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ANALYSIS OF OCCLUSAL AND ARTICULATING RATIOS OF JAWS IN PATIENTS AFTER PROSTHETICS WITH VARIOUS TYPES OF FIXED STRUCTURES

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Abstract

A new trend in medicine is the introduction of digital technologies in dentistry, with the help of which patients with partial loss of teeth achieve the necessary occlusal ratios of the jaws and aesthetic results. Modern processes for manufacturing fixed dental prostheses shorten the treatment period and accelerate the adaptation process, and the introduction of digital processes at the stage of planning and manufacturing of fixed structures makes it possible to increase the productivity of dentists-orthopedics.

Aim: to study the peculiarities of the distribution and magnitude of the contact pressure that occur on the surface of the teeth in patients with different types of occlusion.

Materials and methods. In order to solve the set goal, we performed clinical and laboratory examination of patients with defects of the crown part of the tooth before prosthetics and 6 months after prosthetics. Of these: 80 (48.5%) patients were prosthetically implanted with fixed structures manufactured in the laboratory, and 85 (51.5%) were digitally implanted. The total number of patients with crown defects on the upper jaw was 84 (50.9%) and 81 (49.1%) on

the lower jaw. Of them, 85 (48.5%) were women and 80 (51.5%) were men. To study the peculiarities of the distribution and magnitude of the contact pressure that occur on the surface of the teeth in the studied patients with different occlusion variants, we used the T-Scan computer analysis system of occlusion.

Research results. Bridge-like prostheses made by the analog method have certain disadvantages that persist throughout the registration period. The occlusal pattern of load on certain groups of teeth worsens. These are excessive overloads of the lateral group of teeth in each adaptation period of registration. Weakened or even absent occlusal contacts of the front group of teeth. After selective grinding of the teeth, the situation does not change significantly. At each of the stages, the fissure-tuberous contacts are corrected, which improves the occlusal balance, but turns point contacts into flat ones. This in turn leads to possible prolonged chewing time and myofascial imbalance. as well as overloading of the temporomandibular joint. At the same time, it should be noted that the time of closing and opening of tooth rows remains within the physiological norm.

Conclusions. It was established that patients who had temporary bridge-like fixed structures manufactured by the analog method had an underestimation of the interalveolar height, which resulted in premature contact of the teeth with their subsequent overload. Preservation during the entire period of registration of supracontacts indicates a lack of adaptation to them and an increase in the time of the dentist-orthopedic doctor for selective grinding and interference with the physical properties of fixed structures.

Key words: occlusal relations of the jaws; fixed structures; photoactivation; TMJ and TM dysfunction; digital method; relaxation splints.

Topicality. A new trend in medicine is the introduction of digital technologies in dentistry, with the help of which patients with partial loss of teeth achieve the necessary occlusal ratios of the jaws and aesthetic results. Clinical stages become more comfortable for patients, and for the dentist, clinical and technological processes accelerate the production of orthopedic structures. Modern manufacturing processes of fixed dentures shorten the treatment period and speed up the adaptation process. The implementation of digital processes at the stage of planning and manufacturing of fixed structures increased the productivity of employees of institutions and improved management.

A major development in the world over the past 10 years has been in the field of software in dental organizations, related to the modern demands of patients and directly to the development of medical technologies. Analyzing the work of institutions after the introduction of digital technologies, we can testify to a reduction in the number of errors, as well as the absence of technical negligence in the manufacture of fixed structures by the analog method at the laboratory stages.

So, before us is an urgent question to analyze the expediency of introducing digital diagnostic methods and technological stages of manufacturing fixed orthopedic structures into dental practice.

Aim: to research the features of the distribution and magnitude of contact pressure that occur on the surface of teeth in patients with different types of occlusion.

Materials and methods. In order to solve the set goal, we performed clinical and laboratory examinations of patients with defects of the crown part of the tooth before prosthetics and 6 months after prosthetics. Of these: 80 (48.5%) patients were prosthetically implanted with fixed structures manufactured in the laboratory, and 85 (51.5%) patients were digitally implanted. The total number of patients with crown defects on the upper jaw was 84 (50.9%) and 81 (49.1%) on the lower jaw. Of them, 85 (48.5%) were women and 80 (51.5%) were men. All patients were divided into IV groups depending on the type of prosthetics in the manufacture of permanent aesthetic structures of dental prostheses.

Group I - patients with defects of the hard tissues of the teeth and defects of the dentition, who were made veneers and artificial crowns according to a digital protocol (preceramics, zirconium dioxide). In this group 45 (27.3%) patients were examined.

