4. Choi C, Hums MA, Bum CH Impact of the Family Environment on Juveline Mental Health: eSports Online Game Addiction and Delinquency. Int. J. Environ. Res. Public Health. 2018; 15: 2850.
5. Langerak W, Langeland W, van Balkom A, Draisma S, Terluin B, Draijer N A validation study of the Four-Dimensional Symptom Questionnaire (4DSQ) in insurance medicine. Work. 2012; 43 (3): 369–380.
6. Li AY, Lo BC, Cheng C It ls the Family Context That Matters: Concurrent and Predictive Effects of Aspects of Parent-Child Interaction on Video Gaming-Related Problems. 2018; 6: 374–380. Available at: https://doi.org/10.1089/cyber.2017.0566.
7. Mark D Griffiths, Nuyens F An Overview of Structural Characteristics in Problematic Video Game Playing. Curr. Addict Rep. 2017; 4: 272–283. Available at: https://doi.org/10.1007/s40429-017-0162-y.
8. Nakayama H, Mihara S, Higuchi S. Treatment and risk factors of Internet use disorders. Psychiatry Clin Neurosci. 2017; 71(7): 492–505. Available at: https://doi.org/10.1111/pcn.12493.
9. Soldatkin VA, Mawani DCh, Dyachenko AV Game addiction: criminogenicity, victimization and suicidogenicity. Suitsidology. 2012; 7 (1): 13–17.
10. Tebbe BB, Terluin B, Koelewijn JM Assessing psychological health in midwifery practice: A validation study of the Four-Dimensional Symptom Questionnaire (4DSQ), a Dutch primary care instrument. Midwifery. 2013; 29(6): 608–615.
11. Terluin B, van Marwijk HWJ., Adèr HJ, de Vet HCW., Penninx BWJH, Hermens MLM, van Boeijen CA, van Balkom AJLM, van der Klink JJL, Stalman WAB The Four-Dimensional Symptom Questionnaire (4DSQ): a validation study of a multidimensional self-report questionnaire to assess distress, depression, anxiety and somatization. BMC Psychiatry 2006; 6: 34.
12. World Health Organization, International Statistical Classification of Diseases – Mortality and Morbidity Statistics. 11 th revision (Dec. 2018). Available at: https://icd.who.int/browse11/ lm/en#/http%3a%2f%2fid.who.int% 2ficd%2 fently% f334423054.

Стаття надійшла 12.05.2020 р.

DOI 10.26724/2079-8334-2021-2-76-103-107
UDC 616.314–084+616.314–089.23

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EARLY PREVENTION OF OCCLUSAL DISORDERS OF DENTAL ARCHES

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Dental caries is one of the main factors of occlusal disorders, that changes location of occlusal contact points and is the cause of atypical mandibular movements, occlusal overloading and trauma. The objective of the research was to carry out early prevention of occlusal disorders in patients with carious lesions using modern restorative methods in order to prevent occlusal disorders using the methods of restorations of the affected chewing surfaces considering functional anatomy and subsequent checking of occlusal relationships with the help of the T-Scan Novus occlusal analysis system. Ninety students living in the regions with low fluoride level were examined. The treatment was carried out by the methods of direct and indirect restorations. The paper contains the results of redistribution of occlusal contacts in carious lesions and restoration of the first molar without considering the principles of functional anatomy, and the results immediately and 6 months after restorations of the chewing surfaces of the first molars considering the occlusal determinants.

Key words: occlusal disorders, analysis of occlusion, tooth restoration, prevention of occlusal disorders.

