept is quite time consuming, due to the fact that the designer has to retrace boundaries for each subsequent 2D CT slice. Therefore, it is not desired approach; other, more efficient options are described below. Fig 5b shows the improvement in design where, after a 3D model of the mandible was obtained from the CBCT dataset, borders were traced digitally on the base of the mandible. This served as the contact surface of the new bone graft. From there top surface was obtained by offsetting the bottom surface and connecting them with so called "bridges". Additional work was required in terms of filling the gaps to obtain fully enclosed 3D model, and modifying the top surface with sculpting tools to give it its final shape. Fig. 5c shows the application of optical 3D scanners for designing removable partial dentures (RPDs). In this case close-range photogrammetry was used due to its ability to capture object textures, along with its geometry. After a 3D model of the dental cast was obtained with its texture, it contained those manually drawn lines. From there, the 3D model was imported in designing software where those lines were digitally traced in order to form a base of the RPD. By offsetting the base and with further modifications of the RPDs 3D model, the final design was achieved. Fig. 5d also consists of application of external 3D scanners (in this case structured light 3D scanner was used) in order to obtain 3D geometry of dental cast with the purpose of designing a surgical guide. This approach differs from previous ones because the base borders have been digitally drawn and

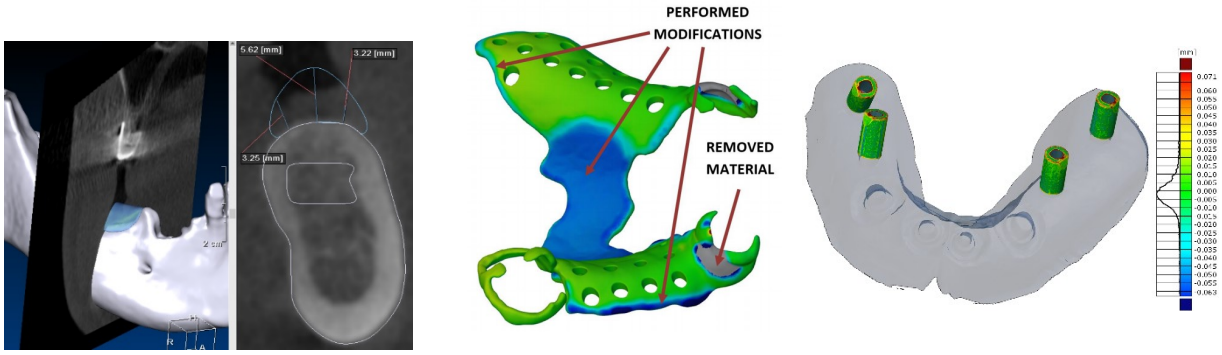
extracted from the 3D model of the cast. By using the "Offset" function in proprietary software (in this case *Meshmixer* software was used) a "rough" version of the surgical guide was obtained which contains fully enclosed 3D model. With further use of sculpting tools, the final 3D model of surgical guide is obtained by shaping only the top surface. Also, it was required to prepare the exact spot which will guide the surgeon during the procedure. Fig. 5e shows the most advanced application of designing tools and equipment by application of haptic device and proprietary software Geomagic FreeForm. This haptic arm allows user to receive a touch sensation feedback when interacting with virtual 3D model [16]. Designers receive feedback by using the haptic device during sculpting the dental model (in this case RPD), which more realistically mimics the physical process of fabrication in waxes and other materials. One note is that it takes a little bit of time by practicing and getting familiar with the use of this device.

2.3 Design validation and verification

After the designing process has been completed, there is still a question of its reliability to perform its intended function. This may be required to comply with regulations. For example, the recently introduced European Medical Device Regulations (MDR) have tightened requirements on custom

made medical device manufacture [17]. Depending on the area of insertion, the newly designed dental model should serve its purpose in providing a good support to normal bodily functions and should not interfere with any biological functions of the patient.

With that in mind, both design validation and verification should be included as a final step that can also pinpoint any possible need for further modification in the design of the medical models. Today, there are various types of analysis that can be performed, in order to assure the reliability of the designed dental model. Figure 6a-c shows different types of analyzes which involve both 2D and 3D analysis, in order to investigate and conclude that the designed patient-specific dental model will satisfy its use, or show the need for further modification.



a) b) c)

Fig. 6. Showing design verification step which includes both 2D and 3D analyzes a) dimensional verification of the bone graft [5], b) performed modifications for RPD based on 3D analysis [15] and c) CAD-Inspection analysis of the angular abutments [18]

3. CONCLUSIONS

This paper demonstrates the use of modern 3D computer-aided tools used in the design of patient-specific dental and maxillofacial models. These advanced approaches allow greater freedom to design complex custom forms to reconstruct defected more efficiently that manual hand-crafting methods. An increasing range of affordable software and hardware has become a major enabler for more widespread use. Limitations still remain, including the need for certified training in software and hardware and clarification around regulatory compliance in certain surgical applications of the technology.

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MANDIBULAR PREMOLARS WITH COMPLEX ROOT CANAL ANATOMY: AN ENDODONTIC CHALLENGE

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Abstract: *Mandibular premolars are considered as the most difficult to treat endodontically due to high rate of anatomical variations in their roots. The most common anatomical variations are a bifurcation and C-shape root canal, while a trifurcation is less common. The extensive knowledge of root canal morphology and all possible variations along with the clinical and radiographic assessment of the tooth are essential to diagnose and manage during endodontic treatment. Proper modification of access cavity preparation and chemo-mechanical instrumentation, as well as quality obturation of these anatomical variations could certainly improve endodontic success rate even in the most challenging cases.*

Key words: *Mandibular premolars, Root canal anatomy, Endodontic Management*

Introduction

The extensive knowledge and understanding of root canal anatomy and all possible anatomical variations is a significant prerequisite for the success of root canal treatment. Complex canal morphology, if not considered in time, may lead to poor prognosis and failure of the treatment.

Mandibular premolars are considered as the most difficult to treat endodontically because of high rate of variations in their root canal morphology [1,2]. According to an extensive study in the United States, failure rate of endodontically treated mandibular first premolar was the highest of all examined teeth and amounted to 11.45%, while of second mandibular premolar was 4.54% [3]. The most common anatomical variations are a bifurcation and C-shape root canal, while a trifurcation is less common. Other variations are extremely rare. The prevalence of anatomical variations of mandibular premolars is given in Table 1 [4-11].

Table 1. The prevalence of root canal variations of mandibular premolars

Tooth	Bifurcation	Trifurcation	C-shape
First premolar	24-28.5%	0.4-5%.	1-18%
Second premolar	1.5-8%	0.4%	0.6%

Inconsistency of research results can be explained by different methodological approaches, but also by documented variations according to genetics and race [12]. As shown in Table 1 the second mandibular premolar has a lower rate of anatomical variations. The final diagnosis of tooth anatomy should be based on the thoroughly assessed, common interpretation of radiographic and clinical data.

Preoperative identification of aberrant mandibular premolars morphology

An accurate diagnosis of the type of root canal configuration is a critical factor in achieving successful endodontic therapy. Awareness of the probable anatomical variations in mandibular premolars reduces the possibility of missed root canals during treatment.

Preoperatively, internal root anatomy should be analyzed by using periapical radiographs or CBCT (cone-beam computed tomograhic) images. Multiple periapical radiographs, one parallel and the others with horizontally angulated cone, will help in visualization of many anatomical details and type

of root canal system we are dealing with. Tracing the continuity of the periodontal ligament space may indicate the presence of multiple roots, bifurcated/trifurcated roots or aberrant anatomy. The presence of radiolucent lesion that doesn't match entirely with the radiographic apex may indicate a presence of multiple roots. Also, a sudden disappearance or narrowing of a root canal space indicates the presence of an additional canal and the level of branching. If three root canals exist, the coronal part of the canal space is usually wider with no taper at all. It has been documented that bilateral appearance of the same canal configuration is over 80% in mandibular premolars [11,13]. These results indicate that a contralateral tooth with a known anatomical configuration may be used as a clue in predicting the root canal morphology. Three-dimensional images provided by CBCT are a great tool for diagnosing the type of canal anatomy. CBCT eliminates the problem of superpositioning of canals and roots by surrounding anatomical structures. It provides insight into all anatomical details relevant to the therapy, and should be used whenever complicated canal anatomy is presented. American Association of Endodontists recommends the use of CBCT for the initial treatment whenever there is a suspicion that complex root canal morphology exist [14].

Detailed observation of the pulp chamber floor is the next significant factor in determing the type of root canal configuration. Unexpected crown shapes and dimensions, additional cusps and tubercles, deep longitudinal grooves, and teeth fusion imply anomalous tooth often associated with anomalous root canal morphology [15]. If a pulp chamber doesn't have expected oval appereance there is a great probability of existing second or even third root canal. Adequate visibility and detailed inspection of the pulp chamber floor are essential in detection of hidden or extra canal orifices. The use of sharp explorer,ultrasonic tips or long shafted burs mounted on low-speed hand piece are helpful in detection canal orifices and reduce excessive tooth structure removal [16]. If one canal bifurcates into two, the distribution is usually buccal and lingual, where the lingual canal separates from the main buccal canal at a sharp angle. In addition, bifurcations are predominantly at the middle or even apical third of the root [17]. To overcome this problem, the access cavity shoud be extended lingually to allow unobstructed passage of instruments into lingual canal. If three canals exist, they are usually positioned into two roots, one wider canal in the lingual root and two smaller canals in the buccal root positioned mesially and distally [17]. Bucco-lingual and triangular shape of the pulp chamber are predominant in teeth with two and three canals, respectively. C-shaped canal is difficult to confirm from the coronal approach which amplifies the significance of coronal enlargement, improved illumination, and magnification. Radicular grooves in these canals have been found mostly at the mesial or mesiolingual aspects of the root [10,11,18]. The dental Operating Microscope and magnifying loupes will significantly facilitate the access cavity exploration. Krasner and Rankow laws, as well as alternative methods like staining the pulp chamber floor with methylene blue dye, „champagne bubble test" with sodium hypochlorite and visualizing canal bleeding points may also be helpful [3,19]. However, frequent position of additional canals apically from the cementoenamel junction (CEJ) makes them difficult to identify at this stage of treatment. Tactile examination with a small precurved hand files in all directions along the canal walls helps in detection of extra canal orifice. Whenever the instrument shows an eccentric direction when penetrating deeper into the canal, an additional canal should be expected.

