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CONTENTS

EDITORIAL

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Anxiety in the dental office during the COVID-19 pandemic.

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Discussions and research related to anxiety in the dental office are not recent, in the last 20 years this topic has been discussed more and more intensely. Research is aimed especially in the field of patient anxiety, stress factors related to both the office and treatment itself are identified, and we are constantly looking for ways to lessen this anxiety [1].

Among the stress factors related to dental treatment we mention: the appearance of the office, the doctor's behavior, previous negative experiences related to dental treatment, fear of pain, office equipment, smell, taste of substances, pronouncing "trigger" words (needle, syringe, anesthesia), blood vision and, until a year ago, the fear of contamination in the office or during treatment was on the last positions [2]. It is known that the rules of sterilization and the rigor of this operation have always been paramount in the dental office, so the fear of contacting a disease from or by the patient was almost ruled out.

The fact that following the declaration of the pandemic in March 2020, dental offices were first closed and presented by the authorities as a major source of infection with the SARS-COV-2 virus, induced the state of anxiety regarding the possibility of infection during treatment. Worldwide authorities, through the measures adopted, focused on finding solutions to limit the spread of the virus and its treatment. Major problems, however, with uncontrollable effects in the short, medium and long term have led to the onset and worsening of psychological problems in the entire population.

Indian psychiatrist Debanjan Banerjeev outlined some of the ways in which the COVID-19 pandemic affects us. Thus the author identifies: the fear of not surviving a possible infection; increased anxiety due to family separation; the phobia of leaving the house; desire to take medication; fear of not wearing a mask, even when it is not necessary; the constant feeling of insecurity; uncontrolled abuse of disinfectants; the appearance of fear towards other people; the stress of not coughing or sneezing in order not to be considered ill, the frustration of the medical staff obliged to contact the sick and the fear of becoming a transmitting agent of the disease [3].

Although the psychological effects of the pandemic are still being discussed, its effects can be counted largely retroactively. Against the background of an anxiety given by the situation itself, on the one hand there is the fear of not being infected by the patient and on the other hand not being infected by the doctor. The patient's fear that the economic situation will not allow him a dental treatment overlaps with this. Thus, he gives up on or postpones this treatment, while the doctors fear that their practices will be closed again, or they will not be able to pay their employees.

What can we do? Let's not fall into extreme measures, let's not panic, let's try to look at things realistically, let's look for solutions and not for problems. The more we catastrophize, the higher our anxiety level, in addition to the physical problems we may have, the chances of being able to solve this problem decrease [4]. And in fact it is not even a question of solving the problem but of finding a balance to go through this crisis well. Nobody says that it is easy, but it needs conscious involvement. We need to take things as they are, to think about what we can actually do at this time, how to manage the situation with both patients and employees [5].

We need to make efforts to lower the level of anxiety and there is no shame in calling a specialist in the field (we each have the specialist we trust whether it is the

psychologist, psychiatrist, priest, mentor or the man of the soul). We need to empathize with the patient, to make him feel that we understand his fears and that we will do everything to ensure the safety of his health.
Even if we are caught in this collective hysteria related to physical health, we should not forget to take care of mental health, because its effects will be felt later.

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References

1. Ahmed MA, Jouhar R, Ahmed N, et al. Fear and Practice Modifications among Dentists to Combat Novel Coronavirus Disease (COVID-19) Outbreak. Int J Environ Res Public Health. 2020;17:2821.
2. Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: literature review. Clin Cosmet Investig Dent. 2016;8:35-50. doi: 10.2147/CCIDE.S63626. PMID: 27022303; PMCID: PMC4790493.
3. https://www.natureasia.com/en/nindia/article/10.1038/nindia.2020.46
4. Suryakumari VBP, Pallavi Reddy Y, Yadav SS, Doshi D, Surekha Reddy V. Assessing Fear and Anxiety of Corona Virus among Dental Practitioners. Disaster Med Public Health Prep. 2020;1-6. doi: 10.1017/dmp.2020.350. Epub ahead of print. PMID: 32921326.
5. Pereira LJ, Pereira CV, Murata RM, Pardi V, Pereira-Dourado SM. Biological and social aspects of Coronavirus Disease 2019 (COVID-19) related to oral health. Braz Oral Res. 2020;34:e041. doi: 10.1590/1807-3107bor-2020.vol34.0041. PMID: 32401931.

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STATE-OF-THE-ART ARTICLE

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The use of occlusal splints in temporomandibular disorders - an overview.

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Abstract

Temporomandibular disorders (TMD) affect the temporomandibular joints, the masticatory muscles, and surrounding tissues. Among symptoms such as jumps, joint noises, reduced mouth opening (closed lock), difficulties in closing the mouth (subluxation or open lock), pain is the most common symptom encountered among patients diagnosed with temporomandibular disorders. As literature on this topic is abundant and sometimes controversial, the authors focus on reviewing the state of art of occlusal splints indications. Therefore, the most common occlusal splints, like Lucia jig, nociceptive trigeminal inhibition (NTI), directive splints, etc., are being described, based on their design and therapeutic indications. Cases of malocclusions associated or not with parafunctions are usually manageable using the splints mentioned in this article. In case of disc displacements, occlusal appliances can be used, but as the etiology is multifactorial, there are some limitations, depending on the complexity of each clinical situation.

Keywords: occlusal splints, NTI, Jeanmonod anterior bite-plane.

Introduction.

Temporomandibular disorders (TMD) represent a real challenge in everyday practice due to the high complexity of different aspects such as diagnostic methods or treatment options [1]. Temporomandibular disorders refer to a group of musculoskeletal and neuromuscular conditions, affecting the temporomandibular joints and the masticatory muscles as well as the surrounding tissues. Pain is the most common symptom encountered among patients diagnosed with TMD [2], but other symptoms, including joint jumps, joint noises, reduced mouth opening (closed lock), difficulties in closing the mouth (subluxation or open lock) may often be encountered as well [3].

There are several treatment options in case of temporomandibular disorders: occlusal equilibration (adjustments), drug therapy, occlusal splint therapy, surgical techniques, physiotherapy (laser therapy, ultrasound, TENS, acupuncture, etc.), patient's education (associated with behavior therapy). Often, a combination of several types of treatment options is used in the management of TMD [3].

Occlusal splints are intraoral appliances used for diagnosis or treatment, for occlusal stabilisation, dental wear prevention, or in case of temporomandibular disorders (muscle relaxation or joint stabilization), as they affect the relationship of the mandible to the maxillae [3].

The extensive number of studies published so far proves that occlusal splints are widely used today in the management of TMD. Nevertheless, because various splint designs are available, it is important to analyze the different outcomes which could influence the clinical decision [4, 5, 6].

This article presents the types of occlusal splints available, based on their characteristics, aiming to provide helpful information for clinical practitioners in treating patients suffering from temporomandibular disorders.

Why an occlusal splint?

Occlusal splints are commonly used in the management of patients with temporomandibular disorders (TMD) as their main effect is muscle relaxation [7]. Those appliances aim to protect the temporomandibular joint (TMJ) discs from dysfunctional forces, preventing any permanent displacements or even disc perforations. There are also additional goals in splint therapy, such as preventing muscle parafunctions and relieving associated pain by maintaining a stable and balanced occlusion [8, 9].

What types of occlusal splints are available?

In daily practice, the information gathered during clinical and para-clinical examinations along with the differential diagnosis will influence the decision process regarding the prescription of a particular type of splint. In this matter, understanding the effects of each splint will also guide the decision-making [10].

Several types of occlusal splints have been developed over the years. For a better understanding they have also been classified into two different categories, depending on their design: (1) permissive splints - anterior midpoint contact permissive splint, and full contact permissive splint, (2) anterior repositioning directive splint [7, 10].

Permissive splints have classic designs and their role is to eliminate the abnormal occlusal contacts as well as to determine a balanced muscle function (by reducing parafunctional activity). The principle behind a permissive splint is that by altering the occlusion, teeth will no longer interfere with complete seating of the condyles, this way the muscle activity can also be controlled [8].

1. Anterior midpoint contact permissive splints have a design which allows the dis-occlusion of all teeth, except the incisors. Among those types of splints, the most popular are Lucia jig (Great Lakes Orthodontics, LTD, Tonawanda, NY), nociceptive trigeminal inhibition (NTI), B splint (Bruxism), or Hawley anterior biteplate [8].

The anterior midpoint contact permissive splints are believed to determine the release of the lateral pterygoid muscle on closure, as well as neck positioning muscles, to remove the occlusal interferences, and to allow the mandibular condyles freedom for full seating during the closure [11].

While a classic anterior midpoint stop appliance can be fabricated in the office (like Lucia jig), NTI devices and B-splints are commercially available and then customized for fit and occlusion directly in the patient's mouth. When using NTI splints, only 1 or 2 lower anterior teeth should touch the occlusal platform, which will lead to reflexive relaxation of the masticatory muscles. Nevertheless, there are some disadvantages in using anterior midpoint stop appliances, which imply occlusal changes, including intrusion or proclination of the incisors, or even open bite [12, 13].

The Hawley anterior biteplate will cover the 6 anterior teeth +/- the first premolars which may offer a better stability in both anterior and posterior areas of occlusion. However there should be strict limitation of only nighttime wear. The Hawley device may also be indicated when tooth clenching (associated with myofascial pain) determines the breaking of a full coverage appliance [12].

Jeanmonod anterior bite-plan (figure 1) covers the 6 anterior maxillary teeth and it is designed as a palatal-coverage horseshoe shape with an occlusal table. It has the ability to prevent clenching, as the posterior teeth will no longer be engaged in functional or para-functional activities. The result is the muscle relaxation, as well as pain reduction [14, 15].

Figure 1. Jeanmonod anterior bite-plane

Full contact permissive splints' design allow to create an ideal occlusion, but in a reversible manner. The occlusion on the splint should be adjusted in centric relation, this way it provides joint stabilisation. An anterior ramp will provide the anterior guidance, while all posterior teeth will disocclude immediately, in order to reduce the elevator muscle activity [10].

One of the most common full contact permissive splints is Michigan splint. It is usually indicated on the maxillary arch, but for phonetic and aesthetic reasons, it can also be placed in the mandibular arch [3]. Among other advantages of lower full contacts permissive splints we can also mention a better patient compliance, when the instructions indicate to wear the splint during daytime as well as nighttime, or even less tooth discomfort when the retention is assured only by the lingual surfaces of the lower posterior teeth [10].

Full contact permissive splints will eliminate any discrepancies between seated joints (in centric relation - CR) and occlusion (during maximum intercuspal position - MI), and will offer the opportunity to observe occlusion and joint stability over time, distribute the occlusal forces evenly while eliminating the occlusal interferences [11].

2. Anterior repositioning directive splints have the purpose to guide the condyles away from the fully seated joint position, in situations when joint pain is an issue. The mandible is guided into a forward posture on closure into the occlusal splint [10]. This is the reason why those types of splints are useful in two clinical situations: severe trauma with retrodiscal edema, and in case of chronic painful disk displacements [10, 11].

Apart from the two types of splints mentioned above, there are also other types of splints available, such as posterior bite plane appliance, pivot appliance, and pseudo permissive splints (e.g soft splints).

Posterior bite plane splints are applied on the lower arch, and the design consists of a bilateral hard acrylic resin table connected through a lingual metal bar, positioned only on the posterior teeth, and creating the dis-occlusion of the anterior teeth. Although there is no significant scientific evidence, some authors reported that this type of splint may enhance the athletic performance, increasing the physical strength. This type of splint is also indicated in cases of severe loss of vertical dimension of occlusion or when major changes are required in anterior positioning of the mandible [3, 11].

Pivoting appliances are hard devices, manufactured either on the maxillary or mandibular arch, with a single posterior occlusal contact, and placed as distally as possible, on each hemi-arch. Those appliances are known to reduce the pressure inside TMJ, as the mandible fulcrums around the pivot, unloading the joints. Unilateral pivot appliance is a modified version of the pivot appliances, having only a unilateral occlusal contact, placed as posterior as possible. This way, when the mouth closes, the pivot will load the contralateral TMJ and slightly unload the ipsilateral joint [3, 16].

Pseudo permissive splints, like soft and resilient splints or hydrostatic splints (Aqualizer®) are fabricated from resilient materials. Soft rubber splints cannot balance the occlusal contacts, this is why they do not provide the characteristics necessary for successful splint therapy and can be used mainly as mouth guards. They are usually placed on the maxillary arch [8].

A hydrostatic splint, Aqualizer®, is known to immediately improve biomechanics, due to its unique water system. Several features of this appliance should be mentioned: it supports the mandible in a comfortable position, eliminates abnormal tooth contacts, straightness the bite and enables systemic function and balance, while allowing the whole body to naturally balance itself [17,18, 19].

Aqualizer® was originally developed by Lerman, and it consists in a bilateral water-filled plastic chamber attached to an acrylic palatal appliance. This way, the lower teeth will occlude on water filled chambers [3].

AquaSplint® (figure 2) is a pre-fabricated appliance which can be customized and self-adjusted; two water pads united together by a tube represent the pre-fabricated splint, while the acrylic saddle can be relined with a long-term silicone material, providing individualization. It offers stability and comfort, while immediately reducing the pain,

and offering a hydrostatic balance between the two arches, because of the two water pads [20].

Figure 2 - AquaSplint® appliance [20]

When to indicate splint therapy and which type of splint?

Splint therapy should be indicated in order to obtain masticatory muscle relaxation, to allow the mandibular condyles to seat comfortably in centric relation, or to protect dental units from bruxism or other parafunctions.

In case of temporomandibular disorders, the indication of a certain type of occlusal appliance will be according to the disorder's type - muscle disorder (Type I)/ joint disorder without inflammation (Type II - disc displacement) or with inflammation (Type III) [10, 12].

In a research published in 2018, Greene synthesises that, no matter the type of TMD, as an initial therapy, a full contact permissive appliance should be taken into consideration. Then, if symptoms persists or they aggravate, different approaches should be considered: for type I disorders, refractory to the initial splint therapy (full contact appliance), an anterior midpoint contact appliance (either Lucia jig, NTI or Hawley device) can be used until the symptoms disappear; afterwards, when the patient becomes asymptomatic, the appliance should be changed with the initial one - full contact permissive splint [12].

For type II temporomandibular disorders, in case of patients presenting symptoms even after full contact permissive splint, a directive splint should be considered for 2 to 3 months, and afterwards it is indicated to return to the initial appliance [12].

In case of type III disorder, the same approach is indicated: a full contact permissive appliance, but in cases with severe inflammation, a directive splint can be used for 1 to 2 months, or until the inflammation is reduced; afterwards, the initial splint can be reused [12].

Dawson's approach regarding the treatment options refers to the symptoms' complexity, from simple scenarios to more complex ones.

In cases with simple occluso-muscle problems, where there are minimal signs of disorder such as tooth wear, tooth mobility, muscle tenderness during palpation, occlusal instability and uncoordinated muscle activity (due to interference between centric occlusion and maximum intercuspal position), Dawson's approach would be the wear of an anterior midpoint contact permissive splint (Lucia Jig, NTI, etc.) for 1 to 5 minutes/day, and occasionally, for several hours during nighttime (when total relaxation of the masticatory muscles is required)[10, 21].