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РАННЯ ПРОФІЛАКТИКА ОКЛЮЗІЙНИХ ПОРУШЕНЬ ЗУБНИХ РЯДІВ

Одним із факторів оклюзійних порушень є карієс, що викликає зміни розташування точок в оклюзійному контакті, які є причиною виникнення атипових рухів нижньої щелепи, перевантаження зуба і утворення оклюзійної травми. Мета нашого дослідження полягала в профілактиці оклюзійних порушень методом реставраційного відновлення уражених жувальних поверхонь з урахуванням функціональної анатомії та подальшій перевірці оклюзійних співвідношень з допомогою комп'ютеризованої системи T-Scan Novus. Для цього ми обрали 90 студентів, які проживають у регіонах з низьким рівнем фтору. Лікування проводилось методами прямого й непрямого реставраційного відновлення оклюзійних поверхонь. В статті наведені результати перерозподілу оклюзійних контактів при каріозному ураженні та реставраційному відновленні першого моляра без урахування вимог функціональної анатомії, також результати одразу та через 6 місяців після відновлення жувальних поверхонь уражених зубів з урахуванням оклюзійних детермінант.

Ключові слова: оклюзійні порушення, аналіз оклюзії, реставраційні відновлення, профілактика оклюзійних порушень.

The study is a fragment of the research project "Clinical efficiency of complex treatment of hard tissues diseases of teeth and periodontium among the population of ecologically unfavorable regions", state registration No. 0118U004144.

Occlusion, in a dental context, is the harmony between dental arches, the temporomandibular joint (TMJ) and the neuromuscular system (masticatory muscles). We differentiate between static and dynamic occlusion. The static occlusion refers to contacts between the teeth when the jaw is closed. According to Angle's classification, there are three classes of occlusion. This classification is based on molars correlation. The dynamic occlusion refers to occlusal contacts occurring during movement of the mandible [5, 6, 8, 9, 11].

A pair of the antagonist teeth form the functional complex, which includes a certain number of basic elements for stable jaw closure and performance of functional movements. Centric jaw relation (CJR) is the position of functional comfort for the components of the masticatory apparatus.

CJR contacts are critical to achieve jaw closure. Their location on the distolingual cusp ridge of the mandibular first molars and the mesiolingual cusp ridge of the maxillary first molars is considered perfect, as at this position the lower jaw is able to move forward and upward until the intercuspal relation is achieved. According to foreign studies, in case of cusp-fossa occlusion, maximum bite force was the highest on the molars: 13.3 % ±4.3 and 13.6 %±5.4 – on the first molars, 15.7 %±7.1 and 18.7 %±7.5 – on the second ones.

The starting point of CJR in oral cavity was found to appear on different teeth. Such position of CJR contacts is considered as premature contacts [2, 3, 6, 10].

Premature occlusal contacts form a variety of mandibular displacements during jaw closure under the influence of directing occlusal surfaces [3].

The alteration of occlusal relationships is observed in many dental diseases resulting in the occurrence of pathological processes in the masticatory apparatus [1, 5].

Dental caries is one of the main factors of occlusal problems that results in changing location of occlusal contact points and is the cause of atypical mandibular movements. As a result, occlusal overloading and trauma are observed [1, 4-7, 11].

The occlusal surfaces of the first molars are the most vulnerable for caries process. As the position of the first molars determines the relationship between dental arches (Angle's classification) and the height of centric occlusion, carious lesions of their surfaces are the cause of a number of complications, supracontacts on the intact teeth and lead to an alteration of both static and dynamic occlusions being causative and concomitant factors in the occurrence of changes in the TMJ [1, 5].

The methods of direct or indirect restorations without considering the determinants of occlusion are often used to treat carious lesions of tooth surface. The shape of the tooth, contacts with adjacent teeth and antagonists are the main occlusal determinants, that provide chewing, aesthetics, pronunciation and protection. The ignorance of these requirements of functional anatomy leads to occlusal trauma (occlusal overloading) [2, 10].

The purpose of the work was to carry out early prevention of occlusal disorders of the teeth with carious lesions using modern restorative methods.