Endodontic management of aberrant mandibular premolars morphology

The whole process of endodontic management is very difficult and challenging due to close proximity of canals, mostly low-positioned branching, and the presence of apical deltas. Confirmatory working length radiograph may serve as one more check of a well-defined canal configuration; if file is not centered within the root, the tooth anatomy should be reconsidered. During biomechanical preparation, the use of new, flexible Ni-Ti rotary or hand files are highly recomended, as well as frequent inspection of files in order to discard those with distortion or damage. Any stoppage in the canal during the gently file movements may indicate the presence of extra canal or split. Special care should be taken during instrumentation along the sharp angles where the canals split to avoid file separation. The whole procedure must be performed carefully because excessive instrumentation can lead to strip or lateral perforations. In certain segments of the root, the thickness of the dentin can be extremely small, especially if the C-shape of the root is present, which can make a tooth more

susceptible to endodontic failure. The thickness of the remaining dentin in radicular groove area can be accurately measured on the CBCT images. Copious irrigation with a solution of NaOCl and EDTA during the process will disinfect the root canal system and allow facilitated file movements. As the canal space of the mandibular premolars often contains isthmus, ramifications, apical deltas and other irregularities, the use of any irrigation activation, sonic or ultrasonic, is recommended. A small diameter irrigation needle enhances the irrigation activity in these hard-to-reach areas [11,12,15].

When it comes to obturation of the root canal space, preference should be given to the obturation techniques with heated gutta-percha. Warm vertical compaction, as well as small-sized heat carriers, pluggers and back-filling needles are recomended. In the case of thin canals, lateral compaction with small sized spreaders or cone-fit are a technique of choice [20]. A low viscosity root canal sealer and its ultrasonic activation are recommended in order to fill isthmuses, narrow and inaccessible areas of the root canal system [21]. Although the coronary third of the canal is usually adequately flared, often there is still not enough space to accommodate two or more master gutta-percha cones simultaneously. In that case, the larger gutta-percha master cone should be cut extraorally at the level of extra orifice or the level of bifurcation/trifurcation. The shortened master cone should be compacted into the canal by using an appropriate plugger. In order to prevent blocking of the other canals with sealer or remnant gutta-percha, a paper points or a hand file should be placed within the canal/canals that will be filled later, by the same technique. Upon radiographic confirmation, the coronal parts of the canal should be backfilled. If there are segments of the root with thinned dentin, care should be taken because the heat transferred to the outer root surface can cause undesirable thermal damage of the supporting periradicular tissues [22]. The whole process of obturation is technicaly-sensitive and requires good clinical skills. Postoperative X-ray, in addition to determing the quality of the obturation, may indicate aberrant morphology of the root if it has not been previously diagnosed. Namely, if the canal filling outline doesn't match the geometry of the outer root surface or the periodontal ligament space, it may indicate the missed anatomy and retreatment might be considered.

Conclusion

Mandibular premolars can exhibit complex root canal morphology more common than expected and present a real challenge to diagnose and manage during endodontic treatment. The extensive and updated knowledge of root canal anatomy and all possible anatomical variations, careful and detailed interpretation of radiographs before and during the treatment, proper modification of access cavity preparation and chemo-mechanical instrumentation, as well as quality obturation of these anatomical variations are factors that lead to the success of therapy.

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FULL PAPERS

INFLUENCE OF CENTRAL INCISORS MORPHOLOGY ON THE FORMATION OF STEEP BITE

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***Abstract**: Class II division 2, is malocclusion, which consists of cases with distal molar relationship, retrusion of the upper central incisors, while lateral ones are protruded in most cases. The aim of the study was to determine whether there is a difference in the values of "neck angle" and vestibule-oral diameter in the cervical third of the permanent upper central incisors of class II / 2 patients and the rest of the population. Lateral X-ray cephalometric images were used to measure the "neck angle" of the incisors and digital study models to measure the vestibulo-oral diameter in the cervical third. The "neck angle" in patients with Class II/2 malocclusion was significantly lower compared to patients from the control group, while the vestibulo-oral diameter of permanent maxillary central incisors in the cervical third was smaller, but without statistically significant difference.*

***Keywords:** Keywords: II class, division 2; Neck angle; Vestibulo-oral diameter; Central incisors.*

Introduction

Malocclusion is a condition in the oral cavity in which morphological, functional and aesthetic irregularities of the masticating apparatus are combined [1]. In 1899, Edward Angle made a classification of malocclusions, during which he divided all malocclusions into three classes.

Class II malocclusion is characterized by the lower first molars being in the distal position relative to the upper ones, with the mesiobuccal nodule of the upper molar occluding with the distal surface of the lower second premolar and the mesial surface of the lower first molar. Due to drastic changes in the morphology of the central incisors, Angle, depending on the inclination of the incisors, divided the second class into two divisions [2]. Depending on the size of the distal relationship, class II can still be divided into:

- Semi-class II (singular antagonism) - when the lower dentition is shifted by half the width of the premolar in relation to the upper dentition. The most common in practice.
- Full Class II - when the lower dentition is moved the entire width of the premolar in relation to the upper dentition.

Class II division 1 malocclusion

In addition to the distal relationship of the dental rows, malocclusion of class II, division 1 is characterized by an elongated maxillary dental arch in the shape of a narrowed loop, which in extreme situations resembles the Latin letter “V”, followed by protrusion of the upper incisors. For these reasons, we have an increased incisal distance, i.e. the distance between the labial surfaces of the lower incisors and the incisal edges of the upper incisors.

Class II division 2 malocclusion

Class II division 2 malocclusions are cases with distal relation of the lower molars and retrusion of the upper central incisors, while the lateral ones in most cases are protruded, slightly mesiolabially rotated and overlap the distolabial surfaces of the central incisors. In this dento-alveolo-gnato-facial anomaly

in the lower dentition, the Spee curve is highly expressed due to supraposition of frontal (which in most cases are in coronary anxiety due to their retro inclination) and infraposition of lateral teeth.
The function of the circummoral musculature is common, although we have examples of people with incompetent lips.

This study will examine the influence of the morphology of the central incisors on the development of malocclusion II class, division 2, also called: degbis, steep or folding bite. Degbis is a dento-alveolo-gnato-facial anomaly [1].
Morphological characteristics of the upper permanent central incisors were examined in different groups of malocclusions [3-9]. This type of malocclusion occurs in 5% of all malocclusions [6].

The variability of the morphology of the upper permanent central incisors is an important factor in achieving the aesthetic and functional effect of orthodontic treatment. It has a significant role in planning the position of orthodontic braces, as well as the outcome of therapy and the stability of the results achieved. The angle between the crown and the root part of the upper central incisor limits the degree of torsion in therapy, in order to avoid perforation of the palatal bone [3].

The angle formed by the longitudinal axial axes of the crown and the root, the so-called "neck angle", is most often examined in research using this technique [3,4, 6-9,13,14].

Goals

The goals of this research are:

1. To determine whether the "neck angle" that covers the crown and root of the upper central incisors differs between subjects with Class II division 2 malocclusion compared to the rest of the population.
2. To examine whether there are differences in morphology (vestibulo-oral diameter in the cervical third) in persons with degbis compared to the rest of the population.

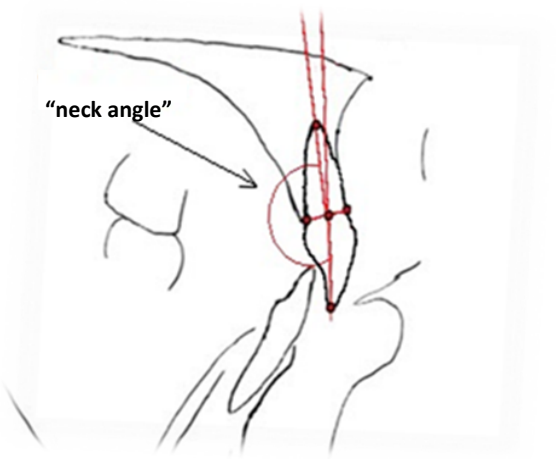


Figure 1. Neck angle and vestibulo-oral diameter of the tooth

Material and methods

The research was conducted at the Clinic of Dentistry of Vojvodina, the teaching base of the Medical Faculty of the University of Novi Sad, with the approval of the Ethics Commission. The research was conducted as a cross-sectional study. Measurements were performed on a computer in the OnyxCeph 3D Lab program, where the vestibulo-oral diameter of the central incisors in the cervical third was measured on 60 digital study models of patients of the Department of Orthopedic Orthopedics, with 30 models of patients with degbis and 30 models of control group, persons with proper occlusion.

Measurement of angles that coincide with the axial axes of the crown and root of the upper central incisors on lateral cephalometric X-ray images performed in the X-ray room of the Dental Clinic of Vojvodina, by standard technique and under 12 uniform conditions, on on the apparatus Orthophos XG5 (Sirona Dental GmbH, Wals bei Salzburg, Austria).
Analyzes of the obtained cephalometric X-ray images were performed using OnyxCeph analysis software (Image Instruments GmbH, Chemnitz, Germany).