Group II - patients with defects of the hard tissues of the teeth and defects of the dentition, who were made veneers and artificial crowns according to an analog protocol (metal ceramics, preceramics). In this group, 40 (24.2%) patients were examined.

Group III - patients with defects of the hard tissues of the teeth and defects of the dentition, who were made bridge-like prostheses according to a digital protocol (zirconium dioxide). 38 (23.3%) patients were examined in this group.

Group IV - patients with defects of hard tissues of teeth and defects of dental rows, who were made bridge-like prostheses according to an analog protocol (metal ceramics, zirconium dioxide). In this group, 42 (25.5%) patients were examined.

To study the peculiarities of the distribution and magnitude of the contact pressure, which occur on the surface of the teeth in the studied patients with different types of occlusion, we used the T-Scan computer analysis system of occlusion.

The processing of the obtained research results was determined by calculating the mean value (M) and the mean square deviation (SD), as well as the Student's test and the Pearson correlation coefficient (to identify the relationship between quantitative characteristics). When checking the population for normality of distribution, the Shapiro-Wilk test was used. The analysis was carried out in the program "Statistica 6.1" (SN AJAX909E615822FB). A statistically significant difference was considered at $p<0.05$.

We emphasize that all the research conducted by us was conducted after the patients had read and signed the informed voluntary consent to participate in the research in compliance with the Declaration of the World Medical Association on Ethical Principles in the Conduct of Scientific Medical Research Involving Humans (2000, Helsinki), as well as the well-known provisions of the Convention Council of Europe on Human Rights (1997).

The examination of the submitted materials was carried out by the Commission on Bioethical Examination and Ethics of Scientific Research at the Bogomolets National Medical University , Kyiv, Ukraine (protocol No. 185 dated May 27, 2024).

Research results and their discussion. As a result of our research, it was determined that 45 (27.3%) patients who received prosthetics with crowns made digitally after the laboratory have occlusion within the physiological norm, supracontacts are rare in them, and occlusal contacts are mostly point. The time of occlusion and deocclusion is normal. The balance of occlusal contacts is at a high level. Such patients almost do not need polishing (Fig. 1).

The integrity of the contacts of the tooth rows, where each tooth is included in the closing chain, indicates the uniformity of the load on the periodontal tissues, which is also confirmed by the closing time in the central occlusion (0.24s) and the opening time (0.11s), which corresponds to the physiological interval norm. At the same time, it should be noted that the balance of occlusion at the moment of maximum fissure-tuberous closure is 50.3% and 49.7%, which indicates the occlusal balance of the right and left sides of the tooth level.

In all patients of this group, after 6 months, the situation does not change significantly, the force of contact on the molars increases, the occlusion is stable, the time of occlusion and

deocclusion is normal. The sequence of occurrence of occlusal contacts is within the norm (Fig. 2).