Materials and Methods. To determine occlusal disorders in carious lesions and to study the correlation between them, we examined 90 first-/second-/third-year students of the Ivano-Frankivsk National Medical University (45 students were diagnosed with fissure caries of the first molars, 45 students underwent the restoration of the first molars without considering functional anatomy) with the help of the T-Scan Novus occlusal analysis system. It allowed us to visualize the contacts occurring between the teeth of the upper and lower jaws, time and sequence of contact occurrence, the location and the trajectory of force center (balance between the right and left sides) as dynamic 2D and 3D images.

The prevention of occlusal disorders was performed by the methods of direct and indirect restorations considering the determinants of occlusion with subsequent conducting computerized analysis of occlusion before, immediately after and 6 months after treatment.

Statistical analysis of the data distribution using the Shapiro-Wilk W test showed that most of the received measurements did not correspond to the Gaussian (normal) distribution ($p<0.05$). Therefore, to describe the typical values (a measure of central tendency), the median (Me) and the interquartile range (lower quartile – LQ, upper quartile – UQ) were selected. Accordingly, statistical significance of the difference in the data between the comparison groups was estimated by non-parametric methods: within the group for comparison with the data before treatment – the criterion of signs; between separate groups – Mann-Whitney U test.

Results of the study and their discussion. The results of occlusal analysis of patients in the control group showed an even distribution of occlusal load on the teeth. The greatest effort falls on molars 13.2 (13.0–13.5) % –the first molars; 14.0 (13.8–14.3) % – the second molars), on the second premolars the occlusal load is 8.9 (8.5–9.2) %, i.e. the increase in masticatory pressure is directly proportional to the increase in the area of the chewing surface of the tooth. The balance of occlusion is about 50% for each side of dentition (fig. 1).

The data obtained using the T-Scan Novus system showed that, in dental caries of the first molar (fig. 2a) we observe a decrease of masticatory force directly on the affected tooth to 8.2 (6.7–10.1) % ($p<0.05$). The emphasis of bite force is transferred to the adjacent second molar, i.e. to the tooth with a larger area of occlusal surface, and increases to 17.2 (15.1–22.9) % ($p<0.05$). Occlusal interferences are

also present on the first molar antagonist 16.1 (12.8–17.5) % (p<0.05). On the opposite side, in the area of posterior teeth, there were no pronounced occlusal interferences, fluctuation ranged from 11.2 (6.7–11.8) % (p<0.05) to 13.6 (11.2–16.1) % (p<0.05) on the first molars and from 13.2 (11.4–15.2) % (p<0,05) to 14.1 (12.1–18.2) % (p<0,05) on the second ones. On the second premolars the occlusal load is respectively 7.5 (6.8–8.1) % – 8.4 (6.8–9.1) % (p<0, 05) on the affected side and 6.8 (6.0–7.2) % (p<0.05) – 7.5 (6.8–8.1) % (p>0.05) on the opposite side. The balance of occlusion ranges from 46.0 % to 65.9 % on the affected side of the dentition.

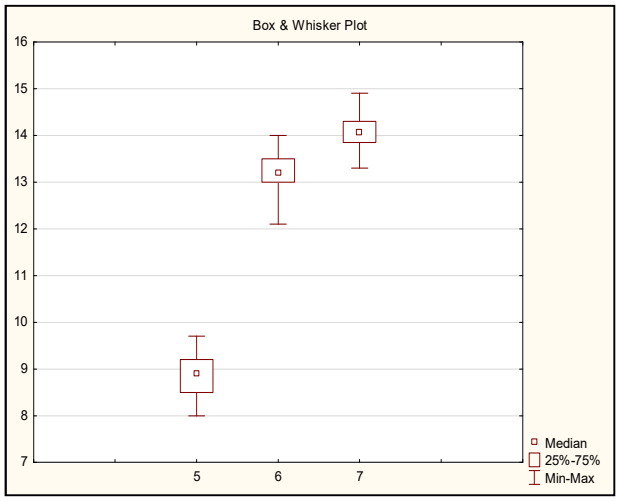

Fig.1. Median value of bite force in patients with intact dentitions (5 – second premolars, 6 – first molars, 7 – second molars).