When the occluso-muscle issues are associated with parafunctions (bruxism, clenching, or grinding) there will be symptoms with a higher impact on the quality of life, with headaches, sore teeth, muscle pain, tooth wear facets, etc. In these situations, in order to resolve the pain, anterior midpoint contact permissive splints should be worn 24 hours per

day (except during mealtimes), between 1 to 4 weeks. Among the splints indicated in such situations are B splints (which can be performed in the office) or NTIs (prefabricated and relined with acrylic materials). In a short period of time (2 to 4 weeks), those types of splints proved to be effective, but therapy should be continued with proper occlusal correction after a complete occlusal analysis. After this phase, the equilibrated occlusion with proper anterior and lateral guidance, without interferences, can be maintained by using a full arch permissive splint. Dawson also believes that in order to prevent the negative effects of nocturnal parafunctions, splints should be worn during nighttime as well, ideally dual splints covering both arches [10, 22, 23].

In case of disk displacement with reduction, the use of full arch permissive splints should be effective; the duration of the treatments should last between 6 to 8 weeks. If the disk displacement is complete (without reduction) then the same type of splint (full arch permissive appliance) would be indicated for a minimum of 3 months. In this situation, occlusion on the splint should be adjusted weekly, until it stabilizes [10, 11].

Some authors suggest an anterior repositioning directive splint (for a short period of time – 2 weeks), if joints cannot not be seated fully without discomfort (inflammation of the joint), followed by a full arch permissive splint (for 3 months or even more) [10, 11]. But this aspect is controversial, as some patients accuse an exacerbation of pain when treated with directive splints.

What characteristics should a splint meet, for functional consideration?

A splint should assure stable occlusal contacts with the antagonist teeth, preferably in centric relation; it should provide immediate posterior disocclusion by the anterior and condylar guidance; the splint should be adjusted continuously, and it should offer freedom in movement for neuromuscular harmony; also, the splint should not negatively affect the aesthetics, and the patient should be comfortable wearing the splint [11, 23, 24].

What would be the limitations of splint therapy?

Several studies published underline the complications that may occur in case of extended use of segmental appliances. The most common complications refer to intrusion of the teeth covered by the splint or in contact with it, and the extrusion of the teeth not touching the appliance. For preventing those complications, the practitioner should consider indicating the patient either a full arch permissive splint, or dual splint covering both arches, during nighttime [25,26]. There is also some evidence suggesting that anterior midpoint contact permissive splints might increase the risk of further disk displacement [10].

Additionally, the development of digital techniques (CAD/CAM and 3D printing) for performing occlusal splints offers several advantages, like perfectly adjusting the splint's thickness, time-efficiency, the possibility of duplication at any moment [27].

Conclusion

Splint therapy is an effective method of treatment in case of temporomandibular disorders. But special attention should be paid on establishing a correct and complete diagnosis, as signs and symptoms will vary, depending on the type of temporomandibular disorder.

Cases of malocclusions associated or not with parafunctions are usually manageable using the splints mentioned in this article, but periodic check-ups are needed in order to prevent further complications. In case of disc displacements, occlusal appliances can also be used, but as the etiology is multifactorial, there are some limitations, as creating long term joint stability is questionable.

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All authors contributed equally to this article.

References

1. Garrigós M, Elizagaray-García I, Domínguez AA, Del-castillo JL, Gil-Martinez A. Temporomandibular disorders :improving outcomes using a multidisciplinary approach. J MultidiscipHealthc. 2019;12:733-747.

2. Conti PCR, Da Mota Correa AS, Lauris JRP, Stuginski-Barbarosa J. Management of painful temporomandibular joint clicking with different intraoral devices and counseling : a controlled study. J Appl Oral Sci. 2015;23(5):529-535.
3. Alqutaibi AY, Aboalrejal AN. Types of Occlusal Splint in Management of Temporomandibular. J Arthritis. 2015;4(4):176.
4. Fricton J, Look JO, Wright E, et al. Systematic review and meta-analysis of randomized controlled trials evaluating intraoral orthopedic appliances for temporomandibular disorders. J Orofac Pain. 2010;24(3):237-254.
5. Gray RJM, Davies SJ, Quayle AA. Temporomandibular Disorders: A Clinical Approach. London: British Dental Association;1995.
6. Ebrahim S, Montoya L, Busse JW, Carrasco-labra A, Guyatt GH. The effectiveness of splint therapy. J Am Dent Assoc. 2012;143(8):847-857.
7. Mishra A, Mahajan S, Tandon R. A-Z of Occlusal Splints in Orthodontics - Part II. Heal Talk, Orthod. 2018;10(6):59-60.
8. Bali SK, Naqash TA, Rajput G. Occlusal Splint Therapy : An Overview. Univ J Dent Sci. 2015;1(1):82-84.
9. Yadav S, Karani JT. The Essentials Of Occlusal Splint Therapy. Int J Prosthetic Dent. 2011;2:12–21.
10. Dawson PE. Functional Occlusion: From TMJ to Smile Design. St. Louis, MO: Mosby; 2007.379-392.
11. Jagtap A, Shadakshari S, RaghavendraSwamy K, Bora N. Occlusal Splint Therapy for a Dysfunctional Temporomandibular Joint. J Orofac Res. 2014;4(2):115-117.
12. Hasanoglu Erbasar GN, Alpaslan C, EroglUInan G. Can an NTI-tss device be effective as a first-line therapy in patients with TMD myofascial pain ? J Oral Rehabil. 2017;(9):1-5.
13. Aksakalli S, Temucin F, Pamukcu A, Ezirganlı S, OguzKazancioglu H, Malkoc MA. Effectiveness of two different splints to treat temporomandibular disorders. J OrofacOrthop. 2015;76(4):318-327.
14. Seifeldin SA, Elhayes KA. Soft versus hard occlusal splint therapy in the management of temporomandibular disorders (TMDs). Saudi Dent J. 2015;10(2):1-6.
15. Yeshwante B, Choudhary N, Kadam P. Occlusal Splint Therapy. Ann Dent Spec. 2015;3(4):100-102.
16. Dodeja DL, Singh R, Mistry G. Splints : Decoded. IOSR J Dent Med Sci. 2019;18(5):11-19.
17. Amin A, Meshramkar R, Lekha K. Comparative evaluation of clinical performance of different kind of occlusal splint in management of myofascial pain. J Indian Prosthodont Soc. 2016;16(2):176-181.
18. Srivastava R, Jyoti B, Devi P. Oral splint for temporomandibular joint disorders with revolutionary fluid system. Dent Res J 2013;10(3): 307–313.
19. Wieckiewicz M, Boening K, Wiland P, Shiau YY, Paradowska-Stolarz A. Reported concepts for the treatment modalities and pain management of temporomandibular disorders. J Headache Pain. 2015;16:106.
20. Kui A, Buduru S, Iacob S, Manziuc M, Mitariu L. The use of occlusal splints in the management of temporomandibular disorder. Heal Sport Rehabil Med. 2020;21(2):82-87.
21. Piper MA. TMJ diagnostics and basic management. Seminar manual. Piper Clinic, St. Petersburg, FL. 2006.
22. Shankland WE. Nociceptive trigeminal inhibition-tension suppression system: a method of preventing migraine and tension headaches. Compend Contin Educ Dent. 2002;23:105-113.
23. Altindiş T, Güngörmüş M. Thermographic evaluation of occlusal splint and low level laser therapy in myofascial pain syndrome. Complement Ther Med. 2019;44:277-281.
24. Dalewski B, Chruściel-Nogalska M, Frączak B. Occlusal splint versus modified nociceptive trigeminal inhibition splint in bruxism therapy: a randomized, controlled trial using surface electromyography. Aust Dent J. 2015;60(4):445-454.
25. Kuzmanovic Pficer J, Dodic S, Lazic V, Trajkovic G, Milic N, Milicic B. Occlusal stabilization splint for patients with temporomandibular disorders: Meta-analysis of short and long term effects. PLoS One. 2017;12(2):e0171296. doi:10.1371/journal.pone.0171296
26. Choudhary S, Rao HM, Rohilla AK, Cherenjeevi J. The Occlusal Splint Therapy: A Literature Review. Indian J Dent Sci. 2015;7(1):101-108.
27. 27. Buduru S, Talamaceanu D, Baru O, Buduru R, Szuhanek C, Mesaros A. CAD_CAM occlusal splints : milling and printing methods. Revista de Chimie. 2018;69(12):3461-3463.

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Contributions to the study of common artifacts and errors in conventional and three-dimensional radio-imaging used in the evaluation of odontal, endodontic and periodontal pathology.

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Abstract

Introduction: X-ray radio imaging is commonly used because most diseases in the oral area can only be diagnosed by using this method. Proper identification of elements on a radiological image may also be difficult due to errors that may occur before, during or after the X-ray. These errors are called artifacts.

Aim of the study: The aim of our study is to distinguish the artifacts that can occur on two-dimensional and three-dimensional dental X-rays (intraoral or extraoral) from the actual pathology of the investigated area, by performing control X-rays.

Material and Methods: In our study we viewed, assessed and compared a number of 80 retroalveolar X-rays, 45 orthopantomographs (OPG) and 35 Cone Beam Computer Tomography (CBCT). In case of artifacts or errors, X-rays were repeated within 5 days or a CBCT was performed. In the case of OPGs, another option was to perform retroalveolar X-rays to establish the final diagnosis.

Results: From a total of 80 retroalveolar X-rays, in 13 cases (16.25%) we found artifacts. Of these, in only 4 cases (5%) diagnosis and treatment plan were changed following a clinical examination or a CBCT. In the case of OPGs, out of a total of 45 OPGs, 17 (37.7%) presented artifacts, but only in a percentage of 17.7% (8 cases) they affected the diagnosis. Of the 35 CBCTs, in 10 of them (28.57%) prosthetic works with a metal component or implants were present, with specific artifacts found, but their presence did not influence the diagnosis.

Conclusion: It is necessary for doctors to know the anatomy of the oral region, the most fervent appearance of the components and the different types of artifacts that may occur. Control X-ray is a very commonly used possibility, but there are cases where radiation exposure needs to be minimized.

Keywords: retroalveolar X-ray, orthopantomography, CBCT, artifact, oral diagnosis.

Introduction

Medical imaging is a scientific division that sums up a variety of other sciences to study how to compose, record, communicate, analyze, process and store images of organs and tissues for the diagnosis of various pathologies. One of the branches of medical imaging is dental radio-imaging. Radio-imaging in the field of dentistry can be achieved by means of nuclear magnetic resonance or by means of X-rays.

Nuclear magnetic resonance radiology has a limited use in dental medicine, being used predominantly in the diagnosis of the pathology of the temporomandibular joint (TMJ) [1].

X-ray radio imaging is commonly used because, in the oral sphere, most conditions can only be diagnosed with this method (interdental caries, apical periodontitis, cysts, root fractures, bone support damage, dental implant status).

The radiological image is a complex of two-dimensional graphic representations optically materialized on the radiographic film, the radioscopic screen or the video monitor, corresponding to the anatomical or pathological structures of the investigated region [2].

Currently, in the field of dental medicine, the following types of X-rays are used predominantly:

1. Retroalveolar radiography is intended to investigate teeth and periapical regions, in particular.
2. Endodontic X-ray
3. Bitewing X-ray
4. X-ray with occlusal film
5. Panoramic Radiography (OPG) provides overview of both dental arches and surrounding skeletal structures. Panoramic

dental X-rays are used to diagnose caries, periodontal disease, trauma, pathology of the jaws, supernumerary teeth and for orthodontic evaluation [3].

6. Cranial teleradiography
7. Cone Beam Computer Tomography (CBCT) by three-dimensional imaging (3D) improved the visualization of anatomical structures [4].

Performing an X-ray may result in the detection of unexpected situations. The correct identification of the elements on a radiological image can be difficult for the dentist because of several reasons:

- the human viscerocranium has a complex composition, and on the image the anatomical structures will overlap (orthopantomogram is a 2D representation of a 3D structure)
- incorrect positioning of the patient
- artifacts.

In radiology, the word artifact means an artificial phenomenon occurring on an image reflecting a problem of radiological technique, rather than the actual image of the patient. Recognition of anatomical structures on two-dimensional X-rays is obstructed by the complex anatomy of the middle section of the face, the overlap of different anatomical structures and the change in the orientation of the radiation projection. Objects are viewed in the mesio-distal and apical-coronal plane; however, the buco-lingual plan is not possible to evaluate [5].

Panoramic X-rays are widely used in dental practice, along with bitewing and periapical film X-rays. The clarity of detail is much lower in the case of orthopantomography. Thus the usefulness of diagnosis is limited to the recognition of heavy abnormalities [6]. The panoramic image is a complex projection with multiple overlays and distortions, which can be aggravated by technical errors [7].

With the development of technology, diagnostic methods in dental medicine have been optimized. Cone beam computed tomography is widely used in dentistry because it overcomes the deficiencies of two-dimensional images, projecting the structures investigated into all 3 dimensions (sagital, coronal and axial), removing overlap and deformation [8]. The image quality and diagnostic accuracy of the CBCT are affected by artifacts caused by high-density structures such as enamel and radioopaque materials [9]. The CBCT correctly described all types of defects studied, but involves a relatively high dose of radiation and costs [10].

However, orthopantomography remains the basic imaging method widely available and frequently used to assess dental condition prior to treatment [11].

Very important is the training of doctors to interpret x-ray images [12]. Virtual learning has been proven to be superior to the traditional method [13]. Of course, clinical experience is also very important, in addition to theoretical training. In the case of dentists with theoretical training and extensive experience or experience without formal training, the success rate in interpreting X-rays is higher, approaching 100% [14]. Moreover, training is also needed in the evaluation of CBCT images because computer tapered beam tomography is widely used by dentists [15, 16].

The aim of our study is to distinguish the artifacts that can occur on two-dimensional and three-dimensional dental X-rays (intraoral or extraoral) from the actual pathology of the investigated area, by performing control X-rays.

Material and methods

For this study we viewed and compared a number of 80 retroalveolar X-rays, 45 OPGs and 35 CBCTs. We used 2 radio-imaging systems: X-Ray Soredex for retroalveolar radiography and OPG, and for CBCT we used i-CAT Scanner with OnDemand rendering and visualization software. In the case of X-rays showing artifacts or possible errors, X-rays were repeated at a maximum interval of 5 days or a CBCT was performed, and in the case of OPGs, retroalveolar X-rays were performed to confirm or disprove the diagnosis.

Prior to the interpretation of the radiographic images, the optimal conditions were ensured, which helped to remove artifacts arising from the use of an inadequate technique of making and processing the radiological film, by using obsolete apparatus, damaged films, misadjustment of the apparatus, positioning and improper diaphragm of the apparatus.

Also, due to the fact that today radiology has evolved and is being done digitally, the artifacts related to the processing of radiological film in the darkroom have been removed.

The interpretation of the X-rays was based on their visualization, both using the negatoscope and in digital format. It ensured the possibility of adjusting the brightness and size of the images, which are real benefits for the correct interpretation of the radiographic images. Thus, it was possible to eliminate some technical errors in the examination of X-rays.

Important to note is that in our study the interpretation was carried out by both methods. Control X-rays were performed only when the artifact/error affected the diagnosis. Many of the artifacts listed and found on the films or X-ray images do not pose diagnostic problems, and in those cases, we considered a second exposure of the patient to radiation useless.

Also, if the differential diagnosis could be made by clinical examination, the second X-ray was avoided.