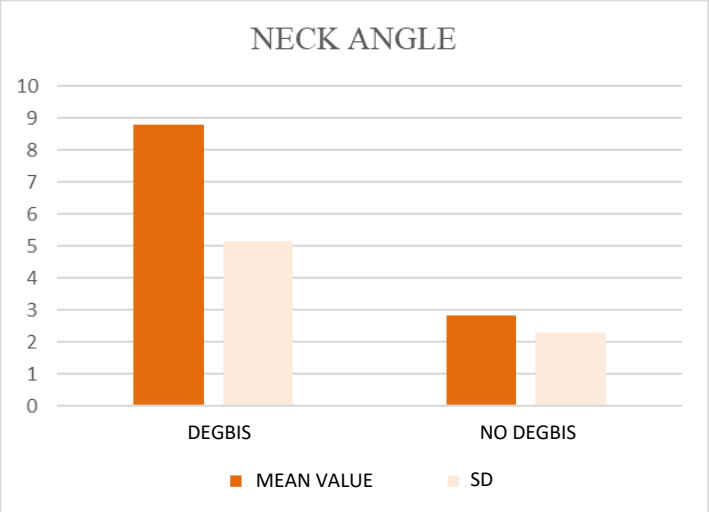
Results

Table 1. Properties of the group of subjects and the control group related to the neck angle

SAMPLE	NUMBER OF SAMPLES	MEAN VALUE ± SD [º]	MINIMUM VALUE [º]	MAXIMUM VALUE [º]	*p*
DEGBIS	30	171,2 ± 5,17	1	22	0,000158
CONTROL GROUP	30	177,17 ± 2,3	1	10	

SD – standard deviation;
p<0,05

Table 1 shows the results obtained by measuring the neck angle on 60 lateral cephalometric X-ray images, of which 30 images were analyzed from patients with degbis, and 30 images were analyzed from patients from the control group.
The mean value of the neck angle in patients with degbis was 171,2º and the standard deviation was 5,17º. The mean value in the patients from the control group was 177,17º, while the standard deviation was 2,3º.
In order to determine whether there was a statistically significant difference between these two groups of patients, a student t-test was performed which showed that p = 0,000158, so that there is a statistically significant difference between patients with degbis and the control group.



Graph 1. Comparison of the neck angle of the permanent upper central incisor between the subjects and the rest of the population

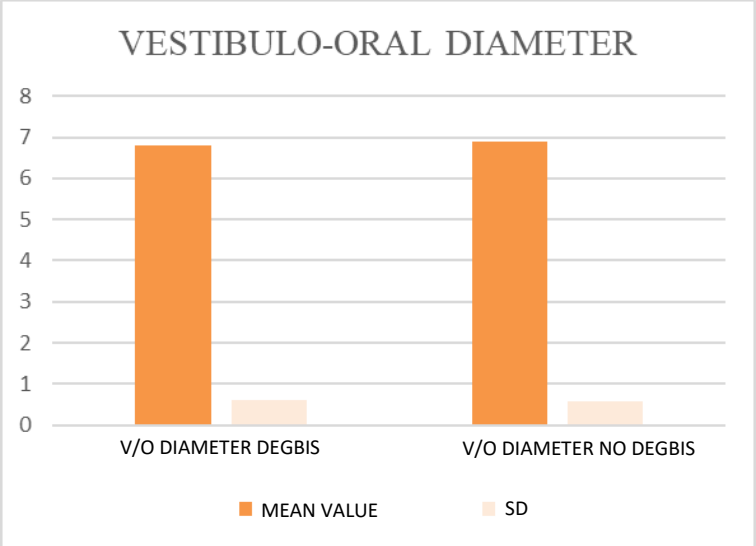
Table 2. Properties of the group of subjects and the control group related to vestibulo-oral diameter in the cervical third of the permanent upper central incisors

SAMPLE	NUMBER	MEAN	MINIMUM	MAXIMUM	*p*

	OF SAMPLES	VALUE ± SD [mm]	VALUE [mm]	VALUE [mm]	
V/O DIAMETER DEGBIS	60	6,81 ± 0,62	5,2	8	0,26
V/O DIAMETER CONTROL GROUP	60	6,88 ± 0,57	5,9	8,4	

SD – standard deviation;
V/O - vestibulo-oral diameter of the permanent upper central incisor in the cervical third;
p<0,05

Table 2 shows the results obtained by measuring the vestibulo-oral diameter of the permanent upper central incisors in the cervical third. Measurements were performed on 60 digital study models, of which 30 were study models of patients with degbis, and 30 study models of persons with proper occlusion from the control group. The mean value obtained by measuring 60 central incisors in patients with degbis was 6,81 mm, and the standard deviation was 0,62 mm. The mean value in the patients of the control group was 6,88 mm, with a standard deviation of 0,57 mm. In order to determine whether there is a statistically significant difference between these two groups, the student's t-test was performed, where it was obtained that p = 0.26, so there was no statistically significant difference in these two groups of patients.



Graph 2. Comparison of the vestibulo-oral diametar of the permanent upper central incisor between the subjects and the rest of the population

Discussion

The research conducted at the Clinic of Dentistry of Vojvodina partially fulfilled the hypotheses that were set at the beginning. The hypothesis that the "neck angle" will deviate to a greater extent in its size in patients with II class, division 2 compared to patients in other classes was confirmed, and a statistically significant difference was obtained, which is shown numerically in Table 1. On the other hand, the vestibulo-oral diameter measured on 30 digital study models (60 central incisors) in patients with degbis was lower by an average of 0,09 mm, which is a lower value than patients from the control group, but not so much to be statistically significant, which can be seen in Table 2.

The age of the patients was not considered in this study. There were patients with mixed dentition, but the condition was that the permanent upper central incisors had fully sprouted in order to measure their vestibulo-oral diameter in the cervical third, while in the analysis of lateral teleradiographs the

condition was that our reference points that were measured, are well visible, i.e. that the images are of good quality, while if there were problems with superimposing and distinguishing the central from the lateral incisors, the ambiguities were resolved by observing study models and X-rays in parallel [15].

The morphological characteristics of the permanent upper central incisor have a great influence on the occurrence of malocclusion II class, division 2. The most important factors are the reduced vestibulo-oral diameter in the cervical third, i.e. development of the cingulum as well as retroinclination of the coronal part of the tooth, which leads to deep bite, in which the lower central incisors reach the palatal mucosa, and the upper incisors have a traumatic effect on the lower ones, later leading to tooth root exposure and periodontal problems [3-5].

As a characteristic of this class and this division, deviations from the usual proportions in the length of the root and crown were also noted, where a shorter root length was determined in relation to the tooth crown. Knowledge of the morphological features of the teeth could contribute to a better effect of orthodontic therapy in terms of causal action, and a lower tendency to recurrence of malocclusions after therapy.

Conclusion

In the presented study, the "neck angle" in patients with Class II division 2 malocclusion was significantly lower compared to patients from the control group, while the vestibulo-oral diameter of permanent maxillary central incisors in the cervical third was smaller, but without statistically significant difference. The results refer to both sexes, because the additional analysis showed that there is no statistically significant difference between these two groups of examinees.

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INFLUENCE OF POLYMERIZATION METHOD OF COMPOSITE CORE MATERIALS ON THE DEGREE OF MONOMER CONVERSION USING INFRARED SPECTROSCOPY

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Abstract: *The aim of this study was to examine the influence of the polymerization method of composite core materials on the degree of monomer conversion. The research included two composite core materials with different modes of polymerization, chemical and light polymerization. Determination of the degree of conversion of monomers was done on 6 samples of each of the two materials. The degree of conversion of monomers to polymer was determined in an infrared spectrometer with Fourier transform (FTIR). The obtained results were processed by standard procedures of descriptive and comparative statistics. The software package SPSS 25.0 (Statistical Package for Social Sciences) was used. Degree of conversion of self-curing materials (Clearfil Self Core) was 55.3%, while the degree of conversion of light curing materials (Clearfil Photo Core) was 66.5%. The polymerization method of composite core materials affects the degree of monomer conversion. For clinical work, the use of light curing composite core materials is recommended.*

Keywords: *composite resin; composite core materials; degree of conversion; FTIR*

1. Introduction

Different composite materials are used in the core build-up procedure. Most of these materials were not developed for this purpose, but due to their properties they have found application in the core build-up procedure. The core build-up procedure is a preprosthetic clinical procedure for the restoration of the damaged crown part of the tooth of the future fixed restoration. [1,2] Given the different materials used today, clinicians are unsure which material is best in the core build-up procedure to obtain long-lasting clinical results.

A special group of composite materials has been developed for the preprosthetic restoration of the crown part of the tooth - composite core materials. The manufacturers state that these materials have high strength, hardness and greater penetration depth of polymerization rays, which provides reliable support for the restoration above. [3] Core materials are usually retained with adhesive systems or post to provide stability for future crown or bridge. All composite core materials were divided into three groups based on the method of polymerization. The first core materials are light-cured (light-curing), the second is double-curing (combining light and chemical polymerization) and the third is chemically-curing. Double-curing composite core materials have been developed to take advantage of both chemically-curing and light-curing composite materials. [2] Research has shown that double-curing composite materials have better curing properties than chemically-curing ones. Composite core materials are usually placed in a single layer 6-8mm thick, which makes it easier for the clinician to work. While conventional composite materials are placed in layers 2 mm thick, which prolongs the working time. Light activates polymerization in the surface layers of composite core materials and thus provides fast hardening of the material as well as the initial stability of the restoration. Chemical polymerizing materials provide complete polymerization even in deeper layers that have received little light from the polymerization source. [4,5,6,7] However, many studies have found that the mechanism of later polymerization in double polymerizable materials is not only slower but also less effective in terms of the degree of conversion compared to light-curable composite materials. [5,6,7,8]

The degree of conversion represents the percentage of double carbon bonds converted to single as a result of the polymerization process, respectively it is the ratio of reacted and unreacted

monomer. Because the viscosity increases due to crosslinking during polymerization, part of the monomer remains trapped between the polymer chains and the degree of conversion can never be 100%. The degree of conversion is a basic measure that affects the mechanical properties of composites such as hardness, strength, elasticity, solubility, water absorption, color stability, dimensional stability, biocompatibility and more. Higher degree of conversion is associated with better mechanical properties of polymeric materials. [2,9] Incomplete polymerization of the matrix can lead to resin-based materials being sensitive to the enzymatic action of some exogenous substances, which we take into the oral environment during meals and beverages. This can compromise their clinical durability. [10,11] Recent research has shown that the degree of conversion is not sufficient to characterize the three-dimensional structure of dental composites. Polymers with a similar degree of conversion may show differences in cross-linking density due to differences in chain linearity. [2,12,13,14] Areas with different concentrations of double carbon bonds may exist in the same polymer. [15,16,17]