When the first molar was restored without considering the principles of functional anatomy (fig. 2b), occlusal overloading occured directly on this tooth 18.7 (17.7–21.4) % (p<0.05), and the opposite one 17.1 (15.4–17.9) % (p<0.05). Bite force was evenly distributed on the adjacent posterior tooth 13.4(12.1–14.5) % (p<0.05) and the antagonist 14.2 (13.9–14.8) % (p>0,05), as well as on the molars on the opposite side of the jaw (12.5 (12.3–12.9) % (p<0.05) – 12.7 (12.4–12.9) %(p<0.05) – the first molars, 14.0 (13.6–14.2) % (p<0.05) – 14.1 (13.8–14.3) % (p<0,05) – the second molars). On the second premolars, the occlusal load ranges from 7.8 (7.5–8.4) % – 8.4 (7.4–9.2) % (p<0.05) on the affected side and 8.5 (7.8–9.1) % – 8.7 (8.1–9.1) % (p<0.05) on the opposite side. The balance of occlusion ranges from 46.3 % to 54.4 % on the affected side of the dentition.

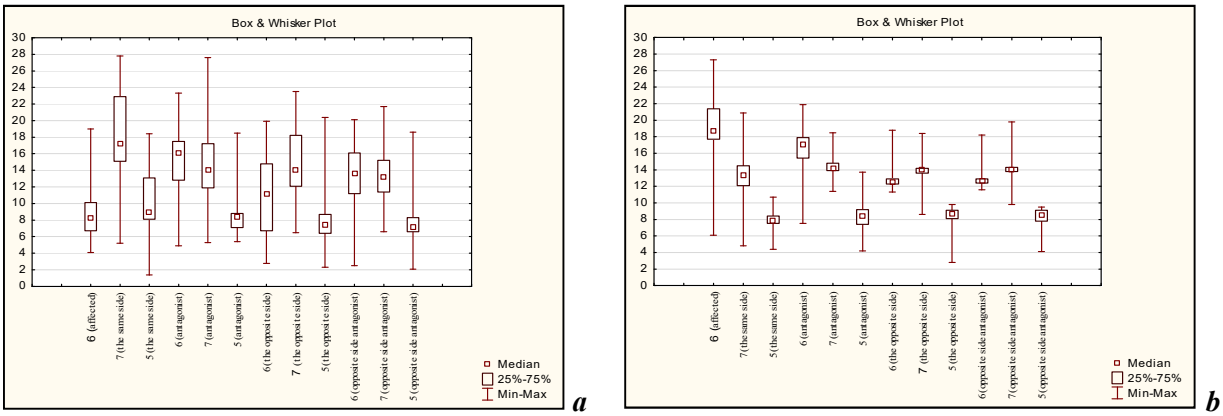

Fig. 2. Median values of bite force in 90 students: 45 – with dental caries of first molar (***a***) and 45 – with inadequate restorations of first molars (***b***).

The results immediately after restoration of carious first molar (fig. 3a) indicated an even distribution of the occlusal load on the molars, namely the increase in bite force was directly proportional to the increase in the chewing surface of the tooth. Bite force on the restored molar increased to 12.6 (12.2–13.2) % (p<0.001) and decreased to 14.1 (12.8–14.8) % (p<0.001) on the adjacent second molar. On the antagonist teeth, the occlusal force was 13.8 (12.4–15.0) % (p<0.05) and 14.8 (12.1–17.5) % (p<0.01), respectively. The proportional increase of occlusal load to 11.9 (8.5–14.7) % (p<0.05) on the first molar and 14.8 (13.4–18.7) % (p<0.05) on the second one is characterized for molars of the opposite side. On the second premolars the occlusal load is respectively 8.1 (7.2–8.7) % – 8.2 (7.5–8.7) % (p<0.05) on the affected side and 7.4 (7.0–8.4) % (p<0.05) – 7.8 (6.8–8.9) % (p>0.05) on the opposite side. The balance of occlusion is about 50% for each side of dentition.