Results

In the group of 160 radiological investigations, we encountered the following types of artifacts:

1. "Burn Out" effect (mesial and distal cervical radio transparency) (figure 1);
2. Radiotransparent artifacts (which can mimic fractures, cysts, apical periodontitis, tumors, secondary cavities or relapses of caries) (figure 2);
3. Radiopaque artifacts (which can mimic tumors, root debris, included teeth) (figure 3);
4. Blurred image (figure 4);
5. Elongated image (figure 5);
6. Mechanical effect (figure 6);
7. Jewelry projected on film (radiopacities) (figure 7);
8. Overlapping of anatomical planes;
9. Bright effect (figure 8).

Figure 1. Burn-out effect

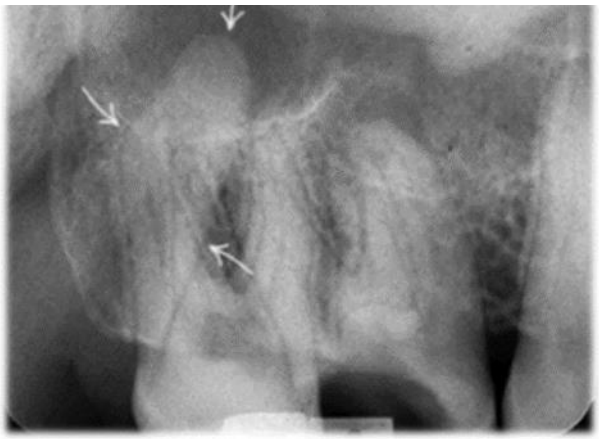

Figure 2. Radiotransparent artifacts – anatomically induced by coronoid process overlapping on the molar roots

Figure 3. Radiopaque artifacts

Figure 4. Blurred image

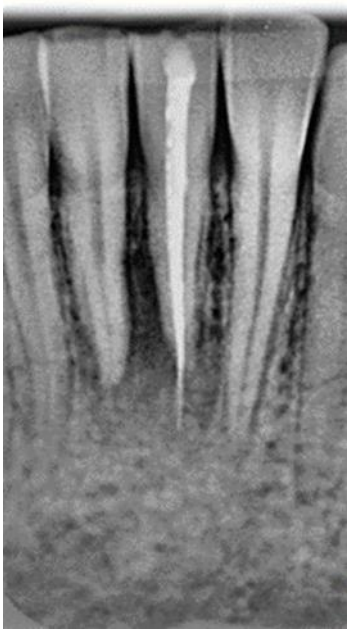

Figure 5. Elongated image

Figure 6. Mechanical effect

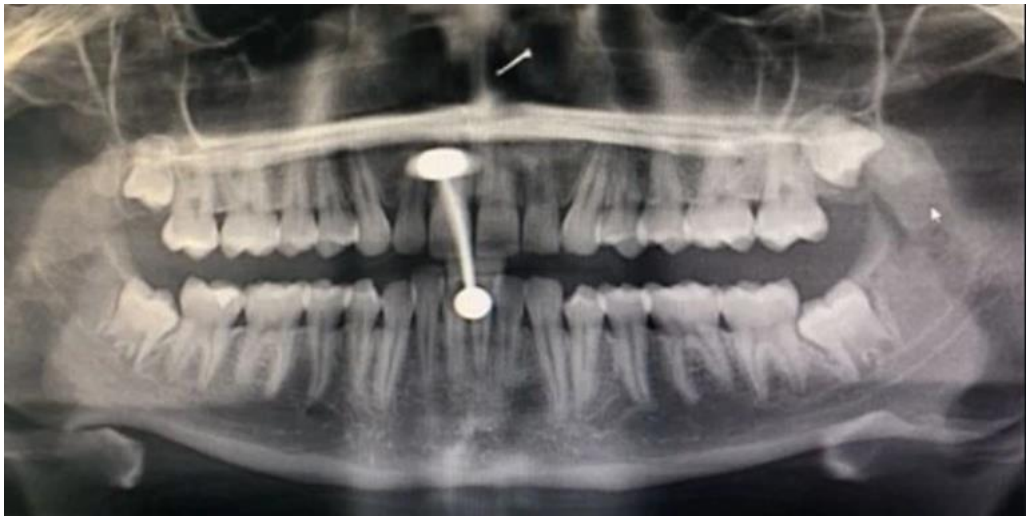

Figure 7. Jewelry projected on film

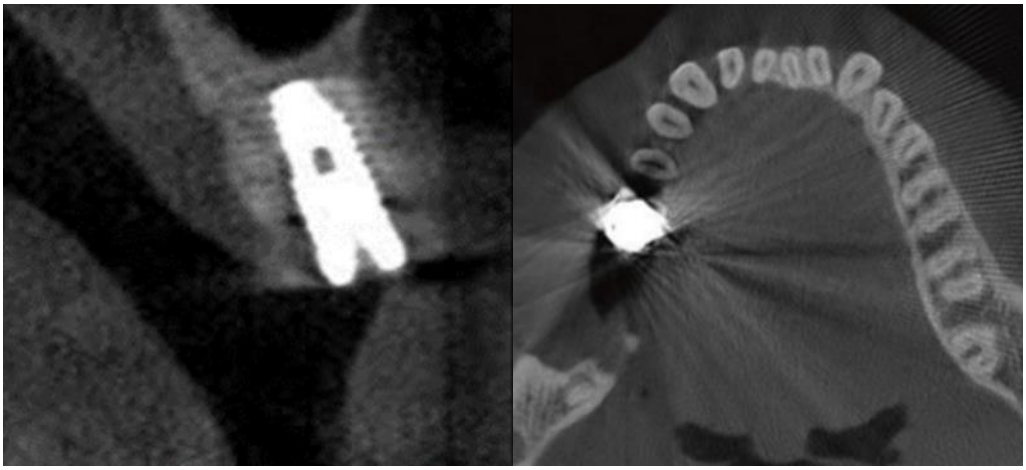

Figure 8. Bright effect

Of the total of 80 retroalveolar X-rays, in 13 cases (16.25%) we found artifacts. Of these, in only 4 cases (5%) diagnosis and treatment plan were changed following a clinical examination or a CBCT. In the case of OPGs, out of a total of 45 OPGs, 17 (37.7%) presented artifacts, but only in a percentage of 17.7% (8 cases) they affected the diagnosis.

Of the 35 CBCTs, in 10 of them (28.57%) prosthetic works with a metal component or implants were present, with specific artifacts found, but their presence did not influence the diagnosis (figure 9).

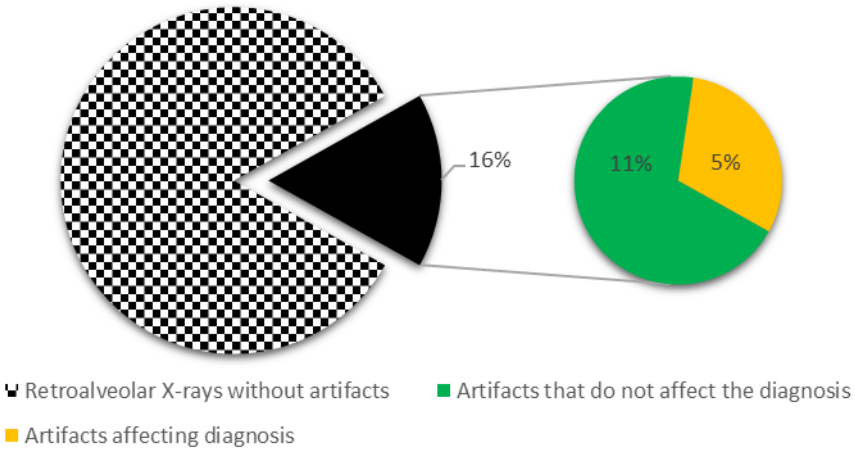

Figure 9. Graphic representation of the situation found in retroalveolar X-rays

Of the 80 retroalveolar X-rays, artifacts were found in 13 of them. The artifacts found in these 13 X-rays were as follows: burn-out effect, elongated image, blurred image, mechanical effect and overlapping anatomical planes. One of the X-rays had a burn-out effect, and a second X-ray was not performed in this case. However, 12 of them required further imaging investigations. In 4 cases the additional investigations resulted in the establishment of a new diagnosis and implicitly a new treatment plan or lack thereof (in case of the occurrence of the burn-out effect). Of these, in three cases it was necessary to carry out some control CBCT's.

The visualization of the 45 panoramic X-rays images led to the discovery of artifacts in 17 of them, in a percentage of 37.7%. Further investigations were carried out in 12 of the 17 cases, and the final diagnosis was modified in 8

cases. In three of the panoramic X-rays there was no need for a control X-ray because the artifact present was a radiopacity, due to the presence of jewelry in the investigated area. Also, in two other panoramic X-rays, the burn-out effect was found, the differential diagnosis being carried out by clinical examination.

In the case of CBCTs, the situation was different from the rest of the investigations. So, although out of the total of 35 CBCTs viewed, we found artifacts in 10 of them, the artifacts were caused by the presence of metal-component prosthetic works or implants, presenting themselves as light artifacts specific to this type of investigation. Unlike other types of radiographic representations, in their case the artifacts did not require a change of diagnosis.

Summarizing the results of this study, it can be specified the 15% percentage in which another X-ray was needed. Although one-fourth of X-rays (40 out of 160) presented artifacts, only 24 of them overlapped with key elements in the diagnosis, thus requiring the resumption of investigations (figure 10).

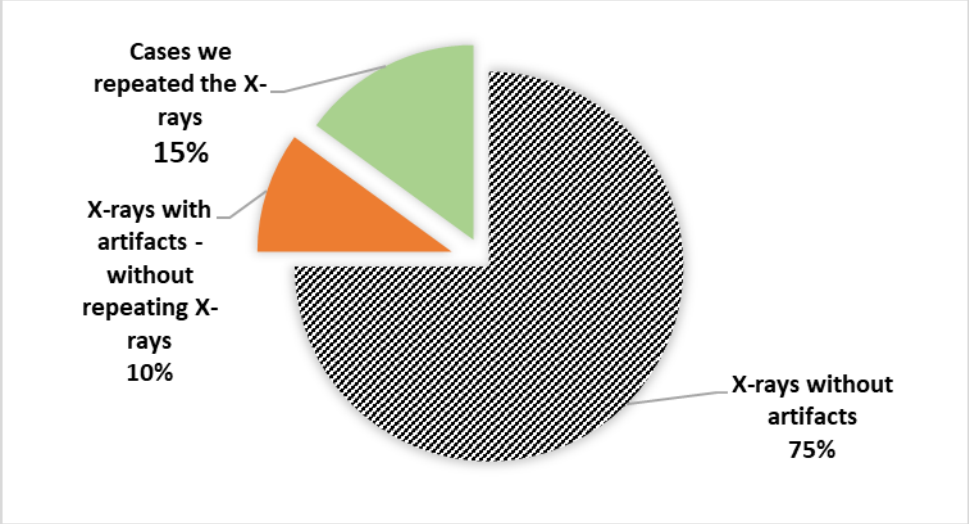

Figure 10. Percentage of X-ray repeated due to the appearance of artifacts

Of the 40 radiological investigations with artifacts, 13 were found in the interpretation of retroalveolar X-rays, 17 artifacts in the interpretation of orthopantomography and 10 in the interpretation of CBCT sections. Although a difference is already observed between these 3 types of radiological investigations and it can be specified that panoramic radiography is the most susceptible of these to the appearance of artifacts, percentages will create a much clearer picture.

In the case of retroalveolar X-rays, artifacts occurred in 16% of cases, in the case of panoramic X-rays, in 37.7%, and in the case of CBCT sections in 28.57%. It can therefore be observed that the largest percentage was in the panoramic X-rays.

On the other hand, diagnostic errors can also occur when interpreting panoramic X-rays. It is noted that the diagnosis was changed (after further investigation) to 8 out of 45 OPG and to 4 out of 80 retroalveolar x-rays. So, although fewer OPGs were investigated, they suffered several errors in interpretation.

Discussions

Radiological investigations in dental medicine are indispensable in establishing a correct diagnosis and an appropriate treatment plan. Different radiological investigations show different types of errors likely to occur, with different sources. Very susceptible to the appearance of artifacts are, however, panoramic X-rays [16]. Thus, out of the total of 45 OPGs investigated, although 17 of them presented different types of artifacts, 8 underwent diagnostic changes, 2 of which only needed a thorough clinical examination, which excluded possible parcel caries, questioned due to the occurrence of the burn-out effect.

In addition to this, panoramic X-rays benefit from a fairly low clarity of detail, so their diagnostic power does not apply to small conditions. Also, the clinical evaluation of mesio-distal angulation of the teeth on this type of X-ray will be approached with caution, while understanding the distortions that may occur [17].

The quality of panoramic X-rays could be improved by improving the radiographic technique [18]. This detail was taken care of when the imaging investigation group was chosen. However, the radiographic technique is a variable that cannot be quantified. So we were only able to approximate and minimize these types of artifacts.

Despite the obvious disadvantages we have exposed, orthopantomographs remain basic imaging modalities [18], dental emergencies being reasons why we frequently use them as diagnostic tools [19].

In general practice, the percentage of repeated X-rays is more than 10% [20]. Our study revealed, from the group of 160 radiological images investigated, a percentage of 25% (40) X-rays with artifacts, of which 15% needed control X-rays to be performed.

Although we encountered artifacts in 25% of X-rays, not all required additional radiological investigations. It can therefore be seen from this detail that a thorough clinical examination, increased attention in viewing the image, adequate illumination and last but not least, theoretical knowledge of medium or higher level, are extremely important.

Of course, diagnostic errors due to the overlap of several anatomical planes occurred in our study as often as in the case of panoramic X-rays. Although this is a normal aspect of X-rays in two dimensions, we have framed it with the other artifacts because it is most susceptible to the appearance of diagnostic errors. This type of artifact occurs in both periapical and panoramic radiography, in a significant proportion. In the case of retroalveolar X-rays, this artifact was found in 8.75% of cases, and in the case of panoramic X-rays in 15.5% of cases.

A way to avoid this inconvenience is 3D X-ray which, however, is not always necessary. CBCT also has some drawbacks, such as artifacts. Such structures can occur due to the patient's movement, the process of capturing and reconstructing images [21].

The percentage of occurrence of artifacts in this study is 28.57%. Compared to data from literature where the values of artifacts ranged from 6.1% to 27.4% for titanium and between 10% and 43.7% for lead, we can say that our study data folds those previously discovered [22].

Image optimization methods improve the quality of the image, but significantly increase the number of artifacts that negatively affect the diagnosis [23].

During the study we experimented with different methods of "improving" images when using the digital method, but not all of them helped. What we noticed was that the function of increasing the size of the X-rays and opening/closing the luminosity function helped the most. The contrast change only helped in some cases, and the one to improve clarity was not helpful.

Understanding the reasons why artifacts appear on radiological images and studying how to prevent them are of high clinical importance [24].

Theoretical training, although it is imperiously required, is not a substitute for practical experience. From the point of view of a sixth year student who carried out this study, I can say that the requirement to correctly and completely evaluate a certain radiographic image is a real challenge. The wealth of information that any image provides can generate errors in diagnosis. Ease of interpretation comes with experience, which I also observed during this study.

Conclusions

1. In order to be able to distinguish between artifacts, errors in radiological paraclinical investigations and osteo-dental anatomy or pathological conditions themselves, it would be necessary for practitioners to know the anatomy of the region, the phisiological appearance of the components, the source of errors and the different types of artifacts that may occur.
2. In the context of the interpretation of a CBCT, there are artifact correction systems and image interpretation techniques that help to eliminate these errors and ensure a

clear and accurate picture of the structures. Similarly, there are different methods of removing artifacts in the case of other types of X-rays, which can be used to reduce the need for further investigation.