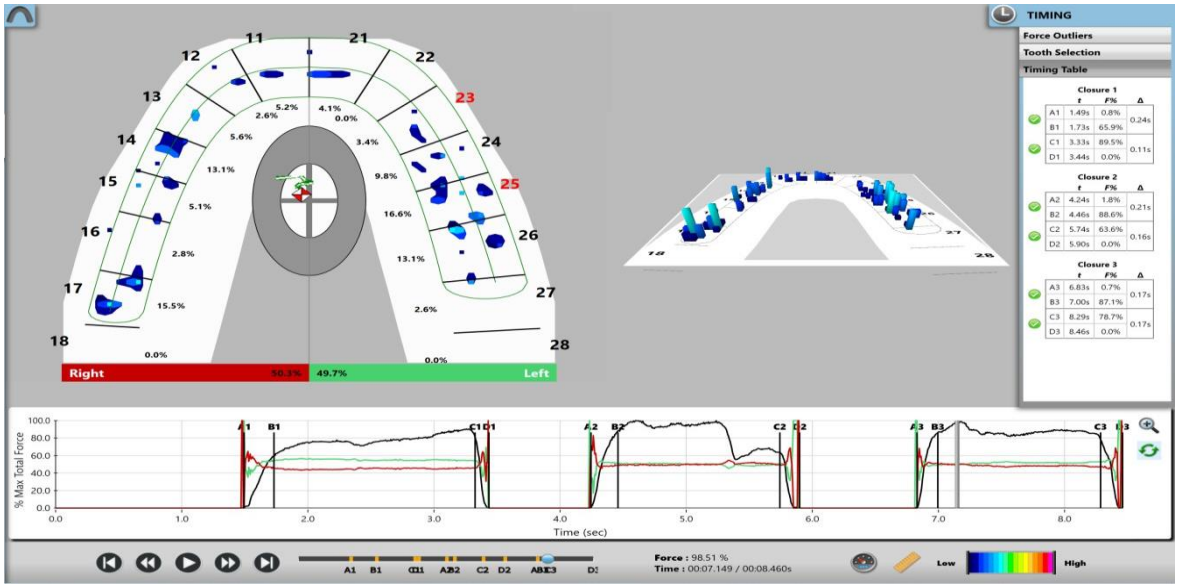

Fig. 1. The result of the T-Scan study in patients of group I, after receiving the design from the laboratory

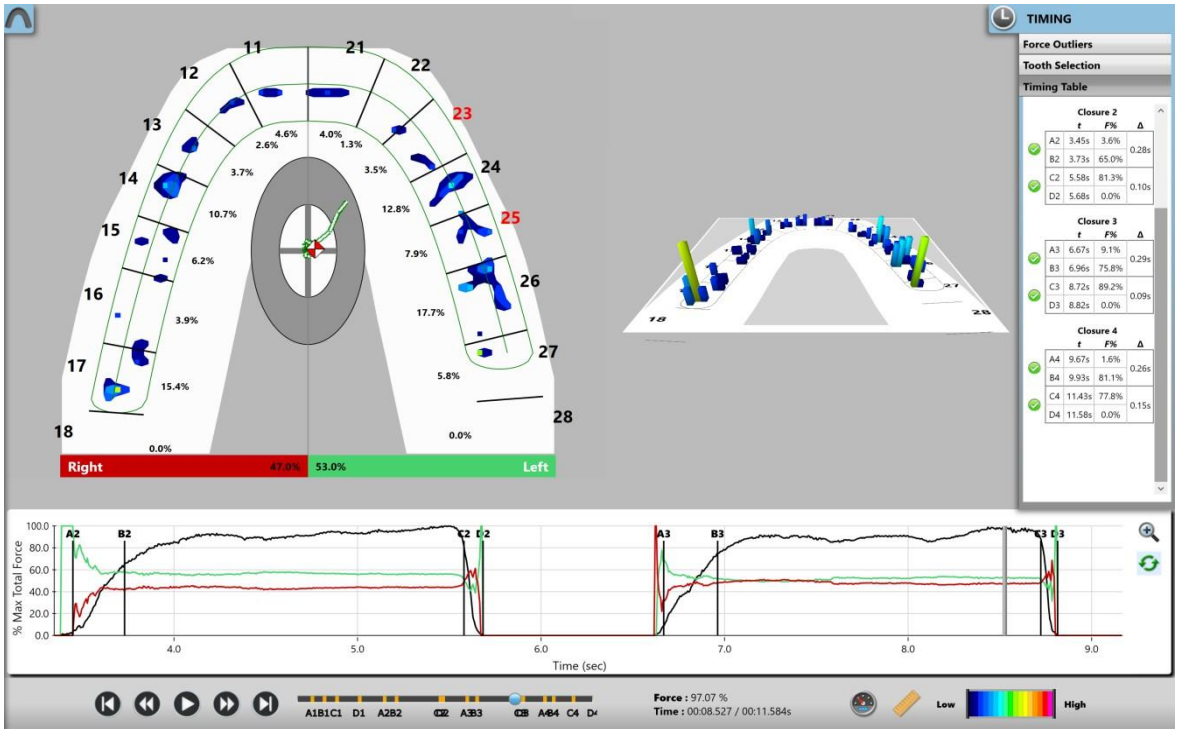

Fig. 2. The result of the T-Scan study in group I patients 6 months after prosthetics

Increased contact is registered in areas 6 and 7 of teeth, which indicates adaptation to new full-fledged contacts of the fissure-tuberous closure, and the redistribution of masticatory pressure in the central occlusion confirms the concept of protecting the front group of teeth with the back teeth for occlusal relief. The closing time of the dental rows is kept at an optimal level, and the occlusal balance of the right and left sides also remains at a good level, which indicates the completeness of the functional characteristics of the crowns made by the digital method.