The degree of conversion depends on: the chemical structure of the monomer, the concentration of polymerization initiators, the size, proportion and type of inorganic filler, intensity, exposure time and distance of the light source from the composite material surface and translucency of composite materials. [9]

The final degree of conversion of composites depends mostly on the chemical structure of monomers and polymerization initiators such as the chemical structure of dimethylacrylate monomers and the concentration of photo-initiators and external factors. The degree of conversion of several Bis-GMA-based composite materials was evaluated using infrared spectroscopy. The obtained values were in the range of 52-75%, with the majority of materials in the range of 55-60%. The required degree of conversion for adequate clinical work has not yet been determined. However, in vivo studies have found an inverse proportionality between the abrasiveness of the material and the value of the degree of conversion in the range of 55-65%. For this reason, composites with a degree of conversion below 55% are not recommended for occlusal restorations. The degree of conversion ranges from 44 to 74% for one study, and 55 to 75% for another. [18,19,20] The degree of conversion of composite materials containing Bis-GMA depends on the amount of TEGDMA. The higher the concentration of TEGDMA, the higher the degree of conversion. TEGDMA increases the mobility of molecules and thus their reactivity. The degree of conversion also depends on the exposure time of the composite material to blue light. The longer the exposure time, the higher the degree of conversion. Many studies have looked at the impact of fillers on degree of conversion. It turned out that the degree of conversion progressively decreases with a linear increase in the content of opaque filler. [21,22,23] The degree of conversion of light-curing composite materials depends on several factors including the percentage of inorganic filler and the particle size of the filler. The higher the proportion of inorganic filler, the higher the degree of conversion. The smaller the size of the filler particles, the lower the degree of conversion, probably due to the scattering of light on the surface of small filler particles, which reduces the light intensity. Differences in filler particle shape did not affect the degree of conversion of experimental composite materials. [21,24,25,26] There are two methods for determining the degree of conversion. The first one is direct method of determination based on the amount of consumed double carbon bonds, which is more precise. The second method is indirect, which is based on the correlation of the degree of conversion with some other property, such as microhardness. [27]

There are several methods for determining the degree of conversion of composite materials. Sophisticated and modern methods of spectroscopy are Raman and FTIR (Fourier infrared spectroscopy). FTIR spectroscopy is a widely accepted method for detecting C=C bonds before and after sample polymerization. This method is based on the fact that molecules absorb electromagnetic radiation in the infrared spectrum, which converts tissues into the energy of intramolecular vibrations. The frequency of absorbed radiation corresponds to the frequency of intramolecular vibrations. Reflected radiation is transmitted through an interferometer. The difference in intensity of the two waves is used to obtain the spectrum. [28,29,30,31]

The advantages of light-curing composite materials over chemically-curable composite materials are a higher degree of conversion, less porosity, greater color stability and time savings. [24]

Possible disadvantages of light-curing resins compared to chemically-curing ones are uneven polymerization, decreasing degree of conversion with respect to depth, due to more difficult

penetration of light into deep parts of the cavity. After activation by light, composite materials continue the polymerization process for 24 hours, but the main part takes place under the influence of light (80 to 85%). TEGDMA is thought to be the main factor responsible for polymerization in the post-irradiation period: the higher the concentration of TEGDMA, the lower the polymerization in the post-radiation period because TEGDMA causes a higher initial degree of conversion due to greater molecule mobility and greater reactivity. [24,26,32,33,34]

2. The aim of study and hypothesis

The aim of this study was to examine the influence of the polymerization method of composite core materials on the degree of monomer conversion. The basic hypothesis in the research is that there is no difference in the degree of conversion in chemically-curable and light-curing composite core materials.

3. Materials and Methods

The research included two composite core materials (Table 1), with different modes of polymerization, chemical (Photo 1) and light polymerization (Photo 2).

Table 1. Composite core materials used in this study.

materials	polymerization method	manufacturer
Clearfil ®Core	self-curing materials	Kuraray Medical Inc. Japan
Clearfil ™Photo Core	light-curing materials	Kuraray Medical Inc. Japan

Photo 1. Clearfil Self Core

Photo 2. Clearfil Photo Core

Sample preparation

To determine the degree of conversion, polymerized samples of disk-shaped materials with a diameter of 5 mm and a thickness of 2 mm were used (Photo 3).

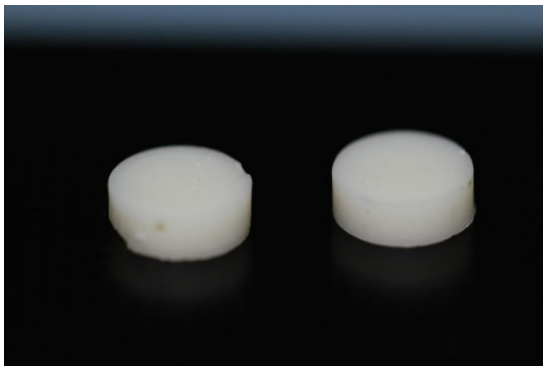

Photo 3. Polymerized samples of disc-shaped materials

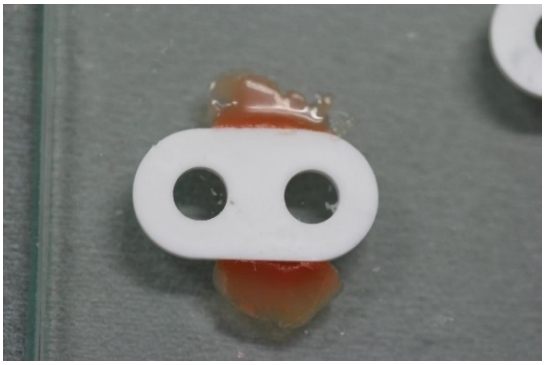

Photo 4. Plastic mold

Disc-shaped samples were prepared with the plastic molds (Photo 4). Plastic molds are placed on a glass plate and fixed with gluing wax. The composite core material was put into the mold by the

bulk technique. The surface of the mold with the composite material was covered with celluloid tape (Mylar strip) over. After that it was pressed with a glass plate to squeeze out the excess material.

The chemically polymerized composite material was placed in molds and left to chemically polymerize for 5 minutes. The light-curing material is exposed to an LED light source for 20 s. The LED light source used in this study (Bluephase, Ivoclar Vivadent, Schaan, Liechtenstein), has a declared intensity of 1200mW / cm2 in HIP mode and an optical conductor tip diameter of 8mm. The samples were illuminated only from the upper side, at a distance of 1 mm between the optical conductor and the sample surface.

Immediately after polymerization, excess composite material was removed with a scalpel, and the surface of the samples was polished with a set of Sof-Lex discs (3M ESPE, USA) for water-cooled polishing for 30 s.

After completion of polymerization and polishing, the samples were removed from plastic molds and stored at 37 ° C in a dark container without water. Samples were prepared 48 h before testing the degree of conversion.

Degree of Conversion

Determination of the degree of conversion of monomers was done on 6 samples of each of the two materials. The degree of conversion of monomers into polymer was determined in an infrared spectrometer with Fourier transform (FTIR) (Thermo Nicolet Nexus 670 Ftir spectrometer, Medison, WI, USA) (Photo 5) under the following conditions: 32 scans with 4cm-1 resolution at room temperature. Frequencies from 4000 to 400 cm-1 were scanned, and then from 1560 to 1670 cm-1. Only one point in the middle of the sample was scanned, which was determined by positioning the sample in the spectrometer. Only one surface of the samples was analyzed, namely the upper surface (which was illuminated with a polymerization lamp) of the sample marked with a scalpel. The spectrum of unpolymerized material was used as a control. The degree of conversion was calculated using a two-frequency technique, C=C group at 1638 cm-1 (analytical frequency) and C ... C group at 1608 cm-1 (reference frequency). Maximum peak intensities at 1638 cm-1 and at 1608 cm-1 of unpolymerized and polymerized material were determined and based on them, the value of the degree of conversion was obtained. The OMNIC 8 operating program, Thermo Fisher Scientific, was used. The degree of conversion was measured after 48 h from the moment of polymerization of the composite resin. Prior to measurement, samples were stored at 37 ° C in a dark, water-free container.

The degree of monomer conversion was calculated using the following formula:

$$DC = \left(1 - \left(\frac{R\ cured}{R\ uncured}\right)\right) \times 100$$

where DC is expressed in %,

R_{cured} is the peak intensity at 1638 cm-1 divided by the peak intensity at 1608 cm-1 of the polymerized material,

$R_{uncured}$ is the peak intensity at 1638 cm-1 divided by the peak intensity at 1608 cm-1 of unpolymerized material.

Photo 5. FTIR spectrometer

Statistical analysis

The obtained results were processed by standard procedures of descriptive and comparative statistics. The software package SPSS 25.0 (Statistical Package for Social Sciences) was used. Descriptive statistics were used to obtain descriptive statistical indicators, respectively variables were described using mean and standard deviation. To test the hypothesis it was used Man Whitney U test. This nonparametric test compares the mean values of two independent groups, regardless of data distribution. It tests the null hypothesis that the mean values of the observed groups are equal, as opposed to alternative to the mean values of the observed groups differ, using the following formula: $U = NM + \frac{n(n+1)}{2} - \sum_{x_i} Rank\,(x_i)$. Testing was conducted at the level of statistical significance of 5% which is the standard level in statistical analyzes.

4. Results

The descriptive properties of the observed variables were examined (Table 2). Clearfil Photo has slightly higher mean values than the other observed Clearfil Self material, as well as slightly lower standard deviation.