3. By increasing the number of continuing education programs, the CBCT applicability can be sustained and may improve general dental practice for all specialties. Including the study of the CBCT imaging as a potential imagistic investigation in dental education is essential and the advantage can be found in the accuracy and reliability of treatment planning using 3D imaging and in the results evaluation.

Conflict of interest: None declared.

References

1. Behzadi F, Mandell JC, Smith SE, Guenette JP. Temporomandibular joint imaging: current clinical applications, biochemical comparison with the intervertebral disc and knee meniscus, and opportunities for advancement. Skeletal Radiol. 2020;11:22-23
2. Petrovan C, Ormenișan A, Bőgőzi B. Radiologie Dentară și Oro-Maxilo-Facială. Târgu-Mureș: Editura University Press. 2013. P:4-64
3. Harvey S, Ball F, Brown J, Thomas B. 'Non-standard' panoramic programmes and the unusual artefacts they produce. Br Dent J. 2017;223(4):248-252
4. Beals DW, Parashar V, Francis JR, Agostini GM, Gill A. CBCT in Advanced Dental Education: A Survey of U.S. Postdoctoral Periodontics Programs. J Dent Educ. 2020;84(3): 301-307
5. Naseem S, Nikhil B, Ajay L. Recent advances in imaging technologies in dentistry. World J Radiol. 2014;6(10):794–807
6. Stelt PF. Panoramic radiographs in dental diagnostics. Ned Tijdschr Tandheelkd. 2016;123(4): 181-7
7. Perschbacher S. Interpretation of panoramic radiographs. Aust Dent J. 2012;57(1):40-5
8. Jing G, Jing S. Comparison between cone beam computed tomography and periapical radiography in the diagnosis of periapical disease. Hua Xi Kou Qiang Yi Xue Za Zhi. 2015; 33(2): 209-13
9. Candemil AP, Salmon B, Freitas DQ, Haiter-Neto F, Oliveira ML. Distribution of metal artifacts arising from the exomass in small field-of-view cone beam computed tomography scans. Oral Surg Oral Med Oral Pathol Oral Radiol. 2020;64-75
10. Vadiati SB, Khosravifard N, Ghandari F, Hadinezhad A. Detection of peri-implant bone defects using cone-beam computed tomography and digital periapical radiography with parallel and oblique projection. Imaging Sci Dent. 2019;49(4):265-272
11. Hingst V, Weber M-A. Dental X-ray diagnostics with the orthopantomography - Technique and typical imaging results. Radiologe. 2020;60(1):77-92
12. Drage NA, Atkin PA, Farnell DJJ. Dental and maxillofacial radiology: confidence, knowledge and skills in the newly graduated dentis. Br Dent J. 2020;228(7):546-550
13. Soltanimehr E, Bahrampour E, Imani MM, Rahimi F, Almasi B, Moattari M. Effect of virtual versus traditional education on theoretical knowledge and reporting skills of dental students in radiographic interpretation of bony lesions of the jaw. BMC Med Educ. 2019;19(1): 233
14. Sholl SA, Moody GH. Evaluation of Dental Radiographic Identification: An Experimental Study. Forensic Sci Int. 2001;115(3):165-9
15. Ganguly R, Ramesh A. Systematic Interpretation of CBCT Scans: Why Do It?. J Mass Dent Soc. 2014;62(4):68-70
16. Janani K, Sandhya R. A Survey on Skills for Cone Beam Computed Tomography Interpretation Among Endodontists for Endodontic Treatment Procedure. Indian J Dent Res. 2019;30(6):834-838
17. Mckee IW, Williamson PC, Lam EW, Heo G, Glover KE, Major PW. The Accuracy of 4 Panoramic Units in the Projection of Mesiodistal Tooth Angulations. Am J Orthod Dentofacial Orthop. 2002;121(2):166-75
18. Akarslan ZZ, Erten H, Güngör K, Celik I. Common Errors on Panoramic Radiographs Taken in a Dental School. J Contemp Dent Pract. 2003;4(2):24-34
19. Sklavos A, Beteramia D, Delpachitra SN, Kumar R. The Panoramic Dental Radiograph for Emergency Physicians. Emerg Med J. 2019;36(9):565-571
20. Bakx S, Syriopoulos K. The dental radiograph: pitfalls and surprises. Ned Tijdschr Tandheelkd. 2015;122(5):280-5;
21. Nagarajappa AK, Dwivedi N, Tiwari R. Artifacts: The Downturn of CBCT Image. J Int Soc Prev Community Dent. 2015;5(6):440-5
22. Pauwels R, Stamatakis H, Bosmans H et al. Quantification of Metal Artifacts on Cone Beam Computed Tomography Images. Clin Oral Implants Res. 2013; 24 Suppl A100:94-9;
23. Clark JL, Wadhwani CP, Abramovitch K, Rice DD, Kattadiyil MT. Effect of Image Sharpening on Radiographic Image Quality. J Prosthet Dent. 2018;120(6):927-933
24. Gulsahi A, Secgin CK. Assessment of Intraoral Image Artifacts Related to Photostimulable Phosphor Plates in a Dentomaxillofacial Radiology Department. Niger J Clin Pract. 2016;19(2): 248-53

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Assessment of dental anxiety and the prevalence of dental caries in a group of 6-9 years old children.

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Abstract

Children`s dental anxiety is responsible for increasing dental health problems, as patients avoid seeking treatment. The aim of our study was to evaluate the level of dental anxiety and its correlation with dental health status in a group of children aged between 6-9 years.

Material and Methods. Our study included 56 children: first, they completed a questionnaire and then the decay-missing-filled teeth index was measured (DMFT).

Results. From a total of 59 children, 29 children had dental anxiety (51.78%) and the prevalence of caries was 69%. The mean and SD for the DMFT index was 1.76+/- 1.54 (2.04 +/- 1.98 for boys and 1.69 +/- 1.72 for girls, with p= 0.0391, p<0.05).

In conclusion, the level of dental anxiety can be reduced by frequent visits to the dental office. A favorable personal experience might help children increasing their confidence for dental treatment. There was a significant negative association between the value of filled teeth and the level of child`s anxiety.

Keywords: dental anxiety, caries, pediatric dentistry, oral health

Introduction

The dental anxiety was defined as a fear towards dentist and dental treatment, being considered the main reason why patients of different ages avoid the visit to the dental office. Dental fear in children has a multifactorial etiology and is related to the child`s age, gender and personality, presence of other general fears, a history of painful dental experiences or the negative influence of the parental dental fear. Its prevalence was reported to range between 3% to 43% in different populations, girls and younger children being more affected [1].

Childhood fears were reported to have a tendency to decrease in time, but not in a linear manner, as peak fear scores might be noticed at different ages. For example, in children over 8 years of age, social fears or the fear of injury are mostly encountered and this could explain why the level of dental fear of these children is higher during the first visit to a dental office. It was shown that dental anxiety experienced in childhood usually persists into adolescence and it might determine the patients to avoid treatment and neglect their oral health. Therefore, it is of great importance for dental health professional to identify children who have dental fear, in order to apply appropriate management and clinical techniques at the earliest age possible [2,3]. Self-reported scales are considered to be the most reliable methods to assess anxiety in children, but despite the great number of methods available, none of them is considered ideal or suitable to evaluate children`s dental anxiety worldwide [4-6]. In the attempt to overcome all the shortcomings of previously used scales, Abeer A-Namankany et al [7] introduced a new dental anxiety scale suitable for children and adolescents, known as Abeer Children Dental Anxiety Scale (ACDAS). This was proven to be useful in both clinical and nonclinical settings and it was considered that ACDAS fulfills the required criteria as a gold standard dental anxiety scale for children.

The correlation between the level of dental fear and decay, missed or filled teeth is presented differently by specialists; some reported that children with many decayed teeth had reduced levels of dental anxiety [8], and others showed that children with more dental lesions had higher levels of dental fear. This difference is probably due to the previous dental experience of the children in the different samples [9]. The aim of this cross-sectional study was to assess the level of dental anxiety in a group of young children and to

correlate it with their dental health status, evaluated according to World Health Organization`s criteria of decay-missing-filled teeth index.

Material and methods

The study was conducted during the spring semester of 2019 in a group of 63 children of 6-9 years old (25 boys and 38 girls) from a primary school located in Târgu Mureş. The ethical approval for this investigation has been previously obtained from the Ethics Committee of our university (Nr. 274/21.11.2018). A written consent was signed by the parents or legal representatives and children were also asked if they agree to participate to this study. Children were randomly selected and included in the study if they agreed to listen to the examiner and answer to all the questions. We excluded from the study the children whose parents did not approve their enrollment in the investigation and for which we could not perform all ACDAS evaluations or children with had received dental treatment before due to complications of dental caries. The dental part of ACDAS score (Table 1) was applied, which includes 13 questions with 3 possible answers, based on a Likert scale using faces, as follows: 1-relaxed, not scared, 2-neutral, feeling OK, 3-scared or feeling anxious. The same examiner (R.V.) conducted this part of the study, so there was no need for inter-observer calibration. Each child was asked to indicate the face that best represented her/his response to the questions and the answer was recorded as 1, 2 or 3 (range 13-39) and a score < 26 indicated that the child was not experiencing anxiety.

Table 1. Dental part of ACDAS scores (Dr. Abeer Al-Namankany scale,2012)

How do you feel about:	Happy (score 1)	OK (score 2)	Scared (score 3)
Sitting in the waiting room?			
A dentist wearing a mask on his face?			
Laying flat on the dental chair?			
A dentist checking your teeth with a mirror?			
Having a strange taste in your mouth? (from filling material or gloves)			
Having a “pinch” feeling in your gum?			
The feeling of numbness (fat lip or tongue)?			
A dentist cleaning your teeth by buzzy electric arm that is spraying water?			
The sounds that you hear at the dentist?			
The smell at the dentist?			
Having a tooth taken off?			
Wearing a small rubbery mask on your nose to breath special gas to help you feel comfortable during treatment?			
Having a “pinch” feeling on the back of your hand?			

The dental control examinations were conducted in the Integrated Center of Dental Medicine of our faculty by the same examiner (MM) who was unaware of the results of the questionnaire survey at the time of examination. The diagnostic criteria used for caries were the same as those published by the WHO [10]. All decay-missing-filling teeth and surfaces (DMFT and DMFS) were registered in the young permanent teeth expected to be present at these age interval, namely the upper and lower front teeth and first molars.

The statistical analysis was performed using GraphPad Prism 7 for Windows (GraphPad Software, California, USA). The categorical variables were expressed as absolute numbers and percentages and the continuous variables as mean and standard deviation. All statistical

tests were chosen after applying the Kolmogorov-Smirnov normality test. For independent data showing Gaussian distribution, t test assuming equal or unequal variances was chosen based on the F test. The level of statistical significance was set at $p< 0.05$.

Results

From the initial study group, 7 children were withdrawn as we could not have complete data and therefore the evaluation was made on 56 children (38 girls and 22 boys). The distribution of the study group according to age and sex is presented in Table 2. The mean age of the study group was 8.4 years (range 6.4-9.6) and children between 8-10 years old represented 50% of the study group. The results of ACDAS score are presented in Table 3, in which we considered that a value of 26 points is the cut-off point for dental anxiety. The unpaired t test Welch corrected indicated a value of $p = 0.0434$ ($p< 0.05$).

Table 2. Characteristics and distribution of the study group

Years of age	Girls N (%)	Boys N (%)	Total N (%)
6.1-7.0	6 (10.71%)	4 (7.14%)	10 (17.85%)
7.1-8.0	11 (19.65%)	7 (12.5 %)	18 (32.15%)
8.1-9.0	8 (14.28%)	6 (10.72%)	14 (25%)
9.1-10.0	9 (16.08%)	5 (8.92 %)	14 (25%)
Total	34 (60.72%)	22 (39.28)	56 (100%)

Table 3. ACDAS scores in the study group according to age.

Age interval	ACDAS score Mean +/- SD
8-9 years old	27.55 +/- 1.54
6-7 years old	28.3 +/- 1.18
P value	0.0425*

*Statistically significant differences ($p<0.05$).

The statistical analyze of data correlating the mean and Standard Deviation of ACDAS scores in the study group according to age shows significant differences, as older children have lower values, which could be explained by more experience of this age group with dental clinic environment, the fact that they understood it was just a control visit, or previous good experience during dental treatment appointments all these contributing to lower scores of dental anxiety ($p = 0.0425$, $p<0.05$). Overall, 27 children (48.21%) were under the cut-off point of anxiety, meaning that they did not have fear of anxiety related to dental treatment, compared to 29 children (51.78%) who were considered anxious.

The prevalence of dental caries in the study group was 69%, with a mean and Standard deviation (SD) for the DMFT index of 1.76+/-1.54; the mean and SD values of each component were as follows: D = 1.69 +/- 1.75, M = 0.04 +/- 0.25, F = 1.14 +/- 0.63. According to gender, the mean and SD value of DMFT recorded for the boys were 2.04 +/-1.98 and for girls it was 1.69 +/- 1.72, which is statistically significant ($p= 0.0391$). The prevalence of dental caries in the young permanent teeth of children enrolled in the study group is presented in Table 4.

Table 4. The prevalence of dental caries and DMFT components in the study group

Age	Decay component	Missing component	Filled component	Mean +/- SD of DMFT
6.1 – 7.0	0.60 +/- 0.02	0.0 +/- 0.0	0.51 +/- 0.22	0.41 +/- 0.03
7.1 – 8.0	0.93 +/- 0.41	0.02 +/- 0.13	0.90 +/- 0.35	0.72 +/- 0.63
8.1 – 9.0	1.52 +/- 1,29	0.04 +/- 0.21	1.23 +/- 0.74	1.28 +/- 0.90
9.1 – 10.0	2.64 +/- 1.85	0.05 +/- 0.58	1.10 +/- 0.59	1.92 +/- 1.21
Total	1.69 +/- 1.75	0.04 +/- 0.25	1.14 +/- 0.63	1.76 +/- 1.54

We compared the DMFT values and ACDAS scores in the study group and we could not find a correlation between dental caries and dental anxiety. However, there was a statistically significant negative association between the value filled teeth (F component) and the level of child`s anxiety, meaning that children with more filled teeth had less dental fear.

Discussions

Dental anxiety is a common problem which develops mostly in childhood and adolescence, with almost half of children reporting low to moderate and 10-20% high levels of dental anxiety. It is associated with different specific factors, such as needles, injections, drilling or just the dental setting [11]. This emotional disturbance has important implications for both child and dental team, as in children with high levels of dental anxiety there is an increasing number of decayed, missing and filled teeth compared to non-anxious young patients.

Furthermore, the treatment of dentally anxious children is time consuming and demanding for the clinician, factors that lead to referral of these patients to secondary dental care services [12-14]. Dental caries prevalence is a problem recognized by many specialists and researchers, proved by the great number of studies with this topic. According to data from WHO, caries prevalence has decreased in European Union countries during the last 35 years, which could be attributed to constant use of preventive measures and awareness of population on the importance of oral hygiene maintenance measures. However, in countries with a lower economic level, the prevalence of dental caries among 12-year-old children is still high.

The amount of increasing evidence that shows the positive correlation between dental anxiety and poor oral health, it is important to identify children with dental fears or phobias from an early stage, in order to reduce the impact of these emotional disturbances on the population.

Several methods of assessing child`s dental anxiety have been developed and three directions are commonly used: first, the direct observation of the child's physiological state in the dental context (by dental personnel and/or researchers), second, the completion of a questionnaire by the parent as a measure of how anxious the child is, and third, the use of self-reported scales completed by the child [15-17].