In 31 (77.5%) patients of the second group, immediately after prosthetics on the crowns, mainly point contacts with a tendency to prolonged occlusion time due to uneven occurrence of occlusal contacts during closing, which can cause muscle parafunctions, are observed. This is confirmed by the extended closing time, which is 0.43s. The increase in closing time beyond the norm is explained by the presence of many supracontacts on teeth 17, 15, 14, 24, 26, 27 (Fig. 3). After the initial correction, normalization of occlusion time was observed in patients, but the area of occlusal contacts on artificial crowns increased. This may indicate a lack of adaptive and compensatory capabilities in response to excessive planar overloading of certain groups of teeth, which leads to repeated selective grinding by the doctor, interference with the physical structure of fixed structures.

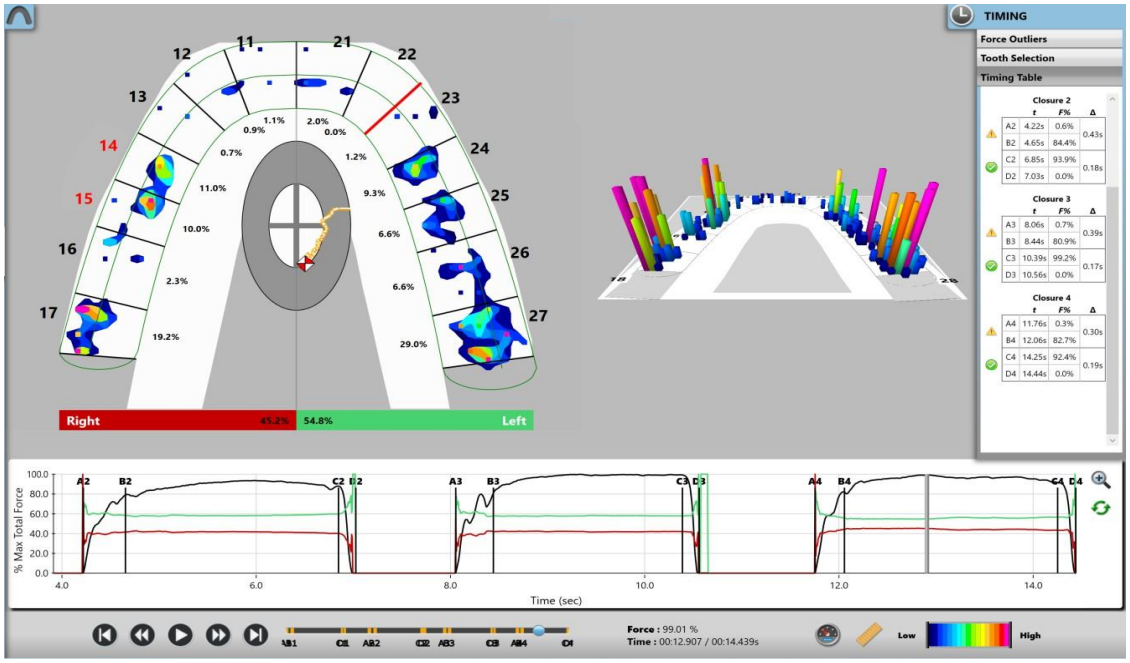

Fig. 3. The result of the T-Scan study in patients of the II group after receiving the structures from the laboratory

In the III group, after fixation of non-removable orthopedic structures made by the digital method, 37 (97.3%) patients have optimal occlusal balance (Fig. 4) and complete absence of supracontacts. The nature of the closing is point. In this case, the correction will be minimal, and there is almost no risk of transforming a point into a planar occlusion scheme. It should be noted that the contacts of the frontal group of teeth are complete, where each tooth perceives the corresponding physiological load.