Table 2: Descriptive indicators of the examined variables

	Clearfil Self	Clearfil Photo
Sample mean ($\overline{X}$)	55.3	66.5
Median	54.8	66.4
Sample Standard Deviation	2.913	0.788
Sample size (n)	6	6

Figure 1 shows the degree of conversion of the tested materials, and it can be seen that the degree of conversion is slightly higher for materials from the Clearfil Photo group than for materials from the Clearfil Self group.

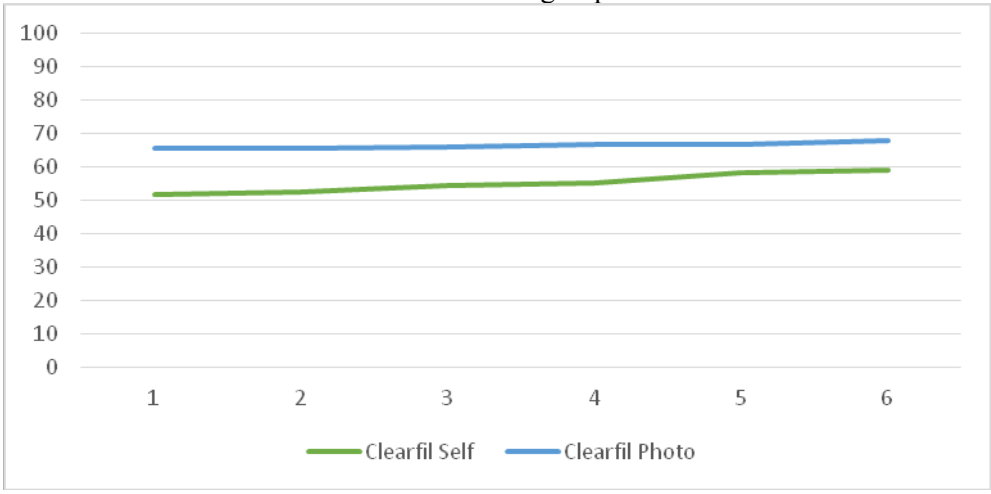

Figure 1: Degree of convention of the observed materials

Figure 2 shows the mean values of the degree of conversion of the observed materials. As in the previous figure, the degree of conversion of Clearfil Photo material is on average higher than that of Clearfil Self material.

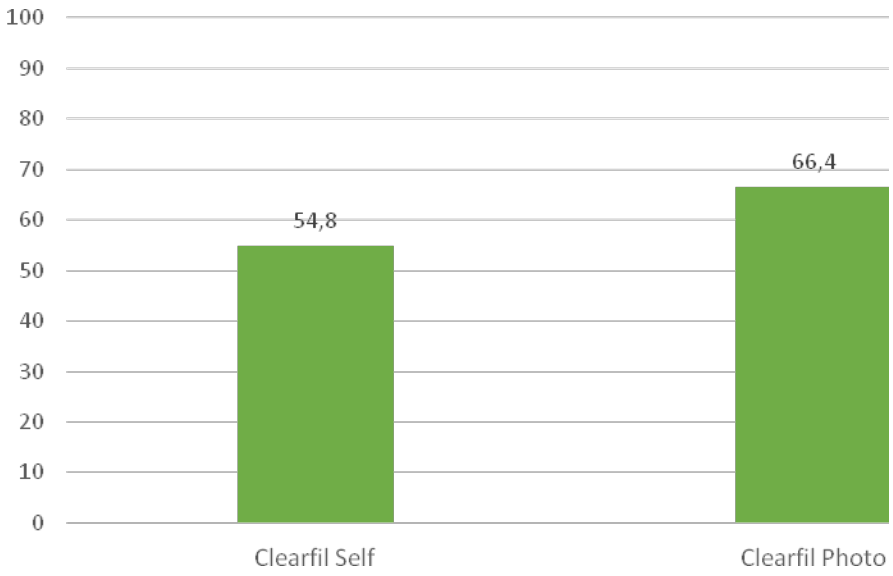

Figure 2: Mean values of the degree of conversion

Descriptive indicators showed the existence of certain differences in the degree of conversion in favor of Clearfil Photo material. The Mann Whitney U test was used to confirm whether these differences were statistically significant, respectively to answer the hypothesis. The results of this test are given in Table 2 and Table 3. Table 2 gives the rank values for both groups, and then it was calculated whether the ranks of these groups differ significantly. Table 3 gives the test results. The Mann Whitney test revealed a significant difference in the degree of conversion between the observed materials ($p < 0.05$). The degree of conversion of Clearfil Self material and Clearfil Photo material differ statistically significantly, so Clearfil Photo has a higher degree of conversion than Clearfil Self material.

Table 2: Ranks of observed groups

	N	Mean Rank	Sum of Ranks
Clearfil Self	6	3.50	21.00
Clearfil Photo	6	9.50	57.00

Tabela 3: Mann Whitney U test

	Degree of conversion
Mann-Whitney U	0.000
Wilcoxon W	21.000
Z	-2.882
Asymp. Sig. (2-tailed)	0.004
Effect size*	0.83205

The magnitude of the impact, that is, the magnitude of the effects that indicate the magnitude of the difference between the groups, and not just whether the difference is random or not, can be expressed using the Cohen indicator. This indicator has values in the range from 0 to 1. The calculated magnitude of the impact of differences in this example is 0.8 which is considered a large impact.

5. Discussion

Modern dental science and practice do not know the ideal material for prosthetic tooth restoration. Preprosthetic tooth restoration is a common restorative procedure. Proper selection of composite core material is very important for the clinical success of a restored tooth. The research includes two modern composite core materials with different methods of polymerization. A sophisticated spectroscopy method, FTIR, was used to determine the degree of conversion. The average degree of conversion of chemical polymerizable materials was 55.3%, while light polymerizable materials showed a higher degree of conversion of 66.5%. A similar average value was obtained in the research from 2013, when Alshali and co-workers obtained values of the degree of conversion in the range of 52-75%, with the majority of materials in the range of 55-60%. The degree of conversion was measured by Fourier infrared spectroscopy immediately after polymerization and 24 hours after polymerization at 37 °. They compared the degree of conversion of bulk-fill and resin-based composites. Eight samples of resin-based composites and three samples of bulk-fill material were used in the experiment. A statistically significant difference was obtained between the degree of conversion of these two groups of materials. Resin-based liquid composite showed the highest degree of conversion (77.1%), while the degree of conversion of materials from the bulk-fill group had slightly lower results (49.5-62.0%). In addition, they compared the degree of conversion of these substances immediately after polymerization and after 24 h. The degree of conversion immediately after polymerization was in the range of 34.7-77.1%. After 24h the degree of conversion of these materials was different and was in the range of 50.9-93.1%. After activation by light, composite materials continue the polymerization process for 24 hours, but the main part takes place under the influence of light (80 to 85%). [18] In our study, we measured the degree of conversion after 48 h and the samples were stored at 37 ° in a dark container. Keeping composite materials in dark rooms and in the refrigerator prolongs their value by slowing down the decomposition of peroxide initiators.

There are no literature data on the relationship between the quality of polymerization of core composites and their mechanical properties and elution of potentially harmful substances. Therefore, the study from 2021 aimed to compare the DC, mechanical properties and monomer elution from self-, dual- and light-cured core composites from the same manufacturer and study the correlation between these properties. Five samples of each of the following materials were prepared for each test: Clearfil (Core, Photo Core, Automix), Bisco (Core-Flo, Light-Core and Bis-Core). DC was determined using FTIR, compressive and flexural strength and modulus of elasticity using a universal testing machine and microhardness using Vickers hardness. Elution was measured using HPLC. One-way ANOVA with Tukey's post-test and Pearson's correlation were used to statistically analyze the data. DC of Clearfil-Dual (70.1%) and Clerafil-Photo (66.8%) were higher than Clearfil-Self (55.4%) and all Bisco materials (51.4–55.3%). Flexural strength of Clearfilwas higher than that of Bisco composites. The microhardness of Clearfil-Dual (119.8VHN) and Clearfil-Photo (118.0VHN) were higher compared to other materials. The greatest elution was detected from self-cured materials. DC positively correlated to microhardness and compressive/flexural strength and negatively to BisGMA elution. Clearfil-Photo and Automix showed higher conversion, lower monomer elution and, generally, better mechanical properties. Self-cured composites should not be recommended for routine clinical use as their performance was inferior to dual- and light-cured composites. Microhardness may be used as an indicator of elution. [3]

In the research from 2015, five different light-curing and four double-curing materials were used. The degree of conversion of these materials was measured by Fourier infrared spectroscopy. In the group of light-curing materials, no statistically significant difference in the degree of conversion between these materials was proven. The position of the polymerization lamp during the polymerization of the sample is very important. Degree of conversion of material that is polymerized by a lamp at the distance of 1mm was significantly higher than the degree of conversion of the material polymerized by the lamp at a distance of 10mm. The decrease in the degree of conversion between these two materials was in the range of 16.9-26.4%. In this regard, the authors recommend that during the clinical work, the polymerization device is placed as close as possible to the material. In the group of double-curing materials, it has been proven that the share of light-curing material has the most significant influence on the higher degree of conversion. [35] In our work, the distance between the optical guide of the polymerization lamp and the sample surface was 1mm.

A study conducted by Karakis and associates in 2017 showed a statistically significant difference in the degree of conversion of double-polymerizing composite core materials and chemically polymerizable composite core materials. Twelve samples from the group of double polymerizable materials were polymerized using a quartz halogen (QTH) lamp. While twelve samples from the second group chemically polymerized. The degree of conversion was measured by Fourier infrared spectroscopy. Double polymerizing materials showed superior polymerization characteristics. The degree of conversion of these materials was in the range of 56.83-71.78%. Also, their research confirmed the previous views that the degree of conversion of double-polymerizing substances depends on their composition. [2] Some believe that chemically activated composite resins first polymerize on tooth/resin bonding surfaces, because the resin is rapidly activated here due to heating by the tooth and by dentin bonding components.