Our study showed that 48.21 % of the children did not express dental anxiety, meaning that in these cases there is a reduced risk for development of emotional disturbances towards dental treatment in the future. However, these figures are much lower than those reported by Boka et al [1] who found that 84.6% of 12 years old children do not suffer from dental fear. It is important to underline that some of the anxious children are cooperative during dental treatment and therefore, other factors such as achiness or aggressiveness might influence the way the child expresses the dental anxiety [18].

According to our results, when dental fear was compared with the prevalence of caries in young permanent teeth, we found no statistically significant correlations; however, when comparing ACDAS scores with each component of DMFT we found that children with a high F (filled teeth) component had lower anxiety scores, below 26 points, meaning that they did not experience anxiety towards dental team or clinic environment. This is in agreement with previous studies, which confirmed that children who had visited the dental office several times and experienced

dental treatment before have a lower degree of dental anxiety [19-21].

Conclusions

Children`s dental anxiety is influenced by the own experience with the dental team members and frequency of treatments, as children with more fillings proved to be less anxious. Therefore, in order to reduce the prevalence of dental caries in children, further research is needed to study this relationship and to find proper solutions for increasing the confidence of children towards frequent control or treatment visits to the dental office.

Conflict of interest: None declared.

References

1. Boka V, Arapostathis K, Karagiannis V, Kotsanos N, van Loveren C, Veerkamp J. Dental fear and caries in 6-12-year-old children in Greece. Determination of dental fear cut-off points. European J of Paediatric Dentistry. 2017;18(1):45-50.
2. Barros L, Buchanan H. Correspondence between dentist and child ratings of dental anxiety in Portugal. A preliminary study. Portuguese Journal of Oral and Maxillofacial Surgery. 2011;52:13-15.
3. Porritt J, Marshman Z, Rodd HD. Understanding children's dental anxiety and psychological approaches to its reduction. Int J Paediatr Dent 2012;22:397-405.
4. Luoto A, Lahti S, Nevanperä T, Tolvanen M, Locker D. Oral-health-related quality of life among children with and without dental fear. Int J Paediatr Dent. 2009;9:115-120.
5. Humphris GM, Dyer TA, Robinson PG. The modified dental anxiety scale: UK general public population norms in 2008 with further psychometries and effects on age. BMC Oral Health. 2009;9:20-27.
6. Al-Namankany A, de Souza M, Ashley P. Evidence-based dentistry: Analysis of dental anxiety scales for children. Br Dent J. 2012;212:219-222.
7. Al-Namankany A, Ashley P, Petrie A. The development of a dental anxiety scale with a cognitive component for children and adolescents. Pediatr Dent. 2012;34:e219-224.
8. Soares FC, Souto G, Lofrano M, Colarwes V. Fear related to dental care in children and adolescents in a low-income Brazilian community. Eur Arch Pediatr Dent. 2015;16(2):149-152.
9. Esa R, Ong AL, Humphris G, Freeman R. The relationship of dental caries and dental fear in Malaysian adolescents: a latent variable approach. BMC Oral Health. 2014;12(14):19-25.
10. World Health Organization Oral Health Surveys: Basic Methods, 3rd Edition, Geneva (CH) WHO;1987.P.20-25.
11. Lee CY, Chang YY, Huang ST. Prevalence of dental fear among 5-to 8-year-old Taiwanese children. J Public Health Dent. 2007;67:36-41.
12. Mendoza-Mendoza A, Perea MB, Yañez-Vico RM, Iglesias-Linares A. Dental fear in children: the role of previous negative dental experiences. Clin Oral Investig. 2015;19(3):745-751.
13. Guinot Jimeno F, Yuste Bielsa S, Cuadros Fernández C, Lorente Rodríguez AI, Mercadé Bellido M. Objective and subjective measures for assessing anxiety in paediatric dental patients. Eur J Paediatr Dent. 2011;12:239-244.
14. Al-Namankany A, Ashley P, Petrie A. Development of the first Arabic cognitive dental anxiety scale for children and young adults. World J Meta-Anal. 2014;2(3):64-70.
15. Shafi S, Alasmri A, Mustafa A, Shiban AlShrani AS, Alasmri H, Bijle MA. An assessment of dental anxiety in nonclinical setting among Saudi Arabian Children using Abeer Children Dental Anxiety Scale. J Dent Res Rev. 2015;2:172-174.
16. DeMenezes Abreu DM, Leal SC, Mulder Z, Frencken JE. Dental anxiety in 6-7-year-old children treated in accordance with conventional restorative treatment, ART and ultra-conservative treatment protocols. Acta Odontol Scand. 2011;69(6):410-416.
17. Caltabiano ML, Croker F, Page L, Sklavos A, Spiteri J, Hanrahan L. Dental anxiety in patients attending a student dental clinic. BMC Oral Health. 2018. Doi/10.1186/s12903-018-0507-5 15-25.
18. Versloot J, Veerkamp J, Hoogstraten J. Dental fear and psychological function in children: its relationship with behavior during treatment. Eur Arch Pediatr Dent. 2008;9(1): 36-40.
19. Kiling G, Akay A, Eden E, Swevinc N, Elliudokuz N. Evaluation of children`s dental anxiety levels at a kindergarten and at a dental clinic. Braz Oral Res. 2016;30(1):e72. doi:10.1590/1807-3107BOR-2016.vol.130.0072 55-68.
20. Pohjola V, Rekola A, Kunttu K, Virtanen JI. Association between dental fear and oral health habits and treatment among university students in Finland: a national study. BMC Oral Health. 2016;16:26-29.
21. Hofer D, Thoma MV, Schmiddlin PR, Attin T, Ehbert U, Nater UM. Pre-treatment anxiety in a dental hygiene recall population: a cross-sectional pilot study. BMC Oral Health. 2016;16:43-47.

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Study about mechano-chemical gingival displacement with single-cord technique.

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Abstract
Introduction: Besides abutment preparation, the impression is essential in order to achieve an esthetical and functional prosthetic restoration. Proper gingival displacement and abutment finish line exposure is crucial for the proper impression technique.
The study aims are to investigate the vertical gingival displacement and if the free gingival margin returns to its original position after seven days by using a retraction cord impregnated with different chemical substances.
Materials and method: Our clinical study evaluated on digital photos the modification of the healthy, free gingival margin position on the labial surface of two upper central incisors in the same female patient during the sulcus enlargement with the mechano-chemical method.
Results: Statistically significant differences were obtained by comparing the mean values of vertical gingival displacement obtained using a non-impregnated and an impregnated retraction cord with different chemical at each time of the measurements.
Conclusion: The mechano-chemical technique is an efficient method for gingival displacement regardless the impregnating solution used.
Keywords: retraction cord, gingival displacement, impregnation.

Introduction

Perfectly executed prosthetic rehabilitation is the result of consistent and complex work processes. Besides abutment preparation, the impression is essential to achieve an esthetical and functional prosthetic restoration. Proper gingival displacement and abutment finish line exposure is crucial for the proper impression technique [1,2].

The most commonly used gingival sulcus expansion method is the mechano-chemical method, which also provides a moisture-free area. The chemical used for gingival displacement must be carefully selected because, in addition to their positive effect can cause irreversible damage to the gingiva [3,4].

The study aims are to investigate the vertical gingival displacement and if the free gingival margin returns to its original position after seven days by using a retraction cord impregnated with different chemical substances.

Material and methods

Our clinical study evaluated on digital photos the modification of the healthy, free gingival margin position on the labial surface of two upper central incisors in the same female patient during the sulcus enlargement with the mechano-chemical method.

For the single-cord gingival displacement technique, the 0 sized, non-impregnated Easy Cord retraction cord was used. The cord was impregnated every week with different hemostatic agents and vasoconstrictors. The impregnating solutions (ferric sulfate: 15.5%, 20%, aluminum chloride: 20%, 25%, aluminum sulfate: 25%, epinephrine: 8%) were prepared at the Department of Biochemistry of the George Emil Palade University of Medicine, Pharmacy, Science and Technology of Târgu Mureș (Figure 1).The free gingival margin's position vertical modification was studied weekly during seven weeks.

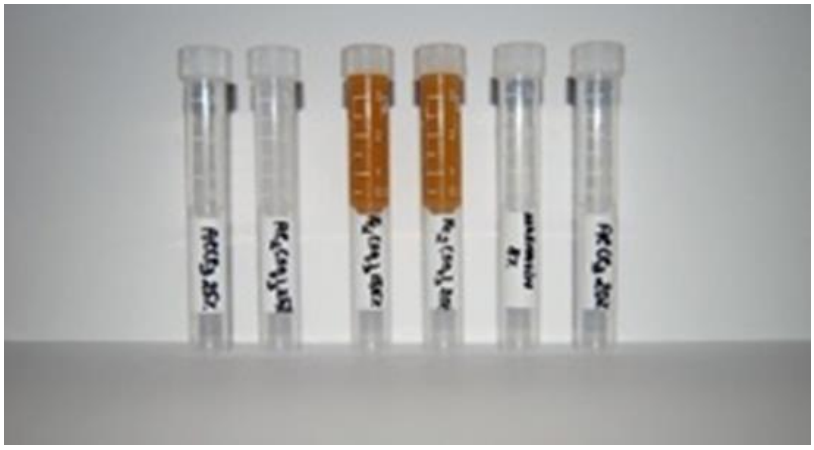

Figure 1. Impregnating chemicals

A thin dental spatula was used to insert the retraction cord in the sulcus. The removal of the cord was performed after five minutes in all cases. Photographs were taken before and immediately after the insertion; at five minutes from the insertion; immediately, and respectively at one, two, five, and ten minutes after removing the cord from the sulcus.

During the photo session, a custom-made bite-fork with an acrylic bite template was used to maintain in the same position's head and teeth (Figure 2). A millimeter-scale was placed on the incisal area of the bite template to calibrate the pictures. The photos were taken using a Nikon D750 digital camera (Nikkor, 60mm, f 2.8) mounted on a tripod. The camera's macro lenses were placed every time at the same distance and perpendicular to the central incisors' labial surface.

Figure 2. Custom-made bite fork with acrylic bite template

The free gingival margin position was determined in the digital photographs in the following moments: before- (T1), immediately- (T2), at five minutes (T3) after the cord placement; immediately (T4)-, and at one (T5), two (T6), five (T7), ten minutes (T8) after removing the cord.

On day seven, the clinical healing and the free gingival margin position were examined on a photograph.

The workflow:

- The working area was isolated by using cotton rolls.
- A control photo was taken to determine the initial position of the free gingival margin.

- For the proper choice of the adequately sized retraction cord, the gingival sulcus depth was measured with a periodontal probe.
- For the impregnation of the cord, different chemicals were used every week. The cord was soaked a few seconds in the impregnating solution and kept on a dry surface until it was inserted.
- In the first week, a non-impregnated (NI) cord was placed in the sulcus. In the second week, 25% aluminum chloride (AlCl3) was used, 25% aluminum sulfate (Al(SO4)3) in the third week, 15.5% ferrous sulfate (Fe2(SO4)3) at week four, in the fifth week, 20% ferrous sulfate (Fe2(SO4)3), the sixth week 8% epinephrine (E), and in the last, seventh week, 20% aluminum chloride (AlCl3).
- The cord was placed in the sulcus from mesial to distal.
- The second photo was taken immediately after inserting the cord. After waiting five minutes, the third photo was taken, and the cord was removed. The next four pictures were taken according to the protocol established at the beginning of the workflow. The last photo was taken after a week to evaluate the healing of the free gingival margin.
- The Digimizer software was used for the measurements of the free gingival margin's position vertical modification. The millimetric-scale, attached to the bite template, was used to calibrate the digital measuring program's ruler. Each measurement was performed three times, in mm, perpendicular to the gingival margin from the same reference points of the millimetric-scale.

Figure 3. The Digimizer photo analysis software – determination of the free gingival margin's position

- The data obtained were processed in Microsoft Excel.
- The statistical analysis was performed by using GraphPad Prism 8 for macOS version 8.4.3. software. The statistical significance was set at $p < 0,05$. The mean (M), median (Me), and standard deviation (SD) were calculated. Confidence interval was established at 95%. The used test: Kruskal Wallis followed by Dunn's multiple variance analysis, Mann-Whitney (non-Gaussian distribution).

Results

The moments of the measurements of vertical modification of the gingival margin's position after displacement with retraction cord impregnated with different chemicals are presented in Figure 4 and 5.

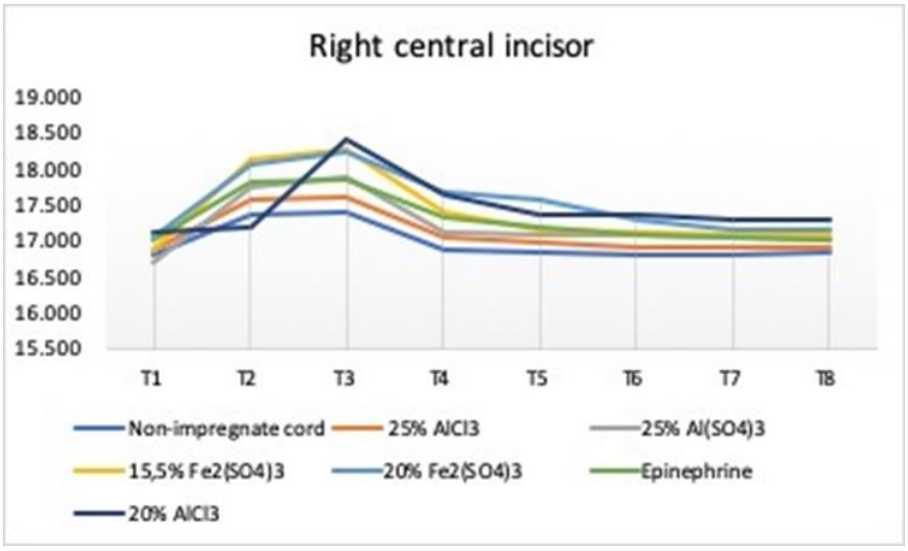

Figure 4. The vertical gingival displacement obtained with the different chemicals in different moments - right central incisor

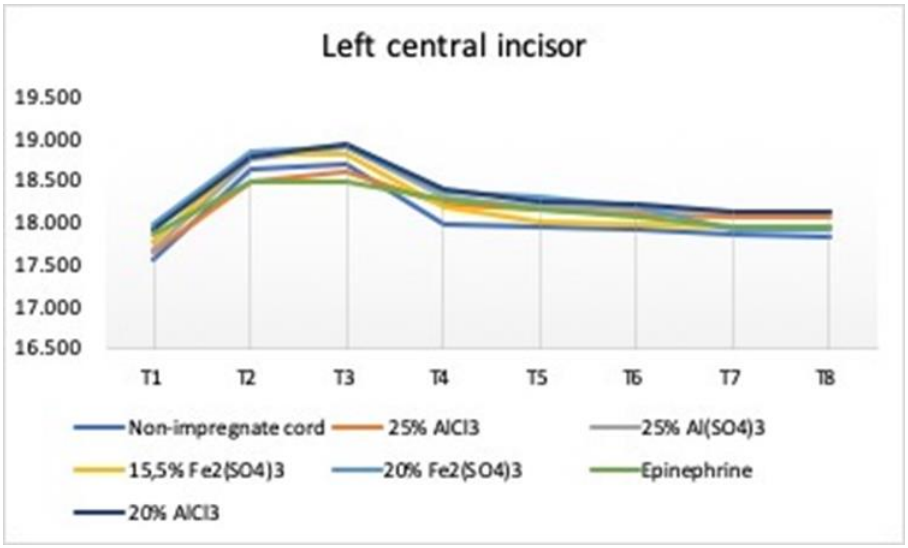

Figure 5. The vertical gingival displacement obtained with the different chemicals in different moments - left central incisor

Comparing the mean values recorded each time, the level of the free gingival margin's position was measured before insertion of the retraction cords, no statistical differences were obtained from one week to another (Mann-Whitney test) (Table 1).