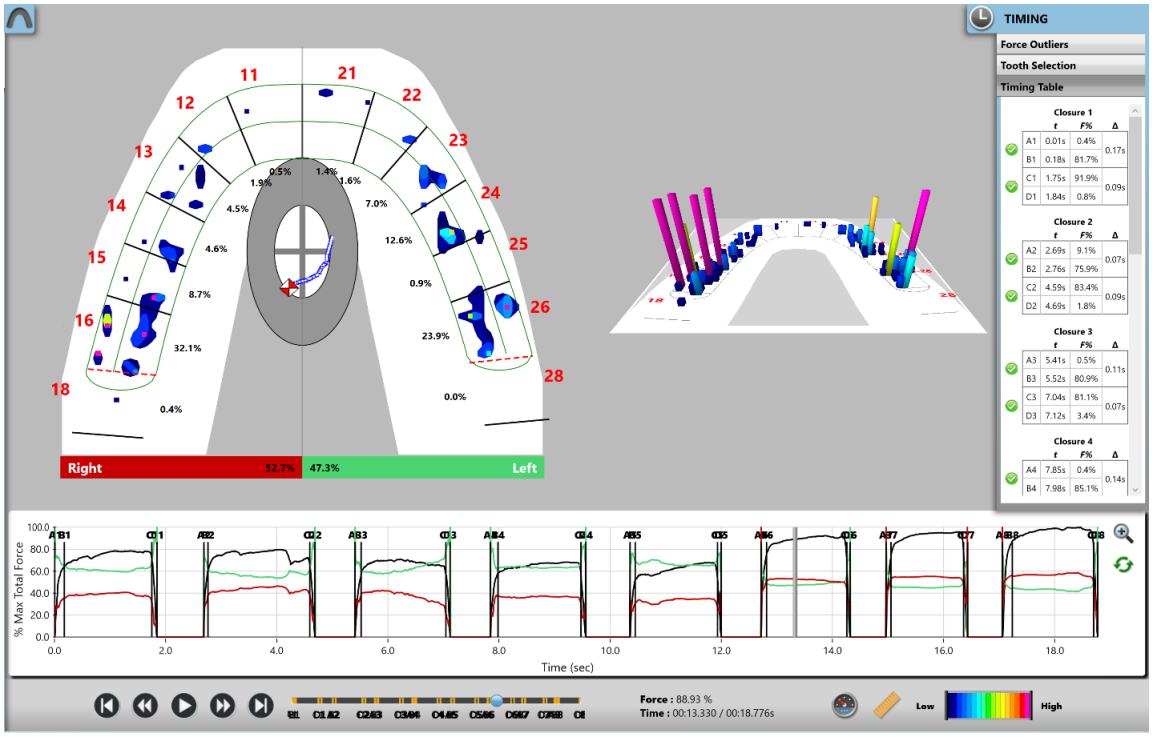

Fig. 4. The result of the T-Scan study in patients of the III group after receiving the structures from the laboratory

After 6 months, occlusal balance remains at the optimal level on the right 48.2% and on the left - 51.8%. There are no excessive contacts on the teeth of the lateral group, which indicates better adaptability to structures made by the digital method. Also, a minimal correction of the initial single minor reinforced contacts will improve the adaptability of the maxillofacial apparatus.

In group IV, after fixation of non-removable orthopedic structures made by the analog method, a change in occlusal balance was registered in 39 (92.8%) patients with a predominance of the left side, i.e. quadrants 2 and 4, which indicates a slight occlusal overload already at the

time of prosthetics with bridge-like prostheses. Excessive and supracontacts are noted mainly on the lateral group of teeth - 17, 16, 27, 26. It should be noted that there are no full-fledged point contacts on certain teeth of the frontal group, that is, the transmission of masticatory pressure is unevenly distributed (Fig. 5).