The results of repeated analysis of occlusion 6 months after restoration did not demonstrate any changes (fig 3b). There was an even distribution of the occlusal load on the molars: from 12.6 (12.3–13.1) % (p<0.001) to 13.7 (12.4–14.9) % (p<0.001) on the first molars and from 13.9 (12.5–14.5) % (p<0.001) to 14.1 (13.1–15.2) % (p>0.05) on the second molars. On the second premolars, the occlusal load ranges from 8.1 (7.7–8.6) % – 8.2 (7.4–8.7) % (p<0,05) on the affected side and 7.8 (7.1–8.4) % – 8.1 (6.8–8.9) % (p<0.05) on the opposite side. The balance of occlusion is about 50 % for each side of dentition.

The results of occlusal analysis immediately after retreatment (fig. 4a) of the first molar considering the principles of functional anatomy are as follows: the absence of occlusal interferences directly on the restored molar, i.e. a reduction in the occlusal force on it to 12.4 (12.3–12.6) % ($p<0.001$), which resulted in the even distribution of the force on the teeth. A similar situation can be seen on the antagonist teeth – reduction of occlusal load on the first molar to 12.6 (12.5–12.8) % ($p<0.05$).An even distribution of bite force was also present on molars (14.1 (13.9–14.3) % ($p<0.05$) – adjacent second molar) and on the molars of the opposite side of jaw (12.6 (12.4–13.1) % – 12.6 (12.5–13.1) % ($p<0.05$) – the first molars and 14.1 (13.8–14.3) % – 14.2 (14.0–14.3) % ($p<0.05$) – the second ones). On the second premolars the occlusal load is respectively 9.1 (8.5–9.4) % – 9.2 (8.7–9.7) % ($p>0.05$) on the affected side and 8.7 (8.2–9.4) % – 8.9 (8.6–9.5) % ($p<0.05$) on the opposite side. The balance of occlusion is about 50% for each side of dentition.

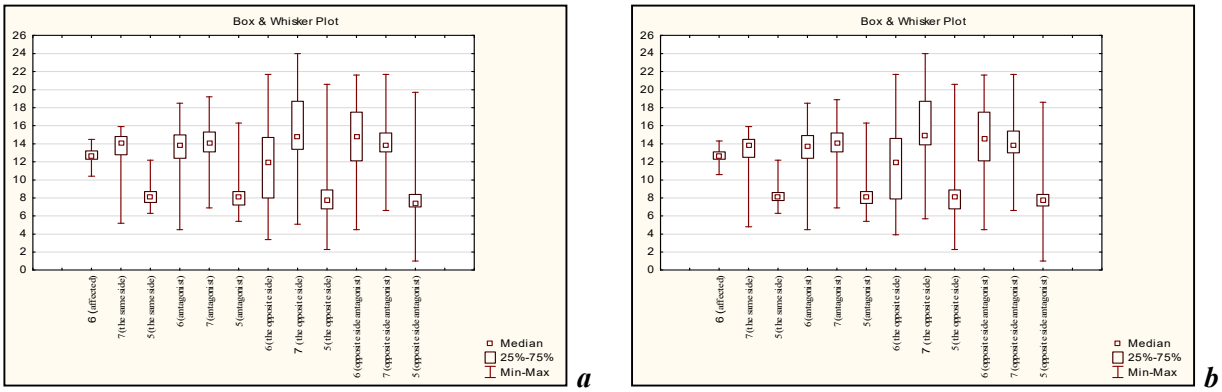

Fig. 3. Median values of bite force in 45 students immediately after (***a***) and 6 months (***b***) after treatment of caries in first molar.