Table 1. Mann-Whitney test results

Period	Gingival displacement method	Mean values	SD	Minimum	Maximum	
Week 1vs 2	NI 25% $AlCl_3$	16.824 17.544	0.004359 1.157	16.819 16.875	16.827 18.880	
Week 2 vs 3	25%$AlCl_3$ $Al(SO_4)_3$	17.544 16.695	1.157 0.002646	16.875 16.692	18.880 16.697	**p>0,05**
Week 3 vs 4	$Al(SO_4)_3$ 15.5% $Fe_2(SO_4)_3$	16.695 16.895	0.002646 0.002646	16.692 16.893	16.697 16.898	
Week 4 vs 5	15.5% $Fe_2(SO_4)_3$ 20% $Fe_2(SO_4)_3$	16.895 17.039	0.002646 0.002646	16.893 17.036	16.898 17.040	

Week 5 vs 6	20% $Fe_2(SO_4)_3$ Epinephrine	17.039 17.007	0.002646 0.001732	17.036 17.005	17.041 17.008	
Week 6 vs 7	Epinephrine 20% $AlCl_3$	17.007 17.129	0.001732 0.002646	17.005 17.127	17.008 17.132	

Statistically significant differences (p=0.0047 – T2, p=0.0036 – T3, p=0.0036 – T4, p=0.0037 – T5, p=0.0038 – T6, p=0.0036 – T7, p=0.0036 – T8) were obtained by comparing the mean values of vertical gingival displacement obtained using a non-impregnated and an impregnated retraction cord with different chemical at each time of the measurements. (Kruskal-Wallis followed Dunn's multiple variance analysis tests) (Table 2-8).

Table 2. Dunn's multiple variance analysis test – T2

Immediately after inserting the cord – T2				
	Right central incisor		Left central incisor	
Comparison	Difference	p-value	Difference	p-value
NI vs 25% $AlCl_3$	0.000	p>0.05	15.000	p>0.05
NI vs 25% $Al(SO_4)_3$	-11.000	p>0.05	3.000	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	-14.000	p>0.05	6.000	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	-8.000	p>0.05	12.000	p>0.05
NI vs epinephrine	-5.000	p>0.05	**18.000**	**p<0.01
NI vs 20% $AlCl_3$	3.000	p>0.05	9.000	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	-11.000	p>0.05	-12.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	-14.000	p>0.05	-9.000	p>0.05
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	-8.000	p>0.05	-3.000	p>0.05
25% $AlCl_3$ vs epinephrine	-5.000	p>0.05	3.000	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	3.000	p>0.05	-6.000	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	-3.000	p>0.05	3.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	3.000	p>0.05	9.000	p>0.05
25% $Al(SO_4)_3$ vs epinephrine	6.000	p>0.05	15.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $AlCl_3$	14.000	p>0.05	6.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	6.000	p>0.05	6.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	9.000	p>0.05	12.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	**17.000**	***p<0.05**	3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	3.000	p>0.05	6.000	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	11.000	p>0.05	-3.000	p>0.05
Epinephrine vs 20% $AlCl_3$	8.000	p>0.05	-9.000	p>0.05

* - significant p ≤ 0,05; ** - very significant p ≤ 0,01

Table 3. Dunn's multiple variance analysis test – T3

Five minutes after retraction cord insertion – T3				
	Right central incisor		Left central incisor	
Comparison	Difference	p-value	Difference	p-value
NI vs 25% $AlCl_3$	-1.000	p>0.05	9.000	p>0.05
NI vs 25% $Al(SO_4)_3$	-8.000	p>0.05	-3.000	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	**-17.000**	***p<0.05**	3.000	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	-11.000	p>0.05	12.000	p>0.05
NI vs epinephrine	-5.000	p>0.05	15.000	p>0.05
NI vs 20% $AlCl_3$	-14.000	p>0.05	6.000	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	-7.000	p>0.05	-12.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	**-16.000**	***p<0.05**	-6.000	p>0.05
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	-10.000	p>0.05	3.000	p>0.05
25% $AlCl_3$ vs epinephrine	-4.000	p>0.05	6.000	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	-13.000	p>0.05	-3.000	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	-9.000	p>0.05	6.000	p>0.05

25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	-3.000	p>0.05	15.000	p>0.05
25% $Al(SO_4)_3$ vs epinephrine	3.000	p>0.05	**18.000**	****p<0.01**
25% $Al(SO_4)_3$ vs 20% $AlCl_3$	-6.000	p>0.05	9.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	6.000	p>0.05	9.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	12.000	p>0.05	12.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	3.000	p>0.05	3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	6.000	p>0.05	3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	-3.000	p>0.05	-6.000	p>0.05
Epinephrine vs 20% $AlCl_3$	-9.000	p>0.05	-9.000	p>0.05

* - significant p ≤ 0,05; ** - very significant p ≤ 0,01

Table 4. Dunn's multiple variance analysis test – T4

	Immediately after removing the cord – T4			
	Right central incisor		Left central incisor	
Comparison	Difference	p	difference	p
NI vs 25% $AlCl_3$	-1.000	p>0.05	-6.333	p>0.05
NI vs 25% $Al(SO_4)_3$	-8.000	p>0.05	-9.333	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	-11.000	p>0.05	5.667	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	**-17.000**	***p<0.05**	8.667	p>0.05
NI vs epinephrine	-5.000	p>0.05	2.333	p>0.05
NI vs 20% $AlCl_3$	-14.000	p>0.05	-3.333	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	-7.000	p>0.05	-3.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	-10.000	p>0.05	12.000	p>0.05
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	**-16.000**	***p<0.05**	15.000	p>0.05
25% $AlCl_3$ vs epinephrine	-4.000	p>0.05	8.667	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	-13.000	p>0.05	3.000	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	-3.000	p>0.05	15.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	-9.000	p>0.05	**18.000**	****p<0.01**
25% $Al(SO_4)_3$ vs epinephrine	3.000	p>0.05	11.667	p>0.05
25% $Al(SO_4)_3$ vs 20% $AlCl_3$	-6.000	p>0.05	6.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	-6.000	p>0.05	3.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	6.000	p>0.05	-3.333	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	-3.000	p>0.05	-9.000	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	12.000	p>0.05	-6.333	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	3.000	p>0.05	-12.000	p>0.05
Epinephrine vs 20% $AlCl_3$	9.000	p>0.05	-5.667	p>0.05

* - significant p ≤ 0,05; ** - very significant p ≤ 0,01

Table 5. Dunn's multiple variance analysis test – T5

	One minute after removing the cord – T5			
	Right central incisor		Left central incisor	
Comparison	Difference	p	Difference	p
NI vs 25% $AlCl_3$	-1.000	p>0.05	-6.000	p>0.05
NI vs 25% $Al(SO_4)_3$	-14.000	p>0.05	-3.000	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	-10.833	p>0.05	12.000	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	**-17.000**	***p<0.05**	3.500	p>0.05
NI vs epinephrine	-5.000	p>0.05	9.000	p>0.05
NI vs 20% $AlCl_3$	-8.167	p>0.05	5.500	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	-13.000	p>0.05	3.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	-9.833	p>0.05	**18.000**	****p<0.01**
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	**-16.000**	***p<0.05**	9.500	p>0.05
25% $AlCl_3$ vs epinephrine	-4.000	p>0.05	15.000	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	-7.167	p>0.05	11.500	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	3.167	p>0.05	15.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	-3.000	p>0.05	6.500	p>0.05

25% $Al(SO_4)_3$ vs epinephrine	9.000	p>0.05	12.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $AlCl_3$	5.833	p>0.05	8.500	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	-6.167	p>0.05	-8.500	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	5.833	p>0.05	-3.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	2.667	p>0.05	-6.500	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	12.000	p>0.05	5.500	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	8.833	p>0.05	2.000	p>0.05
Epinephrine vs 20% $AlCl_3$	-3.167	p>0.05	-3.500	p>0.05

* - significant p ≤ 0,05; ** - very significant p ≤ 0,01

Table 6. Dunn's multiple variance analysis test – T6

	Two minutes after removing the cord – T6			
	Right central incisor		Left central incisor	
Comparison	Difference	p	Difference	p
NI vs 25% $AlCl_3$	-1.000	p>0.05	-3.000	p>0.05
NI vs 25% $Al(SO_4)_3$	**-17.000**	***p<0.05**	-6.000	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	-8.333	p>0.05	12.000	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	-14.000	p>0.05	8.500	p>0.05
NI vs epinephrine	-5.000	p>0.05	6.500	p>0.05
NI vs 20% $AlCl_3$	-10.667	p>0.05	3.000	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	**-16.000**	***p<0.05**	-3.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	-7.333	p>0.05	15.000	p>0.05
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	-13.000	p>0.05	11.500	p>0.05
25% $AlCl_3$ vs epinephrine	-4.000	p>0.05	9.500	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	-9.667	p>0.05	6.000	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	8.667	p>0.05	**18.000**	****p<0.01**
25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	3.000	p>0.05	14.500	p>0.05
25% $Al(SO_4)_3$ vs epinephrine	12.000	p>0.05	12.500	p>0.05
25% $Al(SO_4)_3$ vs 20% $AlCl_3$	6.333	p>0.05	9.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	-5.667	p>0.05	-3.500	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	3.333	p>0.05	-5.500	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	-2.333	p>0.05	-9.000	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	9.000	p>0.05	-2.000	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	3.333	p>0.05	-5.500	p>0.05
Epinephrine vs 20% $AlCl_3$	-5.667	p>0.05	-3.500	p>0.05

* - significant p ≤ 0,05; ** - very significant p ≤ 0,01

Table 7. Dunn's multiple variance analysis test – T7

	Five minutes after removing the cord – T7			
	Right central incisor		Left central incisor	
Comparison	Difference	p	Difference	p
NI vs 25% $AlCl_3$	-1.000	p>0.05	-3.000	p>0.05
NI vs 25% $Al(SO_4)_3$	**-17.000**	***p<0.05**	-6.000	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	-14.000	p>0.05	6.000	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	-8.000	p>0.05	12.000	p>0.05
NI vs epinephrine	-5.000	p>0.05	9.000	p>0.05
NI vs 20% $AlCl_3$	-11.000	p>0.05	3.000	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	**-16.000**	***p<0.05**	-3.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	-13.000	p>0.05	9.000	p>0.05
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	-7.000	p>0.05	15.000	p>0.05
25% $AlCl_3$ vs epinephrine	-4.000	p>0.05	12.000	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	-10.000	p>0.05	6.000	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	3.000	p>0.05	12.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	9.000	p>0.05	**18.000**	****p<0.01**
25% $Al(SO_4)_3$ vs epinephrine	12.000	p>0.05	15.000	p>0.05

25% $Al(SO_4)_3$ vs 20% $AlCl_3$	6.000	p>0.05	9.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	6.000	p>0.05	6.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	9.000	p>0.05	3.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	3.000	p>0.05	-3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	3.000	p>0.05	-3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	-3.000	p>0.05	-9.000	p>0.05
Epinephrine vs 20% $AlCl_3$	-6.000	p>0.05	-6.000	p>0.05

*- significant p ≤ 0,05; **- very significant p ≤ 0,01

Table 8. Dunn's multiple variance analysis test – T8

	Ten minutes after removing the cord – T8			
	Right central incisor		Left central incisor	
Comparison	Difference	p	Difference	p
NI vs 25% $AlCl_3$	-1.000	p>0.05	-3.000	p>0.05
NI vs 25% $Al(SO_4)_3$	**-17.000**	***p<0.05**	-6.000	p>0.05
NI vs 15.5% $Fe_2(SO_4)_3$	-14.000	p>0.05	6.000	p>0.05
NI vs 20% $Fe_2(SO_4)_3$	-8.000	p>0.05	12.000	p>0.05
NI vs epinephrine	-5.000	p>0.05	9.000	p>0.05
NI vs 20% $AlCl_3$	-11.000	p>0.05	3.000	p>0.05
25% $AlCl_3$ vs 25% $Al(SO_4)_3$	**-16.000**	***p<0.05**	-3.000	p>0.05
25% $AlCl_3$ vs 15.5% $Fe_2(SO_4)_3$	-13.000	p>0.05	9.000	p>0.05
25% $AlCl_3$ vs 20% $Fe_2(SO_4)_3$	-7.000	p>0.05	15.000	p>0.05
25% $AlCl_3$ vs epinephrine	-4.000	p>0.05	12.000	p>0.05
25% $AlCl_3$ vs 20% $AlCl_3$	-10.000	p>0.05	6.000	p>0.05
25% $Al(SO_4)_3$ vs 15.5% $Fe_2(SO_4)_3$	3.000	p>0.05	12.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	9.000	p>0.05	**18.000**	****p<0.01**
25% $Al(SO_4)_3$ vs epinephrine	12.000	p>0.05	15.000	p>0.05
25% $Al(SO_4)_3$ vs 20% $AlCl_3$	6.000	p>0.05	9.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $Fe_2(SO_4)_3$	6.000	p>0.05	6.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs epinephrine	9.000	p>0.05	3.000	p>0.05
15.5% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	3.000	p>0.05	-3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs epinephrine	3.000	p>0.05	-3.000	p>0.05
20% $Fe_2(SO_4)_3$ vs 20% $AlCl_3$	-3.000	p>0.05	-9.000	p>0.05
Epinephrine vs 20% $AlCl_3$	-6.000	p>0.05	-6.000	p>0.05

*- significant p ≤ 0,05; **- very significant p ≤ 0,01

Discussions

During dental rehabilitation, the abutment's accurate impression represents one of the most critical clinical steps. The 0.5–1 mm subgingivally placed crown margins are desired when restoring esthetics in the frontal area [5,6]. The gingival enlargement around the abutment is essential to obtain visibility and access to the finish line during the preparation and the impression.

Several mechanical, chemical, mechano-chemical, and surgical gingival displacement procedures have been described in the literature [7,8]. Nowadays, the "classical" mechano-chemical technique is most frequently used [5,9]. The method presented in our study uses the retraction cord and different chemicals (hemostatic and vasoconstrictor) to obtain a moisture-free, accessible sulcus. The gingival displacement was obtained using the single cord technique, which is used more frequently for single-tooth restorations in healthy gingival tissue. It involves inserting a proper size single retraction cord in the gingival sulcus, which is soaked in various chemicals and then removed carefully [10].

Chandra et al. demonstrated this technique's efficiency by obtaining the desired width, which is maintained in the first minute after removing the cord and is lost progressively in time until the free gingival margin returns to its initial position [8]. Considering that the different elastomeric impression materials' setting time is between two to seven minutes [11], we considered essential to evaluate the vertical modification of the free gingival

margin immediately and at one to ten minutes after removing the retraction cord.

According to Baharav et al., to achieve optimal enlargement is recommended to keep the cord in the sulcus for four minutes [12]. In our case, the cord was maintained in the sulcus for five minutes.