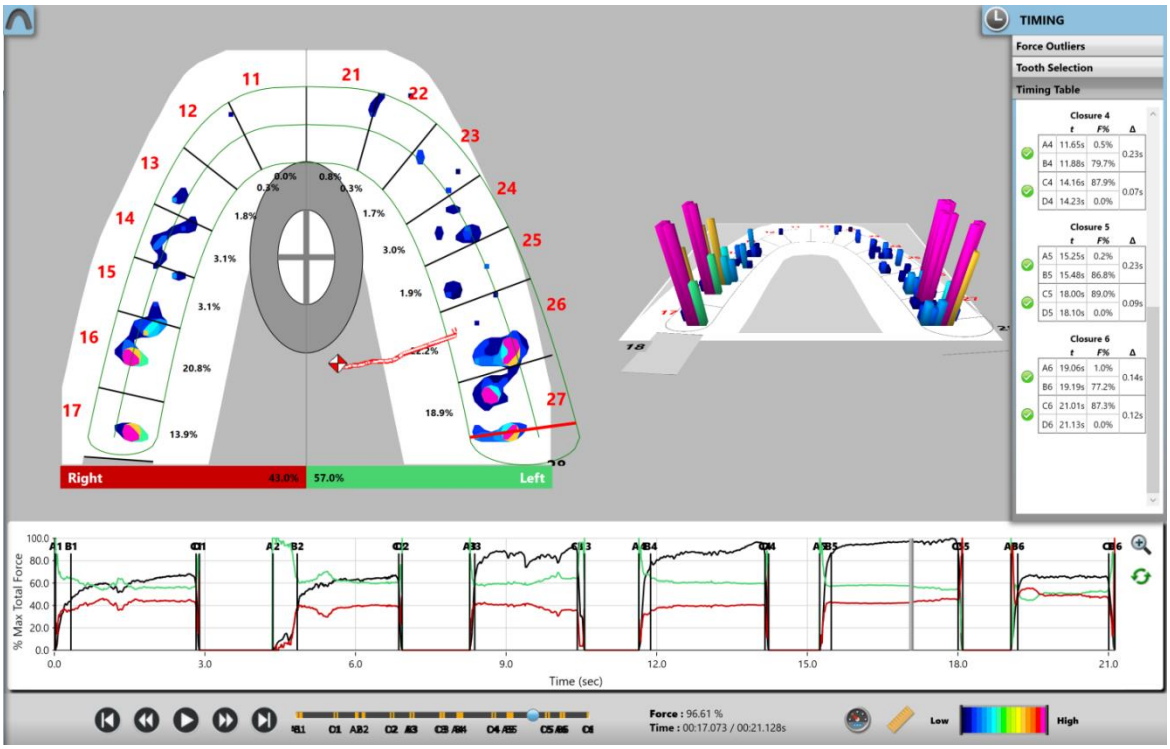

Fig. 5. The result of the T-Scan study in patients of the IV group after receiving the structures from the laboratory

In 10 (23.8%) patients 6 months after prosthetics, the stability of occlusal balance is noted and is 52.3% on the right and 47.7% on the left, which corresponds to the physiological interval. The closing time corresponds to the norm of 0.26 s, the opening time of 0.07 s. It should be taken into account that excessive contacts remain on 17, 27, 26 teeth. The appearance of new supracontacts on 16 teeth indicates planar closure (Fig. 5). It also indicates the possible intrusion of crowns with excessive contacts, which were previously registered. The lack of full contact on the frontal group of teeth indicates possible future diseases of periodontal tissues, as the response of adjacent teeth to occlusal overload - trauma.

Conclusions:

1. Fixed orthopedic structures, namely, bridge-like prostheses made by the analog method, have certain disadvantages that persist throughout the registration period. The occlusal pattern of load on individual groups of teeth worsens. These are excessive overloads of the lateral group of teeth in each adaptation period of registration. Weakened or even absent occlusal contacts of the front group of teeth. After selective grinding of the teeth, the situation does not change significantly. At each of the stages, fissure-tuberous contacts are corrected, which improves occlusal balance, but turns point contacts into flat ones. This in turn leads to possible prolonged chewing time and myofascial imbalance. as well as overloading of the temporomandibular joint. At the same time, it should be noted that the time of closing and opening of the tooth rows remains within the physiological norm.

2. Preservation during the entire period of registration of supracontacts indicates a lack of adaptation to them and an increase in the time of the dentist-orthopedic doctor for selective grinding and interference with the physical properties of fixed structures.

3. We have analyzed the structures and substantiated treatment algorithm of patients with this pathology, the results of the study are the adaptation of the masticatory apparatus to the new interalveolar height and occlusal-articulation ratios of the jaws, which allows us to direct the doctor's actions to the necessary treatment steps.

References:

1. Hammad, T., Elraggal, A., Moussa, H., Marzouk, W., & Ismail, H. (2023). Stability of anterior open bite cases treated with upper and lower extrusion arches in adults: a follow-up study. The Angle orthodontist, 93(6), 659–666. https://doi.org/10.2319/030623-155.1

2. Magne, P., & Cheung, R. (2017). Numeric simulation of occlusal interferences in molars restored with ultrathin occlusal veneers. The Journal of prosthetic dentistry, 117(1), 132–137. https://doi.org/10.1016/j.prosdent.2016.07.008

3. Manfredini, D., Stellini, E., Marchese-Ragona, R., & Guarda-Nardini, L. (2014). Are occlusal features associated with different temporomandibular disorder diagnoses in bruxers?. Cranio : the journal of craniomandibular practice, 32(4), 283–288. https://doi.org/10.1179/2151090314Y.0000000008

4. Kraisiridej, R., Suzuki, B., & Suzuki, E. Y. (2023). Dentoalveolar changes observed after the use of customized bonded Shark-Tooth-Like Spurs (JAWs) in adult patients with

anterior open bite. Dental press journal of orthodontics, 27(5), e2220448. https://doi.org/10.1590/2177-6709.27.5.e2220448.oar