The following results were obtained 6 months after retreatment of the first molar considering the principles of functional anatomy (fig. 4b): the absence of occlusal supra contacts directly on the restored molar and on the antagonist (12.4 (12.3–12.5) % ($p<0.05$) and 13.7 (12.4–14.9) % ($p<0.05$) respectively). This contributes to an even distribution of the occlusal load on the teeth (from 8.1 (7.7–8.6) % ($p>0.05$) on the adjacent premolar to 13.9 (12.5–14.5) % ($p>0.05$) on the adjacent second molar, and from 8.1 (7.4–8.7) % ($p>0.05$) on the antagonist premolar to 14.1 (13.1–15.2) % ($p>0.05$) on the second molar antagonist). On the molars of opposite side of the jaw the increase in bite force was directly proportional to the increase in the chewing surface of the tooth. The balance of occlusion is about 50 % for each side of dentition.

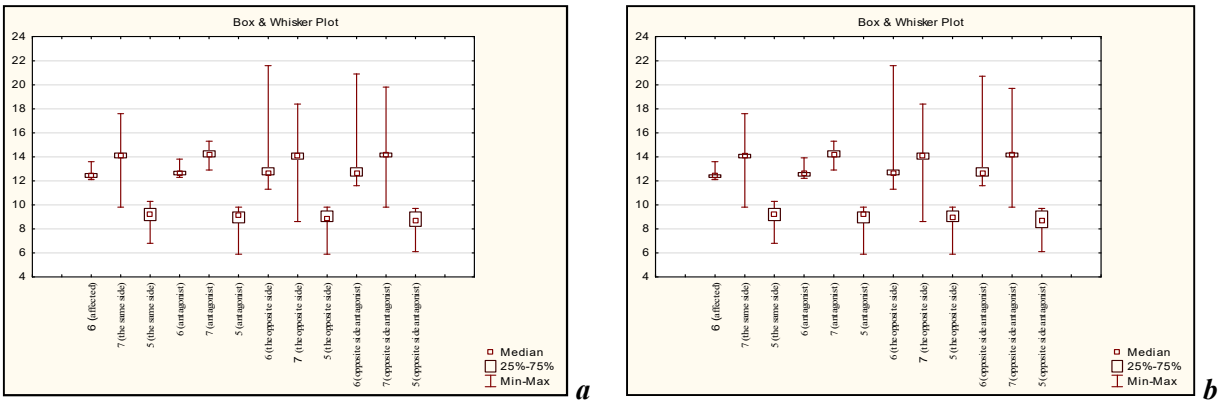

Fig. 4. Median values of bite force in 45 students immediately after (***a***) and 6 months (***b***) after retreatment of first molar.

Having analyzed the obtained data of occlusal load on the intact first molars (13.3 %±4.3 and 13.6 %±5.4) we can assume the following: carious lesion of the first molar led to redistribution of occlusal contacts (a decrease in the occlusal load on the affected tooth to 8.2 (6.7–10.1) %), i.e., the occlusal load was transmitted to the tooth with a large occlusal surface area, namely the second molar (increased to 17.2 (15.1–22.9) %). The restorations of the first molar without considering the principles of functional anatomy caused the occurrence of supracontacts (18.7 (17.7–21.4) %); the similar situation was observed on the antagonist tooth (17.1 (15.4–17.9) %). Computer analysis of occlusion using the T-Scan Novus system showed that restorations of the chewing surfaces of the first molars considering the occlusal determinants led to an even distribution of the occlusal load on the molars (on the restored tooth, the occlusal load increased to 12.6 (12.3–13.1) %, on the adjacent molars, it decreased to 13.9 (12.5–14.5) %; on the retreated

first molars, bite force decreased to 12.4 (12.3–12.5) % and increased to 14.1 (13.9–14.2) % on the adjacent second molars).

It is known, that occlusal disorders occur due to many factors. The most common of these are dental decay, removed teeth, restoration regardless functional anatomy, and pathological attrition, not effective orthodontic and prosthodontic treatment. Various deviations from the generally established norms of occlusion are determined in 91-93 % of adults with intact dentition teeth [2, 3, 6].