After cord removal, the best gingival enlargement (mean values) was achieved using 25% aluminum sulfate (0.53 mm) followed by 20% aluminum chloride (0.50 mm), 20% ferrous sulfate (0.49 mm), 15.5% ferrous sulfate (0.46 mm), and epinephrine (0.36 mm), which are in concordance with researches of Hansen et al., demonstrating why the most commonly used chemicals nowadays are the aluminum sulfate and the aluminum chloride [13].

In the literature, there are only a few studies regarding the vertical displacement of the gingival margin. Gajbhiye et al. obtained a mean value of 0.299 mm with a 25% aluminum chloride impregnated retraction cord [7], a lower value than our measurements, but Thimmappa et al. obtained a higher mean value of 1.24 mm with a non-impregnated retraction cord [14].

In our study, the lowest value was obtained for the non-impregnated cord. Our findings are similar to Cloyd et al. 's results. The impregnation of the cord is important to obtain good results [15]. According to our and some other authors' research, aluminum chloride is the least irritating hemostatic agent and astringent, without contraindications and minimal local and systemic side effects [16].

Unfortunately, it can modify the polyvinyl siloxane impression materials setting reaction, like the aluminum sulfate [17].

Tarighi and Khoroushi [18] have shown that rinsing the preparation boundary with water after removing the cord can reduce the interaction with the impression materials. Machado and Guedes refute the direct, adverse effect of the aluminum chloride on impression materials [19].

The ferrous sulfate above, a 15% concentration, causes significant gum irritation and sensitivity [20]. As demonstrated in our experiment, gingival sensitivity and gingivitis occurred after using both concentrations of our solutions.

The most easily inserted cord has been with epinephrine, an effective vasoconstrictor, and hemostatic agent [17]. According to its systemic side effects, especially in patients with cardiovascular diseases [21], its use is not widespread today.

To avoid the gingival lesions during the cord's removal, Pelzner et al. recommend being moisturized [22].

During our research, the free gingival margin did not return to the original position after a week. However, no statistically significant differences were found between the different positions of the gingival margins during the seven weeks of examination. One week is not enough for complete gingival recovery in case of gingival displacement with retraction cords, how Prasad et al. and Reddy et al. demonstrated in their studies [23, 24]. Alternative methods can be used to obtain faster healing. The carefully handled displacement pastes can be less injurious to the marginal gingiva's health than the retraction cords [25]. According to Andreiuolo et al., retraction with cords usually requires local anesthesia and is time-consuming. Instead of cords, for better results, these clinicians recommend the different astringent pastes [26].

The limitations of this study: the lack of standardization of the landmarks used to perform the measurements does not allow an accurate assessment of the vertical gingival displacement. The clinical use of the single-cord technique has limitations. The double-cord technique is an effective alternative that can result in a different gingival enlargement.

The knitted retraction cord was used for the gingival displacement. Another cord type can result in different modifications. The interpretation of the results did not consider the gingival phenotype. The obtained values can differ for the thin biotype.

Conclusions

Within this study's limitation, the mechano-chemical technique is an efficient method for gingival displacement regardless the impregnating solution used. The use of aluminum chloride as an impregnation solution has proven to be the most efficient gingival displacement method.

The full recovery of the free gingival

margin's position is not completed in a week regardless of whether an impregnated or non-impregnated retraction cord is used.

Conflict of interest: None declared.

References

1. Al Hamad KQ, Azar WZ, Alwaeli HA, Said KN. A clinical study on the effects of cordless and conventional retraction techniques on the gingival and periodontal health. Journal of Clinical Periodontology 2008;35(12):1053-8.
2. Agarwal B, Shekhar A, Singh BP, Sing N, Chand P, Srivastava S. Effect of gingival displacement cord on the closure rate of gingival crevice: Meta-analysis. Indian dental journal. 2015;7:3-8.
3. Sábio S, Franciscone PA, Mondelli J. Effect of conventional and experimental gingival retraction solutions on the tensile strength and inhibition of polymerization of four types of impression materials. J Appl Oral Sci. 2008;16(4):280-285.
4. Shrivastava KJ, Bhoyar A, Agarwal S, Shrivastava S, Parlani S, Murthy V. Comparative clinical efficacy evaluation of three gingival displacement systems. J Nat Sci Biol Med. 2015;6(1): S53-7.
5. Donovan TE, Chee WW. Current concepts in gingival displacement. Dent Clin North Am. 2004;48(2): 433-44.
6. Safari S, Vossoghi Sheshkalani Ma, Vossoghi Sheshkalani Mi, Hoseini Ghavam F, Hamedi M. Gingival Retraction Methods for Fabrication of Fixed Partial Denture: Literature Review. J Dent Biomater. 2016;3(2):205-213.
7. Gajbhiye V, Banerjee R, Jaiswal P, Chandak A, Radke U. Comparative evaluation of three gingival displacement materials for efficacy in tissue management and dimensional accuracy. J Indian Prosthodont Soc. 2019;19(2):173-179.
8. Khajuria RR, Sharma V,Vadavadgi S, Singh R. Advancements in tissue displacement–A review. Ann Dent Spec. 2014;2(3):100-3.
9. Yankov S, Chuchulska B, Slavchev D, Hristov I, Todorov R. The place of retraction cords among the tissue displacement methods. J of IMAB. 2017;23(4):1854-1858.
10. Adnan S, Agwan MA. Gingival Retraction Techniques: A Review. Dental update. 2018;45(4):284-288.
11. Laufer BZ, Baharav H, Langer Y, Cardash HS. The closure of the gingival crevice following gingival retraction for impression making. J Oral Rehabil. 1997;24(9):629-35.
12. Baharav H, Laufer BZ, Langer Y, Cardash HS. The effect of displacement time on gingival crevice width. Int J Prosthodont. 1997;10(3):248-53.
13. Hansen PA, Tira DE, Barlow J. Current methods of finish-line exposure by practicing prosthodontists. J Prosthodont. 1999;8(3):163-70.
14. Thimmappa M, Bhatia M, Somani P, Kumar DRV. Comparative evaluation of three noninvasive gingival displacement systems: An in vivo study. J Indian Prosthodont Soc. 2018;18(2):122-130.
15. Cloyd S, Puri S. Using the double-cord packing technique of tissue retraction for making crown impressions. Dent Today. 1999;18(1):54-59.
16. Gupta A, Prithviraj DR, Gupta D, Shruti DP. Clinical evaluation of three new gingival retraction systems: A research report. J Indian Prosthodont Soc. 2013;13:36–42.
17. Weir DJ, Williams BH. Clinical effectiveness of mechanical-chemical tissue displacement methods. J Prosthet Dent. 1984;51(3):326-329.
18. Tarighi P, Khoroushi M. A review on common chemical hemostatic agents in restorative dentistry. Dent Res J (Isfahan). 2014;11(4):423-428.
19. Machado CE, Guedes CG. Effects of sulfur-based hemostatic agents and gingival retraction cords handled with latex gloves on the polymerization of polyvinyl siloxane impression materials. J Appl Oral Sci. 2011;19(6):628-633.
20. Jain S, Sharma R, Ramola V. Review of Various Gingival Retraction Chemicals Used in Dentistry. Heal Talk. 2012;4(6):25-6.
21. Tyas M. Cotton Pellets and gingival retraction cords. Clinical notes No.2. Aust Dent J. 1984; 29(4): 279.
22. Pelzner RB, Kempler D, Stark MM, Lum LB, Nicholson RJ, Soelberg KB. Human blood pressure and pulse rate respone to racemic epinephrine retraction cord. J Prosthet Dent. 1978;39(3):287-92.
23. Prasad DK, Hegde C, Agrawal G, Shetty M. Gingival displacement in prosthodontics: A critical review of existing methods. J Interdiscip Dent. 2011;1:80-86.
24. Reddy S, Prasad K, Vakil H, Jain A, Chowdhary R. Accuracy of impressions with different impression materials in angulated implants. Niger J Clin Pract. 2013;16:279-84.
25. Wang Y, Fan F, Li X, et al. Influence of gingival retraction paste versus cord on periodontal health: a systematic review and meta-analysis. Quintessence Int. 2019;50(3):234-244.
26. Andreiuolo RF, Abreu JLB, Hirata R. The use of retraction paste to simplify impression and cementation of ceramic veneers and crowns: 3-year follow-up report. Quintessence Int. 2019;50(8):604-610.

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Occlusal sequalae of the loss of first permanent molars among children and adolescents

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Abstract

Objective: The purpose of the present study is to evaluate the disintegration of the contact point system, the occlusal changes, and the masticatory force following the loss of the first permanent molars (FPM).

Material and methods: Clinical examinations were performed among 8-18-year-olds following the changes in the contact points and their effects on the dento-maxillary apparatus. The sample comprises 422 individuals, 220 girls and 202 boys. The occlusal masticatory force was measured using the T-Scan in the case of the opening of contact points. For the statistical data analysis, was used correlation and Chi Square Test in the GraphPad InStat program.

Results: A very weak reverse dependence was found between the size of the edentulous space and the deflection of the upper and lower interincisal lines (r=-0.02) and between the age and size of the edentulous space (r=-0.05). There is a statistically significant chance of mandibular lateral deviation by dental migration following edentulism (p=0.043). In the case of the opening of contact points, there are 1.42 times higher risks of modified sagital relationship in the molar segment (p=0.016) and 2.7 times greater risks of the tipping of the neighbouring teeth (p=0.021). Following the evaluation of the T-Scan measurements, we found in each case a significant decrease in the masticatory force in the edentulous area and the opening of the interproximal contact points.

Conclusion: Based on the obtained results, we can state that the opening of contact points decisively influences the stability of the occlusion and the size of the masticatory force.

Keywords: first permanent molar, contact points, early extraction.

Introduction

The first permanent molar (FPM) emerges at the age of six, so is more prone to dental caries and possible premature extraction before permanent dentition is completed. FPM has a major role in maintaining a balanced occlusion, normal masticatory function and dentofacial harmony. FPM loss due to dental caries negatively affects both arches and has adverse effects on occlusion. It is reported that early extraction of these teeth results in tilting of neighboring teeth toards the existing spaces, supereruption of the teeth in the opposite arch, unilateral chewing, shift in midline and dental malocclusion [1].

Andrews' (1972) six keys to occlusion defines characteristics of normal occlusion. His fifth key requires tight contact points, with no space. The proper interproximal contact plays an important role in the stability and maintenance of the integrity of the dental arches.

However, a weak or slightly open proximal tooth contact would permit food impaction and cause subsequent dental caries, halitosis, periodontal disease, or drifting of teeth. On the other hand, excessive proximal tooth contact would result in wedging of teeth and undesirable tooth movement and trauma of periodontium. Therefore, it is important to maintain proper interproximal tooth contact [2-4].

The purpose of our study is to determine the relationships between the opening of interproximal contact points and the change of occlusal relations and the occlusal force following the loss of FPM. The evaluation of the groups concerning epidemiological investigation is very important. Through the present study, we want to get a broad picture of the children's and the adolescents' dental status of Satu Mare county.

The null hypothesis of the study: the disappearance of interproximal contact points following the extraction of FPM decisively

influences the stability of the occlusion and the occlusal force.

Material and methods

The clinical trial began after signing of the consent documents, first by the headteachers of the schools (Reformed High School of Satu Mare, "Petőfi Sándor" Lower Secondary School of Livada, Lower Secondary School of Orasu Nou), then by the children's legal representatives.

The present transversal study was conducted during a six months period. The inclusion criteria were: communicative, healthy children, aged between 8 and 18, with FPM completely erupted. The exclusion criteria were: healthy but non-communicative children, children with mental retardation, less than 8 years old children, subjects undergoing orthodontic treatment during the examination. 422 children were examined in the three educational establishments, 220 girls and 202 boys.

57,6% of the examined population comes from rural areas, of which 47,9% girls and 52,1% boys. The examinations were carried out in educational establishments by one person.

The materials used in the clinical examinations were: single-use protective materials, articulating paper, dental floss, millimeter gradation measurements, retractors, and light sources.

A datasheet was used for each patient to facilitate handling and to record the data. In each case, we noted the patient's name, age, and sex; if subject has ever received dental treatment, the dental status, the consequences of the extraction – the inner relations of upper and lower interincisal lines (Figure 1), the occlusal relations of the canines, the premolars and the molars in both parts, in all the three planes, the interproximal relations, the tipping, the rotations, the extrusions, the mesiodistal size of the edentulous space (Figure 2).

Figure 1. The measuring of the distance between the upper and the lower interincisal lines.

Figure 2. The mesio-distal size of the postextractional space (the distance between the marginal ridges of the second permanent molar and the second bicuspid).

The independent variables were the sex, age, location, size of the edentulous space, and the change of contact points. The independent variables were the consequences of extractions and dental status.

The interproximal relationships were tested by using waxed dental floss. If the floss penetrated without resistance through the interdental space, we assessed the distance between the surrounding teeth using articulating paper with a thickness of 100 µm. (Figure 3).

Figure 3. The traces of the evaluation of interproximal relationships by using articulating paper

The occlusal force was measured with the T-Scan III apparatus (Tek-Scan Inc. Boston, MA, USA) in patients with open interproximal spaces and missing FPM spaces. 9 individuals were chosen to whom we have conducted this complementary investigation. This investigation aimed to emphasize the importance of the interproximal contact points. Mostly, we examined patients with unilateral edentulous space and a few cases with bilateral lower edentulous spaces, using the T-Scan systems force mode.

The obtained data were introduced in Excel tables. By going through the descriptive statistics steps, the data that statistically deviates from the majority were highlighted with the Grubbs test, we performed the KS test which showed that the frequency distribution of our data does not differ significantly from a Gaussian distribution. The correlation exam was used for statistical analysis of numerical data. The major part of the analyses was carried out with the Chi2 sample. The significance threshold used is 0.05.

Results

In our research, we examined 422 children, with an average age of 13 (8-18) of which 220 girls and 202 boys (Table 1).

Table 1. The distribution of the study group

Variables	Number (n=422)	Percentage (%)
Gander		
Male	202	47,9
Female	220	52,1
Area of origine		
Urban	179	42,4
Gander		
Male	75	41,9
Female	104	58,1
Dental treatment		
Have revieved	174	97,2
Have not yet received	5	2,8

Rural	243	57,6
Gander		
Male	127	52,3
Female	116	47,7
Dental treatment		
Have revieved	182	74,9
Have not yet received	61	25,1

In 11.6% of the cases we encountered the missing of the FPM, the most common cases were over the age of 11, when the spontaneous closure of space is no longer carried out (Figure 4).