A group of German authors investigated residual monomer from three groups of different composite core materials and its correlation with the degree of conversion. Three different composite core materials were tested: chemical, light and double polymerizing. Ten samples of each material were used in the experiment. The light-curing materials were polymerized for 40 s and double-cured for 20 s. The degree of conversion was measured by Fourier infrared spectroscopy after 24 h, 7 and 28 days on four samples from each group of materials. The average degree of conversion of chemically polymerizable materials was 55%, light-curing 73.7%, while the degree of conversion of double-curing materials was 74%. The degree of conversion of chemically polymerizing materials was statistically significantly lower than in the other two groups of materials, which coincides with our result. However, no statistically significant difference has been proven between light and double curing materials. [36]

In our study, the null hypothesis was rejected because a statistically significant difference in the degree of conversion of light-curing core materials compared to chemically polymerized core materials was found. Further clinical research is needed to determine whether the values obtained in this vitro study coincide with the clinical performance of composite core materials.

6. Conclusion

Based on the conducted *in vitro* research and the obtained results, the following conclusions can be drawn:

1. Light-curing Clearfil Photo composite core material had a higher degree of conversion
2. The method of polymerization of composite core materials affects the degree of monomer conversion
3. For clinical work, the use of light-polymerizing composite core materials is recommended.

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APPLICATION OF CAD-CAM TECHNOLOGY IN THE PRODUCTION OF AESTHETIC RESTORATIONS

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***Abstract**: The aim of this paper was to shows the application of CAD-CAM technology in the production of aesthetic restorations. It is a matter of computer-controlled design and production of restorations - creation of two-dimensional or three-dimensional models as well as their materialization. In this way, the manufacturing process is accelerated and enables the production of highly aesthetic restorations from modern ceramic systems. Inlay bridges are minimally invasive dental restorations that are made in conditions of minimal edentulousness. They are indicated for vital intact abutment teeth, small carious lesions or old fillings localized towards the space of lost teeth, while they are contraindicated for teeth with short clinical crowns.*

***Keywords**: CAD-CAM technology; ceramic materials; aesthetic restorations; inlej bridges.*

INTRODUCTION

The origin and development of machinable materials refers to a group of materials, whose specificity consists of physical and chemical properties adapted to the process of computer-controlled machining (CAD-CAM systems). CAD / CAM (Computer Aided Design / Computer Aided Manufacturing) means computer-controlled or controlled design and computer-aided design.

CAD/CAM - computer aided design / computer aided design - computer aided or controlled design and production - this systems are used to create two-dimensional or three-dimensional models and their materialization through numerically controlled machines - essence of robotics is the removal of "dirty" technologies, reduction of human labor, uniformity of quality, simple production process and a wide range of building materials. Today's machining systems operate on 3 different principles:

- copier milling,
- computer-controlled manufacturing and,
- computer-controlled design and production.

CAD -CAM systems in dentistry, consist of 3 components:

1. CAI - (Computer Aided Inspection) device that reflects the preparation of teeth and other supporting tissues and is in charge of spatial digitization of data
2. CAD - a computer on which the shape of the body of prosthetic work is planned and calculated
3. CAM - numerically controlled machine that makes prosthetic work from the basic shape.

In modern dental practice, various directions of computer design and processing are used for the production of dental works. Especially in the creation of ceramic restorations CAD - CAM technology is supported by:

1. Subtractive
2. Additive
3. Combined procedures

Subtractive procedures enable the production of ceramic restorations from ready-made prefabricated blocks (the term subtractive, represents the process of removing material from the block, in order to create the desired shape).

Additive techniques, known as solid-free-form fabrication or layered manufacturing (selective laser sintering, 3D printing and stereolithography) enable the production of restorations from ceramic powder and added components through layered stacking to a given shape, without backlogs. Additive methods enable the creation of complicated shapes with cavities, mines and pores.

Combined procedures are used by some commercial CAD -CAM systems. Vrsta materijala CAD/CAM sistem indikacije:

1.	Dicor mcg	Cerec	inlej, onlej, facets
2.	Vita mark II	Cerec	inlay, onlay, facets, front crowns
3.	Pro cad	Cerec	inlay, onlay, facets, front crowns
4.	In-ceram spinell	Cerec 3D, Cerec	inlay, front crowns
5.	In-cearam alumina	Cerec 3D, Cerec	inlab, DSCpresiden crowns and front bridges

The application of CAD-CAM technology in the production of restorations includes the following steps:

- Intraoral scanning
- Virtual design
- Ordination cad - cam methods
- Machine milling
- Test of the finished inley
- Cementation
- Final processing procedures
- Reocludation and rearticulation
- Polishing, fluorination and inspections

For single-session CAD / CAM methods, after testing and adaptation, a polishing or glazing procedure is optionally used. The procedure of the one-session CAD / CAM method of making ceramic fillings has remained unchanged.

CAD/CAM technology allows inspection, design and production of prosthetic work from ceramic block of selected color in just one visit. After preparation and toilet cavities, the approach is applied for optical printing (3D scanning). The intraoral scanning procedure itself is performed with a setting 3D scanner.

Advantage:

- simpler and faster principle of printing than conventional procedure.

A lack:

- technologically more sensitive
- improper scanner handling
- inadequate preparation of teeth, improper preparation of the gingival sulcus region

Preference should be given to machinable ceramic cylinders and blocks, improved mechanical properties (machine sintered ceramic blocks 3m espe). Advances in the production of new ceramic materials have enabled the application in a wide field of indications, zirconia ceramics in the manufacture of precision bonding elements (CAD-CAM individual attachments), double crowns, maryland and inley bridges.

Inlay bridge is a minimally invasive dental restoration that is made in conditions of minimal edentulousness, with the consent of the patient. These are typical rectilinear three-member bridge structures, which are used in the management of the lack of one dental region, most often the other premolar. Of fundamental importance are the relationships between the dimensions of the clinical crowns of the retiners and the line distance between them (length of the edentulous space up to 10 mm)

Inlay bridges are made of: lithium disilicate infiltration (alumina and zirconium) and zirconia of polycrystal ceramics. It is always adhesive cementation of inlay bridges with composite cements in the patient's mouth. CAD-CAM technologies speed up the manufacturing process and enable the production of highly aesthetic restorations from modern ceramic systems.

CASE REPORT

Inlay bridges are typical rectilinear bridge constructions used in the management of the lack of one tooth of the lateral region, most often the second premolar, minimally invasive dental restorations that are made in conditions of minimal toothlessness. They are indicated for vital intact abutment teeth, present small carious lesions or old fillings localized towards the space of lost teeth.

Conditions of good oral hygiene must be met: the periodontium of retention teeth is healthy, the occlusion is stable with the absence of parafunctions. They are contraindicated in teeth with short clinical crowns (molars in the lower jaw).

Figure 1. Making a ceramic inlay bridge with single-session CAD/CAM methods

The steps of the work include the preparation of the retention teeth cavity, which does not differ from the preparation for inlays, but with the task that an adequate dimension of the proximal cavities must be achieved and a common way of inserting the bridge structure into the prepared cavities. After preparation, the intraoral digital fingerprint is accessed and sent electronically to the laboratory.
On the virtual model, a bridge structure is designed and computers are accessed by guided milling from a block of pre-sintered ceramics. After the completion of the restoration, the test of the bridge structure and the procedure of cementing the adhesive type with composite cements is approached.

CONCLUSION

The application of computer technologies and new ceramic systems provides the possibility of making highly precise, aesthetic restorations and the production itself is fast.

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EDELWEISS VENEERS

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Abstract:
The aim was to examine the difference between Edelweiss veneers and ceramic veneers. Working with the Edelweiss veneer is shorter and more comfortable for work in dentistry and for patients. Edelweiss veneers are the perfection of modern and minimally invasive cosmetic dentistry. They are made at the factory from nano hybrid composite, and then processed with laser beams.
Stand out from other types of veneers due to their specific composition, as well as its advantage that it is an adaptation in one visit and it is a direct technique, from application accessories that require minimal binder, nanohybrid composite and veneer. Unlike ceramic veneers that require more visits, including laboratory, composite cementing and price difference.

Keywords: *veneers, edelweiss veneer, ceramic veneer*

Introduction:

Veneers are thin scales, white in color that are placed on the vestibular surface of the tooth. Their thickness can be from 0.3mm to 1.3mm, and they are most often placed in the frontal region, on the front teeth as this is the visible region when smiling.
Veneers can be composite and ceramic.
Composite veneers are flakes made of composite material.
In some cases, it is better or the only thing possible to make ceramic or metal-free veneers (veneers) because the composite can change color over time and is not as strong as ceramic, and since there is no grinding or it is minimal, it can not hide major flaws. Ceramic veneers are an exceptional solution for achieving a perfect smile.
Edelweiss veneers are the perfection of modern and minimally invasive cosmetic dentistry. They are made at the factory from nano hybrid composite, and then processed with laser beams. Thanks to the unique production of the laser sintering process, transparent enamel and occlusion, the shells stand out especially for their inorganic ceramic surfaces through the process of vitrification and hardening of the composite body. The filler ratio of Edelweiss veneers is 82% by weight = 65% by volume. The variation of inorganic filler particles was between 0.02-3 µm.
With their help, in just one visit to the dentist, it is possible to create a completely natural and youthful appearance of the teeth.
These veneers have the strength of ceramics, they are thin and extremely elastic so that they resist the forces that are created in the oral cavity when chewed. By a special production process, the nano hybrid composite is heated and placed in special molds. When they are finished, the veneers are additionally laser processed. The laser beams penetrate the composite and pull glass particles to the surface, creating an extremely resistant, smooth and shiny surface layer of glass ceramic, which is translucent. The veneers made in this way give the teeth a completely natural look because they imitate the effect of fluorescence and opalescence. X-rays are also contrasting, so they allow easy access to the tooth.
Edelweiss are prefabricated, polymerized, radiopaque, highly filled nano-hybrid composite enamel shells with inorganic surface.
Composite veneers make direct veneering of single or multiple front teeth easier than ever before. They are cemented with the same
the material from which they are made, which leads to a stable bond
After minimal grinding of the front surface of the tooth, they are cemented with nano hybrid composites in the same visit.