5. Elshal, N. S., Mohammad, M. H., Tawfik, M. A., & Fouda, M. A. E. (2024). Dentoalveolar effects of skeletally anchored extrusion arch in anterior open bite patients: A prospective clinical trial. Dental press journal of orthodontics, 28(6), e2323110. https://doi.org/10.1590/2177-6709.28.6.e2323110.oar

6. de Brito Vasconcelos, J., de Almeida-Pedrin, R. R., Poleti, T. M. F. F., Oltramari, P., de Castro Conti, A. C. F., Bicheline, M. H. B., Lindauer, S. J., & de Almeida, M. R. (2020). A prospective clinical trial of the effects produced by the extrusion arch in the treatment of anterior open bite. Progress in orthodontics, 21(1), 39. https://doi.org/10.1186/s40510-020-00339-z

7. Hammad, T., Moussa, H., Marzouk, W., & Ismail, H. A. (2023). Effect of maxillary and mandibular extrusion arches on dentoskeletal changes in adults with anterior open bite: a quantitative analysis. The Angle orthodontist, 93(1), 26–32. https://doi.org/10.2319/021922-155.1

8. Steele, B. P., Pandis, N., Darendeliler, M. A., & Papadopoulou, A. K. (2022). A comparative assessment of the dentoskeletal effects of clear aligners vs miniplate-supported posterior intrusion with fixed appliances in adult patients with anterior open bite. A multicenter, retrospective cohort study. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics, 162(2), 214–228.e4. https://doi.org/10.1016/j.ajodo.2021.03.022

9. Harris, K., Ojima, K., Dan, C., Upadhyay, M., Alshehri, A., Kuo, C. L., Mu, J., Uribe, F., & Nanda, R. (2020). Evaluation of open bite closure using clear aligners: a retrospective study. Progress in orthodontics, 21(1), 23. https://doi.org/10.1186/s40510-020-00325-5

10. Harris, K., Ojima, K., Dan, C., Upadhyay, M., Alshehri, A., Kuo, C. L., Mu, J., Uribe, F., & Nanda, R. (2020). Evaluation of open bite closure using clear aligners: a retrospective study. Progress in orthodontics, 21(1), 23. https://doi.org/10.1186/s40510-020-00325-5

11. Greco, M., Rossini, G., & Rombolà, A. (2021). Simplifying the approach of open bite treatment with aligners and selective micro-osteoperforations: An adult case report. International orthodontics, 19(1), 159–169. https://doi.org/10.1016/j.ortho.2020.11.005

12. Greco, M., Rossini, G., & Rombolà, A. (2022). G-Block: Posterior anchorage device tads-supported after molar distalization with aligners: An adult case report. International orthodontics, 20(4), 100687. https://doi.org/10.1016/j.ortho.2022.100687

13. Inchingolo, A. M., Inchingolo, A. D., Carpentiere, V., Del Vecchio, G., Ferrante, L., Di Noia, A., … Inchingolo, F. (2023). Predictability of Dental Distalization with Clear Aligners: A Systematic Review. Bioengineering (Basel, Switzerland), 10(12), 1390. https://doi.org/10.3390/bioengineering10121390

14. Papadopoulos M. A. (2020). Efficient Distalization of Maxillary Molars with Temporary Anchorage Devices for the Treatment of Class II Malocclusion. Turkish journal of orthodontics, 33(3), 197–201. https://doi.org/10.5152/TurkJOrthod.2020.20064

15. Guo, R., Lam, X. Y., Zhang, L., Li, W., & Lin, Y. (2024). Biomechanical analysis of miniscrew-assisted molar distalization with clear aligners: a three-dimensional finite element study. European journal of orthodontics, 46(1), cjad077. https://doi.org/10.1093/ejo/cjad077

16. Critchlow SB, Ellis JS. Prognostic indicators for conventional complete denture therapy: a review of the literature. J Dent. 2010 Jan; 38 (1), 2–9.

17. Liu, X., Cheng, Y., Qin, W., Fang, S., Wang, W., Ma, Y., & Jin, Z. (2022). Effects of upper-molar distalization using clear aligners in combination with Class II elastics: a three-dimensional finite element analysis. BMC oral health, 22(1), 546. https://doi.org/10.1186/s12903-022-02526-2

18. Todoki, L. S., Finkleman, S. A., Funkhouser, E., Greenlee, G. M., Choi, K. W., Ko, H. C., … Jolley, C. National Dental Practice-Based Research Network Collaborative Group, & Huang, G. J. (2020). The National Dental Practice-Based Research Network Adult Anterior Open Bite Study: Treatment success. American journal of orthodontics and dentofacial orthopedics : official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics, 158(6), e137–e150. https://doi.org/10.1016/j.ajodo.2020.07.033

19. Макеєв В.Ф., Телішевська У.Д., Шибінський В.Я. та ін. Скроневоніжньощелепні розлади. Львів: Кварт; 2018 р. 400 с.