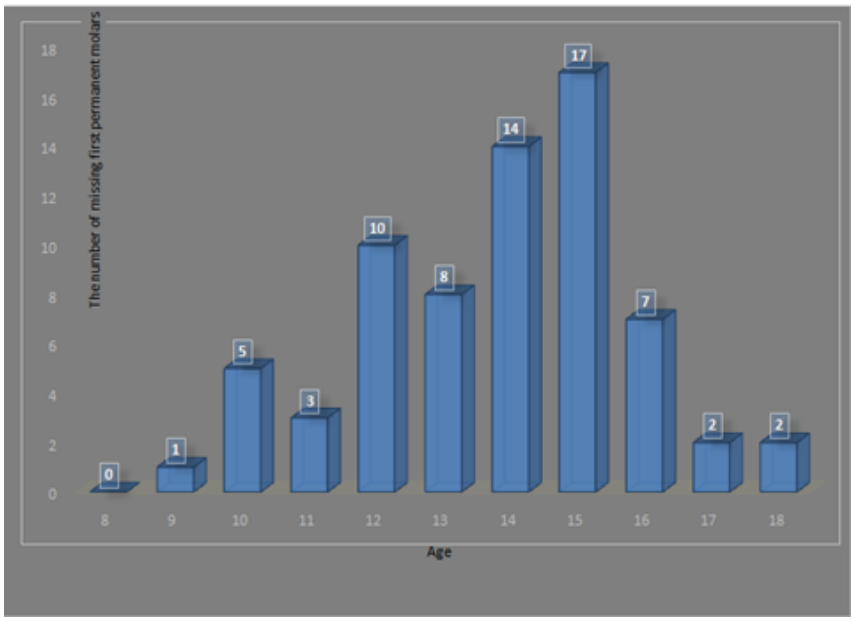

Figure 4. The distribution of the absence of first permanent molars according to the child's age

The number of absent FPM in the examined population was 69. The most common missing molar was the lower left FPM, 30 of 69 missing teeth.

57,6% of the examined population comes from a rural environment (Table I). The prevalence of the absence of the first permanent molar is higher in the rural population (12.75%) than in the urban population (10%).

The prevalence of dental deficiency is also more increased in the case of the girls (57%) than in boys (43%). There is a very slight inverse dependence between the age and the size of the edentulous space (r = -0.05) respectively between the size of the edentulous space and the distance between the upper and lower interincisal lines (r = -0.02). 0.25% respectively 0.04% of the observed variance effect is due to the extractions. This finding would have been more relevant if we could accurately determine the timing of the extractions, since the width of the edentulous spaces have been measured as a function of the time elapsed since the extraction.

There is a statistically significant positive association (O.R. = 1.91, 95% C.I. = 1.01 - 3.61) between the edentulous space and the mandibular lateral deviation through the dental migration (Table 2).

Table 2. The lateral deviation of the interincisal lines (IIL) in the presence of the edentulous space

	IIL≠	IIL=	The Chi^2 sample.	The P-Value	O.R.
The patients with edentulism.	26	18	4,09	0,016	1,91 95% C.I. = 1.01 - 3.61
The patients without edentulism.	154	204			

IIL≠ - the IIL does not coincide; IIL= - the IIL coincide.

There are 1.42 times higher risks (C.I. = 1.04-1.84) of the pathological relations at the molar level (Table 3) and 2.7 times higher risks (C.I. = 1.03-15.3) of the tipping of the neighboring teeth in the case of the opening of contact points (Table 4).

However, the modification is not significant (R.R.=1.1, C.I. = 0.82-1.63) from a statistical point of view in the canines and the premolars (Table III) also with the rotations (RR = 1.3 CI = 0.63-5.10) of the neighboring teeth (Table 4).

Table 3. The interocclusal changes according to the contact points (PC)

	The M relationships		The Chi^2 sample	The P-Value	R.R.
	Class I relation	Class II or III relation	4.12	0,042	1,42 C.I. = 1.04-1.84
The open PC	35	30			
The unmodified PC	112	185			
	The C-PM relationships		The Chi^2 sample.	The P-Value	R.R.
	Class I relation	Class II or III relation	0,99	0,32	1.1 C.I. = 0.82-1.63
The open PC	32	40			
The unmodified PC	67	111			

Table 4. The statistical evaluation results of the relationships between the changes of the contact points and the tippings, respectively, of the rotations in cases with missing molars

	Tipping		The P-Value.	R.R
	Present	Absent	0,021	2,7 C.I. = 1.03-15.3
The open PC	27	8		
The unmodified PC	2	5		
	Rotation		The P-Value.	R.R
	Present	Absent	0,68	1.3 CI = 0.63-5.10
The open CP	20	15		
The unmodified CP	3	4		

There is no statistically significant difference in the changes of contact points in the mixed and in the permanent dentition (RR = 0.74 CI = 0.59-1.04) (Table 5).

Table 5. The frequency of the opening contact points in the permanent and mixed dentition in case of lack of the permanent first molar

	The open CP	The unmodified CP	The P-value.	R.R
Mixes dentition	11	5	0,085	0.74 CI = 0.59-1.04
Permanent dentition	24	2		

15.6% of the subjects studied have not yet received an examination or dental treatment. The vast majority of these children, 92.4% come from rural areas (Table 1).

Following the evaluation of the T-Scan measurements, we found in each case a significant decrease of the masticatory force in the edentulous spaces and the opening of contact points. In this case, due to the lack of tooth 2.6, we noticed the opening of contact points in the premolar-canine area.

On the three-dimensional image, it is obvious the decrease of the occlusal force in the respective area, which is also justified by the percentage data, because the masticatory force measured on the right side (65%) is much higher than the one recorded on the opposite side (35%) (Figure 5).

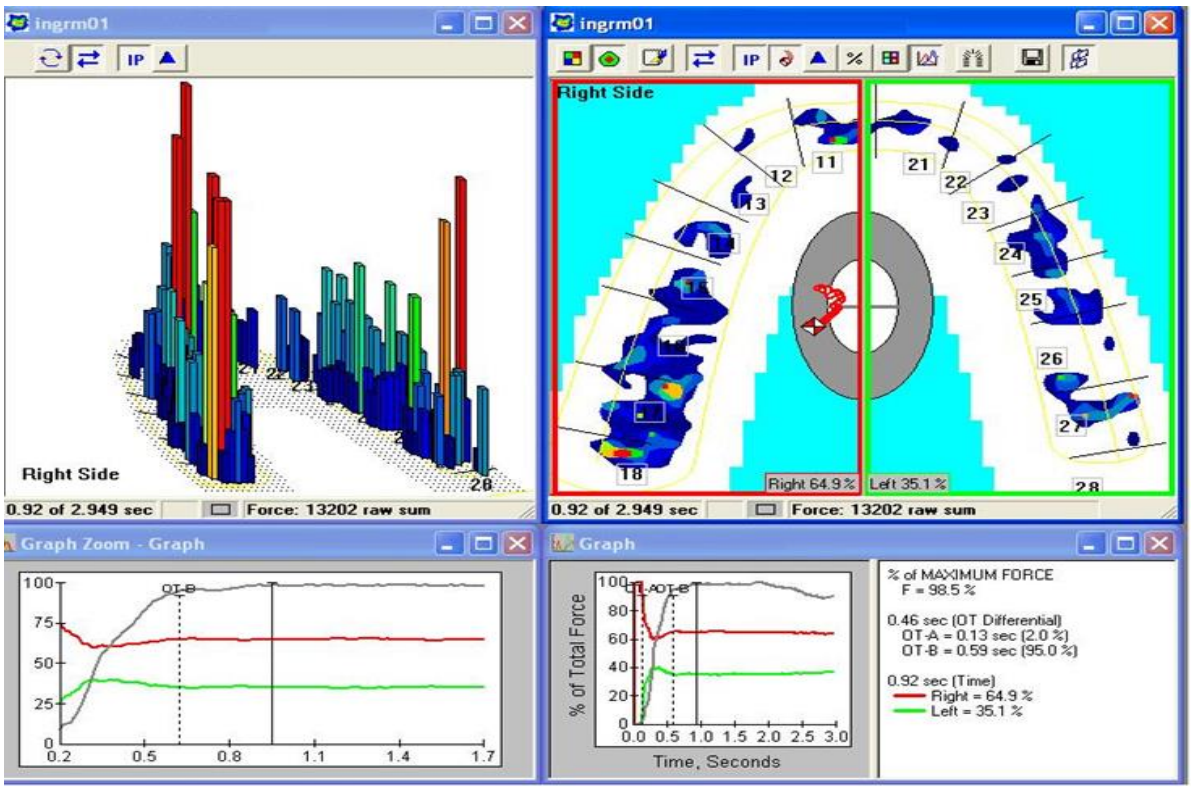

Figure 5. The digital representation of the masticatory force in case of unilateral absence of the first upper left permanent molar

However, we considered the occlusion to be balanced because the force center is within the physiological limits.

Discussions

Through the present study, we analyzed the effect of the open interproximal contact points on the stability of the occlusion and the masticatory force. The prevalence of the missing of the FPM determined by this study is consistent with the data from the researched scientific literature [5-10].

The weaknesses of the present study are:

- We have not received relevant information regarding the date of the extractions.
- We have only carried out clinical examinations without the patients' radiological analysis.

The prevalence of the FPM shortage increases with the patients' age. According to the scientific data, we have also found that the extractions of the FPM are more common in the lower arch [5, 6, 7, 10]. The horizontal migrations are much more common than the vertical migrations [5].

Teo et al categorized the closure of the edentulous space in five categories:

1. The total closure of the edentulous space by making interproximal contact between the 12-year-old molar and the second bicuspid. There are no rotations, no tipping

scans in the mentioned teeth. The second premolar present no distal tipping.
2. 1-5 mm distances between the contact areas of the second permanent molar and the second bicuspid.
3. 5-10 mm distances between the parts mentioned above.
4. Over 10 mm distances between the parts mentioned above.
5. The presence of the rotations or tippings at the level of the second permanent molar and premolar.

The first category reflects the ideal position of the 12-year-old molar as the replacement of the FPM during the eruption process [11]. According to these studies, the population examined by us, in 96% of the cases, falls into the fifth category. Therefore, in patients who had the FPM extracted before the eruption of the second permanent molar, it is very important with regards to the patients' comfort and health to review the patient regularly and to determine any need for orthodontic treatment [12].

According to Ast et al. studies, and our results obtained from the study states the fact that the case of malocclusion, the opening of contact points and mandibular lateral deviations by dental migrations, are more frequent in case of missing FPM than with integral dental arches [1,13]. Besides Kern et al. evaluating changes in interdental spacing depending on two different treatments (partial removable dental prosthesis for molar replacement and premolar occlusion according to the shortened dental arch concept), major interdental spacing could not be observed in neither of the groups [14].

The mandibular migration in patients with edentulous spaces was present in 60% of our cases and on the level of the integral arches in 43% of the cases. Miller et al. achieved a much higher percentage in the same theme, precisely in over 70% of the cases, the population examined in this study had mandibular lateral deviations by dental migration [15]. We explain the difference between the obtained results by the non-coincidence of the age groups of the two surveyed populations.

Y. Yamasaki et al. investigated mastication predominance in healthy dentate individuals and patients with unilateral posterior missing teeth using objective and subjective methods. The results suggest that the individuals with missing unilateral posterior teeth exhibited greater mastication predominance and were more aware of mastication predominance than healthy dentate individuals. At the same time findings suggest that an objective evaluation of mastication predominance is more precise than a subjective method [16]. For this reason we used objective evaluation to determine masticatory force.

Conclusions

1. The prevalence of the permanent first molar shortage increases with the patients' age.
2. The early extraction of the FPM and the opening of contact points following them significantly influences the occlusal stability, because:
   - Through the present study, we examined four (molar relationship, tip, rotations, spaces) of the ideal occlusion six keys. We obtained significant statistical results in three cases (molar relationship, tip, spaces).
   - The horizontal migration of the adjacent teeth and the vertical displacement of the antagonistic teeth are complex and involve the modification of all elements of the dento-maxillary apparatus.
   - Tipping and losing space contributes to space deficiency.
3. The masticatory force decreases provenly in the areas with the open contact points.
4. Losing occurs in the static occlusion, the number of interocclusal contacts decreases and even their location differs from the usual ones.

Conflict of interest: None declared.

References

1. Saber AM, Altoukhi DH, Horaib MF, et al. Consequences of early extraction of a compromised first permanent molar: a systematic review. BMC Oral Health. 2018;15(1):59.
2. Kim HS, Na HJ, Kim HJ, et al. Evaluation of proximal contact strength by postural changes. J Adv Prosthodont. 2009;1:118-123.

3. Vardimon AD, Matsaev E, Lieberman M, et al. Tightness of dental contact points in spaced and nonspaced permanent dentitions. Eur J Orthod. 2001;23(3):305-314.
4. Kim KH, Jung JH, Kim HJ, et al. Evaluation of tightness of proximal tooth contact in permanent dentition. J Korean Acad Prosthodont. 2008;24(4)371-379.
5. Raducanu AM, Victor F, Claudiu H, et al. Prevalence of loss of permanent first molars in a group of Romanian children and adolescents. OHDMBSC. 2009;8(3):3-11.
6. Gupta DK, Singh SP, Utreja A, Verma S. Prevalence of malocclusion and assessment of treatment needs in β-thalassemia major children. Prog Orthod. 2016;17(1):7.
7. Casanova-Rosado AJ, Medina-Solis CE, Casanova-Rosado JF, et al. Factors associated with the loss of the first permanent molar in school children in Campeche, Mexico. Acta Odontologica Venezolana. 2005;43(3):268-275.
8. Sutcliffe PH. A longitudinal study of caries experience and extraction of permanent first molars in English children. Community Dentistry and Oral Epidemiology. 2008;2(4):182 – 186.
9. After PE. Clinical and specific changes of dental arches and occlusal relations after first permanent molar loss, in teenagers and yound adults. Romanian Journal of Oral Rehabilitation. 2015;7(4):73-77.
10. Varshney A, Hegde MN, Yelapure M. Prevalence of Missing First Molar in South Canara District Population. International Journal of Medical and Oral Research. 2018;3(1):26-30.
11. Theo TK, Ashley PF, Parekh S, Noar J. The evaluation of spontaneous space closure after the extraction of first permanent molars. Eur Arch Paediatr Dent. 2013;14(4):7–12.
12. Serindere G, Bolgul B, Parlar T, Cosgun A. Effects of first permanent molar extractıon on space changes observed in the dental arch using data mining method. Niger J Clin Pract. 2019;22(7):936-942.
13. Dimberg L. Malocclusions and Quality of Life. Cross-sectional and longitudinal studies in children. Swed Dent J Suppl. 2015;237:1–88.
14. Kern J, Wolfart S, Hilgers R, et al. The randomized shortened dental arch study: influence of two different treatments on interdental spacing over 5 years. Clin Oral Invest. 2017;21:1945–1951.
15. Miller EL, Bodden WR Jr, Jamison HC. A study of the relationship of the dental midline to the facial median line. The Journal of Prosthetic Dentistry. 1979;41(6):657-660.
16. Yamasaki Y, Kuwatsuru R, Tsukiyama Y, Oki K, Koyano K. Objective assessment of mastication predominance in healthy dentate subjects and patients with unilateral posterior missing teeth. J Oral Rehabil. 2016;43(8):575-582.

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Brief reports refer to articles presenting a short communication related to an original preclinical or clinical study which is not a case presentation or a case series report. While the structure of the abstract and of the full text should be detailed similar to that for full original articles, the length of the manuscript should be shorter, the abstract limited to 200 words and the full text (including references, tables and figures) to 2.000 words.

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A letter to the editor may refer to an article recently published by the journal, commenting on the article in a constructive professional manner the content of which, in the opinion of the author(s) would add the current status of knowledge in the field. If accepted, the letter will be sent to the authors of the original article who will have the opportunity to respond and to have their response published in the same journal issue as the letter to the editor. The letters should be limited to 500 words, 5 references and 3 authors. No abstract is required.

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The journal publishes state-of-the-art articles that aim to provide an update on the current status of areas of high interest to dental medical specialists. The main aim of such articles is to offer the specialist and other practitioners a source of continuous

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Submitted manuscripts are first checked to ensure that they comply with instructions to authors and are in accordance with the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals", Annals of Internal Medicine, 1997,126, 36-47, and that all references, figures and tables meet the journal's requirements.

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