Indications:
-Correction and reconstruction of position, size, shape, color of front teeth and premolars
-Compensation of chemical and mechanical wear of teeth
-Excellent therapeutic modality in young and elderly patients
-Solving aesthetic problems (fluorosis, tetracycline discoloration, devitalized teeth)
-Therapeutic option for patients with bruxism, clenching teeth, bad habits, parafunctions
-Occlusal veneers for raising the vertical dimension of occlusion (VDO)
Contraindications:
-Active periodontitis
-Occlusal pathology (inability to correct occlusion)
-Poor oral hygiene
-Poor cooperation with the patient

Material and methods:
Procedure with Edelweiss veneers step by step
Step 1 - Select the appropriate facet size
Edelweiss veneers are of universal shape that adapts, individualizes with the possibility of combining different sizes (for upper jaw XS, S, M and L, for lower jaw S and M)

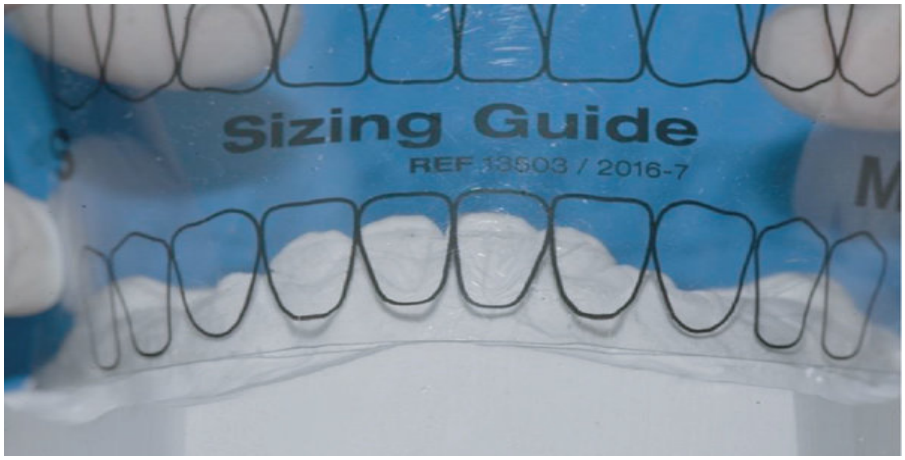

Figure 1. Edelweiss veneer sizing key

Step 2 - Determining the color
With the help of a wrench, where the existing dentin color samples are compared with the tooth color and then a veneer is placed to obtain the final appearance of the dental restoration.

Figure 2. The key to determining the color of dentin

Step 3 - Prepare the veneer
Edge treatment and roughing of the inner surface of the veneer with fine-grained diamond drills. Correction if necessary of the shape of the veneer that should follow the gingival contour and meet the requirements of aesthetic analysis.
Step 4 - Tooth preparation
It is necessary to minimally invasively prepare with a diamond fissure drill, after which check the adaptation to the veneer tooth.
The veneer is prepared by applying a transparent bond which is applied with a microapplicator for 30 sec and then light-cured for 20 sec, after which the veneer is ready for adaptation in the oral cavity.

Step 5 - Preparation of teeth for "cementing" the veneer
According to the standard principles of preparation from adhesive dentistry, enamel etching 30/60 sec, dentin 15 sec, rinsing 20 sec. After that, isolate and protect the adjacent teeth (agonists) with celluloid matrices, apply a bonding agent (bond) for 20 seconds, dry slightly and then polymerize.

Step 6 - CHARACTERIZATION OF THE FACE
It is necessary to determine the color, to individualize the veneer. If necessary, liquid composites can be included in order to achieve better effects of transparency, opalescence, white lines, white spots ..

Step 7 - Application of composite veneers
The enamel or dentin nanohybrid composite is arranged with the instrument so that no cracks or trapped air bubbles remain.

Step 8 - Place the veneer on the tooth
It is necessary to properly position the facet where the initial incisal illumination can be performed so that the instrument can more easily remove excess material.

Step 9 - Light polymerization
It is necessary to perform light polymerization for 40 seconds for each tooth surface.

Step 10 - Finishing and polishing
Polishers, drills, discs and erasers to achieve high gloss. If the polishing procedure is not followed, the edges of the veneer and interdental spaces will be painted with a belt.

Step 11 - CHECK THE OCCLUSION
It is necessary to check the occlusal contacts in the intercuspal position and in the case of eccentric movements of the lower jaw in laterotrusion protrusion.

Case report:
Aesthetic reason, Edelweiss veneers on 4 teeth in the frontal region (teeth 12, 11, 21, 22)

Figure 3. BEFORE the adaptation of the Edelweiss veneer Figure 4. AFTER the adaptation of the Edelweiss veneer

Conclusion:
Edelweiss veneers stand out from other types of veneers due to their specific composition, as well as its advantage that it is an adaptation in one visit and it is a direct technique, from application accessories that require minimal binder, nanohybrid composite and veneer. Unlike ceramic veneers that require more visits, including laboratory, composite cementing and price difference.

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ORAL PRESENTATIONS

THERAPY OF DISTAL BITE BY TWIN BLOCK APPLIANCE

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Abstract: *The twin block (TB) is a functional appliance used to correct the skeletal malloclusion during the growth phase. The indications for TB are Class II div 1, class II div 2, deep bite, dentoalveolar type of the open bite, cross bite, TMJ therapy, growth modification during mixed dentition, abnormal orofacial habits prevention, etc. The advantage of TB is easy adjustment, allows normal oral functions especially talk. Therapeutic effects of TB are skeletal, dentoalveolar and muscular equlibrium. Comfortable and easy to wear, suitable in controling the backward rotation of the mandible, and also can be used for the teeth treatment reposition.*

Key words: *backward rotation of the mandible; bimaxillary appliance; distal malocclusion.*

POSTER PRESENTATIONS

ALLERGIC REACTION TO TOOTHPASTE-CASE REPORT

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Abstract:
Toothpaste and other oral hygiene products can cause contact reactions of the oral mucosa. Toothpaste allergy is rare, most likely because toothpaste is rinsed out of the mouth after the teeth are brushed. Various ingredients in toothpaste can cause these reactions, but recently, we have increasingly met with patients in whom lesions are associated with the use of toothpastes that contain stannous fluoride. There are only a few published reports of allergies to this type of toothpaste.

The aim of this paper is to draw attention to the possible allergy to toothpastes that contain stannous fluoride.
A 25-year-old patient came to our clinic due to swelling of the lower lip in the previous 7 days, which was accompanied by gum pain, burning of the tongue and swelling of regional lymph nodes. She was allergic to certain non-steroidal anti-inflammatory drugs and she has been using Sensodyne® Rapid Relief toothpaste for about two months. Clinical examination revealed moderate swelling of the lower lip, erythema and punctate petechiae of the gingiva, numerous erosions on the mucosa of both labial fornix and atrophy of the papilla in the area of the tip of the tongue.
Due to the possibility of an allergic reaction, Sensodyne® Rapid Relief was replaced with fluoride and detergent-free toothpaste, and the patient was offered allergy testing. At the control examination after 7 days, significant subjective improvement and objective regression of most of the described changes were noted.
An epicutaneous test proved an allergy to the tested toothpaste.

Key words: *toothpaste; stannous fluoride; case report; patch test*

MULTIDISCIPLINARY APPROACH IN CHILDREN'S ODONTOGENIC INFECTIONS. CASE REPORT.

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Introduction: Odontogenic infections in children are an urgent condition. Depending on the patient's cooperation, the type of dental treatment will be performed in order to avoid further complications and the spread of swelling to other structures of the head and neck.
Case report: Patient S.B. at the age of 5, applied to the Dental Clinic of Vojvodina due to swelling in the area of the lower jaw on the left side, which persisted for two months.
Clinical examination: Extraorally present hard swelling which extends submandibularly. Intraoral swelling in the area of the vestibule, in regio of dentis 75 the tooth cusp can be seen. The analysis of the OPT shows a fully developed caries, impacted in infra occlusion, covered with gingiva dentes 75.
Multidisciplinary approach: Clinical examination in cooperation with an oral surgeon indicates surgical intervention of tooth extraction. Due to the urgency of dental treatment and the patient's age, treatement is indicated under general anesthesia. The intervention of surgical complicated tooth extraction was performed two days after the initial examination.
Conclusion: The importance of a multidisciplinary approach to acute odontogenic infections in children is the most important form of cooperation between pediatric dentists and oral surgeons in order to provide adequate dental therapy for children.
Key words: *odontogenic infections, pediatric dentistry, tooth extraction, oral surgery*

ARE DENTISTS UNDER RISK OF CARPAL TUNNEL SYNDROME?

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Objective: Recent research indicates that Carpal Tunnel Syndrome, as one of the leading work-related disorders, are very common among dental profession. Risk factors for the development of this disease are related to the nature of dental work, and the leading ones are: frequent hyperextension of the hands, when working with dental instruments, wearing uncomforted protective gloves, as well as the use of vibrating instruments.
The aim of the study was to determine the occurrence of symptoms that indicate Carpal tunnel syndrome in the population of working dentists in Serbia.
Methodology: The study used designed questionnaires by researchers, which contain questions that define: socio-economic factors, risk factors, symptoms that indicative of Carpal tunnel syndrome, applied treatment and prophylactic activities. The research included 300 working dentists who live and work in the territory of the Republic of Serbia.
Results: It has been noticed that Carpal tunnel syndrome, are three times more common in women, and most often occurs around the age of 30. 22.8% of respondents have pain in the hand area, of which 67.9% of respondents have localized pain in the upper part of the hand and in the palm area, 19.8% of respondents in the palm area and 12.3% of respondents in the upper area works of the hands. The most common symptoms that indicate Carpal Tunnel Syndrome are: pain in the hand and forearm, numbness in the hand, cold fingers, loss of strength in the hand, increased fatigue of the hands, forearms, hands and shoulders.
Conclusion: Preventive measures include proper body position during work, as well as regular physical activity.