20. Макєєв В.Ф. Сучасні погляди на етіологію і патогенез дисфункцій скронево-нижньощелепних суглобів. Огляд літератури. Новини стоматології.2014. No 1. С. 14–18.

21. Яценко О.І. Клініко-рентенологічна характеристика компресійно-болевого симптому скронево-нижньощелепного суглобу. Вісник проблеми біології і медицини. 2015. No 2(1). С. 363-366.

22. Новіков В.М. Кореляційні зв'язки між м'язовосуглобовою дисфункцією СНЩС та оклюзійними порушеннями при різних видах прикусів. Проблеми екології та медицини. 2011. No 15(3-4). С. 120-122.

23. Germec-Cakan, D. Uvulo-Glossopharyngeal Dimensions in Non-Extraction, Extraction with Minimum Anchorage, and Extraction with Maximum Anchorage. European Journal of Orthodontics. 2011. No 33. p. 515-520.

24. Шувалов С.М. Захворювання та дисфункціональні порушення скронево-нижньощелепного суглоба у дітей та дорослих. Клініка, діагностика, лікування/С.М. Шувалов. – Вінниця: Книга-Вега, 2012. 48 с.

25. Ожоган Р.З. Клінічна оцінка стану зубо-щелепної системи пацієнтів із захворюваннями скронево-нижньощелепного суглоба. Вісник стоматології. 2019. No 1. С. 60-64.

26. Макєєв В. Ф. та ін. Сучасні тенденції лікування скронево-нижньощелепних розладів. Новини стоматології. 2018. No 2 (95). С. 55-59.

27. Костюк ТМ. Фізикальне обстеження пацієнтів із дисфункцією скронево-нижньощелепного суглобу. Український журнал медицини, біології та спорту. 2018. No 4 (13, 3). с. 149–153.

28. Graniomandibuläre dysfunction. Interdisziplinäre Diagnostik und Thearapie/ Koneke C. et. al. Berlin, Chicago, Tokio: Quintessence publishing Co. Ltd, 2010. 432 p.

29. Franklin K., Anttila H., Axelsson S. et al. Effects and side-effects of surgery for snoring and obstructive sleep apnea--a systematic review. Sleep. 2009; 32 (1): 27–36.

30. Gelardi M. et al. Double-blind placebo-controlled randomized clinical trial on the efficacy of Aerosal in the treatment of sub-obstructive adenotonsillar hypertrophy and related diseases // Intern. J. Pediatr. Otorhinolaryngol. 2013; 77 (11): 1818–24.

31. Vitanova LS, Goncalves TM, Meirellts L, Garcia RC. Hormonal fluctuations intensify temporomandibular disorder pain without impainng masticatjry function. Int. J. Prosthodont. 2015; 28:72-74.

32. Gui MS, Pimentel MJ, Rizzatti-Barbosa CM. Temporomandibular disorders in fibromyalgia syndrome: a short-communication. Revista Brasileira de Reumatologia. 2015; 55(2): 189-194.

33. Прощенко, А. М., Прощенко, Н. С., Шемелько, М. Л., Решетник, Л. Л., Червонна, Н. В., Сорокіна, К. О. (2024). Оцінка якості лікування пацієнтів з функціональними розладами зубо-щелепного апарату, поєднаних з дентоальвеолярною формою глибокого прикусу. *Клінічна та профілактична медицина*, (4), 26-32. https://doi.org/10.31612/2616-4868.4.2024.04

34. Luciano AF, Grossman E, Januzzi E. Diagnosis of temporomandibular joint disorders: indication of imagine exams. Otorhinolaryngol. 2016; 82(3): 342.

35. Hirsch C, John MT, Stang A. Association between generalized joint hypermobility and signs and diagnoses of temporomandibular disorders. Eur J. Oral Sci. 2008;116:525.

36. Jose G. Temporomandibular Dysfunction and Headache Disoder. Jose G., Fabiola Dach. Journal of Oral Pathology and Medicine. 2015; 55(1): 72- 83.

37. Vitanova LS, Goncalves TM, Meirellts L, Garcia RC. Hormonal fluctuations intensify temporomandibular disorder pain without impainng masticatjry function. Int. J. Prosthodont. 2015; 28:72-74.