THE IDEAL TIME TO TALK ABOUT THE ORAL HEALTH CARE FOR MOTHER AND BABY IS PREGNANCY

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Abstract: *During pregnancy, it is important to emphases on maintain the oral health of both, the future mothers and their babies.*
Within the organized lectures and workshops, future mothers, or other care givers were introduced to the importance and ways of maintaining oral health in pregnancy, and oral health of baby during their first year, in order to prevent early childhood caries.
These workshops aimed to raise the level of information of pregnant women about proper nutrition, the impact of breastfeeding, adequate ways of maintaining oral hygiene, as well as the possibility of using preventive and prophylactic measures.

Introduction
In view of the fact that the early childhood caries is a chronic preventable disease, pregnancy is the best time to raise the awareness about the causes of this disease among future parents, as well as to familiarize them about preventive and prophylactic measures. Timely oral care advice to the future mothers and other care givers is of the paramount importance for establishing a good oral care of the infants and young children.

Methodology
Up to date 260 future mothers were participated in oral health programme.
In order to establish their oral hygiene habits, and to assess their current level of knowledge regarding the use of fluoride and healthy eating habits they have filled out a specially designed questionnaire before our lectures and workshops.
Next, they were exposed to in person lectures, and also trough interactive workshop they watched a specially created video clips that were followed by open discussion about good oral health care and healthy diet. It was emphasized of the importance of fluoride use in a prevention of early childhood caries. The advice is given on an optimal fluoride concentration for daily use in adults, young children and infants. Also, the benefits of the first dental visit by age 1 were explained. The prophylactic measures such as application of fluoride varnishes and fissure sealants were explained. In that occasion, the most commonly use techniques for brushing the teeth were demonstrated on the models. Also, various oral hygiene aids and its appropriate application were presented. Dietary advice was given regarding breastfeeding and bottle-feeding.
At the end of the session they had to fill the evaluation form out. The level of change in attitude to their oral hygiene habits were assessed with this form. Also, the change in understanding of the importance of applying of the preventive and prophylactic measures in order to establish and maintain a good oral health in infants and young children were assessed.

Results
The parent's knowledge about general oral health was to the satisfactory level before the educational training. After analyzing the most significant data revealed that 100% of parents expressed their opinion that they will change their oral hygiene habits. 90% of future mothers believed that early childhood caries can be prevented by good oral hygiene in infants and young children. Only 40 % of the participants were informed that brushing baby's teeth as soon as they erupt is beneficial for infant and children's oral health. Surprisingly, 60% of future mothers had opinion that brushing teeth in

children should start between the first and third year. 30 % of mothers changed the attitude to the benefits of the age one dental appointment.

Conclusion

Since the oral health of mothers during pregnancy and the oral health of young children are global problems, the development of a prevention program at the global level is one of the priorities. Cooperation with gynecologists and pediatricians is also crucial for raising awareness, as well as knowledge among future mothers about the importance and ways to maintain oral health. Multidisciplinary work and cooperation with doctors of other specialties will greatly enable greater trust of patients, wider availability of information and timely education. During pregnancy, gynecologists should refer pregnant women to the dentist, who, in addition to the therapeutic and prophylactic part of their work, will dedicate a significant part of work with pregnant women to introducing preventive methods and the possibility of maintaining oral health, both pregnant women and their future babies.

Also, as pediatricians are the first to come into contact with the baby, and should referred baby to the first dental examination during the first six months, until the first year of life.

Also, these types of educational workshops, which we presented in our work, are very effective and make a great contribution, and help parents maintain the oral health of children.

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INFLUENCE OF CENTRAL INCISORS MORPHOLOGY ON THE FORMATION OF STEEP BITE

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Abstract: *Class II division 2, is malocclusion, which consists of cases with distal molar relationship, retrusion of the upper central incisors, while lateral ones are protruded in most cases. The aim of the study was to determine whether there is a difference in the values of "neck angle" and vestibule-oral diameter in the cervical third of the permanent upper central incisors of class II / 2 patients and the rest of the population. Lateral X-ray cephalometric images were used to measure the "neck angle" of the incisors and digital study models to measure the vestibulo-oral diameter in the cervical third. The "neck angle" in patients with Class II/2 malocclusion was significantly lower compared to patients from the control group, while the vestibulo-oral diameter of permanent maxillary central incisors in the cervical third was smaller, but without statistically significant difference.*

Keywords: *Keywords: II class, division 2; Neck angle; Vestibulo-oral diameter; Central incisors*

TRUE + NATURAL + ANATOMY=TRUNATOMY

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Over-excessive removal of the intracanal layer of dentin structure during the shaping phase in endodontic therapy leads to the increased fracture incidence of endodontically treated teeth. Generally, effective shaping of the root canal system facilitates irrigation and disinfection of the canals. Achievement of both prerequisites - an adequate cleaning and preservation of dentin are hardly to achieve, but possible. TruNatomy rotary file system has been recently launched on the dental market. For the application of this kind of file, Conservative Endodontic Cavity (CEC) is recommended with no need for straight-line access. Owing to its reduced memory properties, it is possible to prebend its tip to allow insertion into the canal orifices. Increased flexibility of these files is provided due to the specific post-grind thermal procedures. These specific files are designed to adapt to the canal with their largest taper at the apical third and regressive taper in the coronal direction. These files are designed to run in continuous rotation at 500 rpm with 1.5 Ncm torque control. Unlike the most commonly used brushing motions with other rotary files, these are intended for 2-3 gentle apical strokes until reaching WL. TruNatomy shaping files are designed with a maximum taper of 4% allowing preservation of the root canal system walls and only removing dentin where clinically needed. This approach to the cleaning and shaping of the root canal system contributes to the increased respect of its natural anatomy, reducing the chance for the vertical root fracture of the endodontically treated teeth.

THE EFFECT OF THE TYPE OF TOOTHBRUSH ON THE EFFICACY OF DENTAL PLAQUE REMOVAL

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Introduction: Accumulation of dental biofilm plays a crucial role in the etiology of periodontal disease. [1] Regular mechanical removal of these deposits with toothbrushes is a essential for disease prevention. [2, 3] Factors that affect the efficiency of dental biofilm removal [4] are brush design, characteristics of fibers, brushing technique, individual dexterity, frequency and length of brushing. There are large differences in the recommendations regarding the maintenance of oral hygiene, which shows that there is no general agreement on this issue. Patients usually do not follow the dentist's instructions consistently and often overestimate their effectiveness. For this reason, the decisive determinant for optimal maintenance of oral hygiene could be the characteristics of the brush itself. [5]
Aim: The aim of this study is to examine the effectiveness of three different types of brushes in the removal of dental plaque.
Material and methods: Participants were 30 students who have at least 5 natural teeth in each quadrant and who suspended oral hygiene for 48 hours. Three toothbrushes of with different hardness, were tested: ultra soft, soft and medium. To evaluate the efficacy of plaque removal, the plaque index (PI) by Sillnes-Löe was used before and after brushing the tooth with modified Bass method for 2 minutes. Participants subjectively evaluated the brushes.
Results: All three types of brushes showed a statistically significant decrease in PI. There was no statistically significant difference between different types of the toothbrush, but participants were most satisfied by soft ones.
Conclusion: All three types of bruses proved to be effective.

Keywords: *Oral Hygiene, Dental Plaque, Toothbrushing*

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TRAUMATIC BONE CYST IN LOWER JOW- CASE REPORT

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INTRODUCTION

In the classification of the World Health Organization (WHO), traumatic bone cystc (TBCs are included in the group of bone-related lesions, together with the aneurysmal bone cyst, ossifying fibroma, fibrous dysplasia, osseus dysplasia, central giant cell granuloma and cherubism. Different causal factors have been proposed : bone tumor degeneration, altered calcium metabolism, low-grade infection, local alterations in bone growth, venous obstruction, increased osteolysis, intramedullary bleeding, local ischemia, or a combination of such factors. It has been suggested that any form of trauma, including tooth extraction could give rise to a cyst of this kind. Typically, the lesions are asymptomatic and are accidentally detected by panoramic radiography, then may resolve without treatment. The most widely accepted theory suggests bleeding within the bone is caused by trauma. Instead of the organization of a blood clot and healing, the clot liquefactively necrotises or is resorbed in another way. The surrounding bone is destroyed by enzymatic activity. In this way the bone cavity enlarges , stimulated by the increased pressure of its content, which, at least partly, is caused by poor venous drainage.

CASE REPORT

A 13 years old female patient came to Clinic of Dentistry in Novi Sad due to the swelling and pain in mental region. Extraoral examination showed hard consistency swelling, with red coloured skin in mental region. Intraoraly luxation of teeth 32, 31, 41 i 42 was present and pain on vertican percusion. Vitality test was negativ on teeth 32, 31 i 41. OPT radiography has showed lesion 2 cm in siye, in regio of teeth. The radiolucency was seen extending between the roots of the involved teeth. Drainge of teeth 32, 31 i 41 had been done, and we received pus and indicated anthibiotic therapy. We put occlusal fillings for desarticulation, to avoid further trauma. Patient was refered to oral surgery for operative treatment. Operation was done after healing of infection. Endodontic treatment was done on teeth 32,31 i 41, surgical treatment of cyst enucleation and apicotomy of teeth 32,31 i 41. 14 days after surgery patient was without any simptoms.

CONCLUSION

The majority of traumatic bone cysts are asymptomatic and accidentally discoveredon routine radiograph examination. Recomendation is to come on regular dental examination after any traumatic injury in oral region.