Caries is the most common disease, affecting up to 98% of the population. It changes the shape of the occlusal surface of the tooth, as a result of what we observe changes in the location of occlusal contacts points, displacement of supporting cusps and fissures [11].

In people with impaired crown integrity due to caries or its complications, a simplified approach to treatment is often used, without taking into account most occlusal determinants, which further cause dysfunction of chewing, aesthetics, pronunciation and protection and lead to changes in static and dynamic occlusion [9, 11].

The results obtained complemented the publications [10] on the mechanism of occurrence and correlation between occlusal disorders and carious disease, which indicated that the teeth with carious lesions have signs and symptoms of occlusal overloading.

Conclusion

The data of computer analysis obtained with the help of T- Scan Novus system showed the occurrence of occlusal overloading on the posterior teeth with carious lesions of the first molar (8.2 (6.7–10.1) %) or in case of its restoration without considering the principles of functional anatomy (18.7 (17.7–21.4) %). The restoration of the chewing surfaces of affected teeth considering the occlusal determinants and computerized repeated analysis of occlusion showed an even distribution of the occlusal force on the molars (12,6 (12.3–13.1) % – 13,9 (12.5–14.5) % –group 1; 12,4 (12.3–12.5) % – 14.1 (13.9–14.2) % – group 2). The results of our study demonstrated the effectiveness of the developed treatment and prevention complex.

References

1. Bragareva NV. Effektivnost obsledovaniya i lecheniya patsientov s razlichnymi faktorami kompensatsii okklyuzionnykh vzaimootnosheniy pri fiziologicheskoy okklyuzii [dissertatsiya]. Stavropol: StGMU; 2014. 130 s. [in Russian]

2. Douson PE. Funktsionalnaya okklyuziya: ot visochno-nizhnechelyustnogo sustava do planirovaniya ulybki. 1 izdanie. Moskva: Prakticheskaya meditsina; Chast 1, Funktsionalnaya garmoniya. Glava 1, Kontseptsiya polnotsennoy stomatologii; 2016.; 15–22. [in Russian].

3. Zhehulovych ZIe. Kliniko-instrumentalnyi analiz poslidovnosti formuvannia dentalnykh oklyuziinykh kontaktiv pry zmykanni shchelep. Medychna nauka Ukrainy. 2015;11(1–2):69–74. [in Ukrainian].

4. Zhehulovych ZIe. Klinichna kharakterystyka dentalnoyi okliuziyi pislya vidnovlennia u konformatyvnomu pidkhodi. Novyny stomatolohii. 2015;2(83):18–23. [in Ukrainian].

5. Zakharova HE. Patohenez, profilaktyka ta likuvannia okliuziynykh porushen u osib z vtratoyu pershykh postiynykh moliariv [avtoreferat]. Kyiv: NMU im. Bohomoltsia. 2009. 20 s. [in Ukrainian].

6. Mamedova LA. Pod gnetom okkliuzii. Stomatoloh Ynfo. 2016;11/12: 22–4. [in Russian].

7. Nespriadko VP, Skrypnyk YL, Tereshchuk EH I dr. Analiz dynamiki izmeneniya pokazateley metoda otsenki funktsionalnoy okklyuzii T-Scan u patsientov s okklyuzionnymi narusheniyami, kotorye voznikli ili byli sprovotsirovany v rezultate nekorrektnyh stomatologicheskikh vmeshatelstv. Sovremennaya ortodontiya. 2016; 1:35–7. [in Russian].

8. Semenenko YuI., Semenenko IP., Yerys LB. Elektromiohrafichnyi kontrol reabilitatsii khvoroho z chastkovoiu vtratoiu zubiv, uskladnenoiu patolohichnym styranniam, vtorynnoyu deformatsiyeyu zubiv ta znyzhenym prykusom. Ukrainskyi stomatolohichnyi almanakh. 2013; 4: s. 93. [in Ukrainian].

9. Sivovol SI. Okklyuziya zubov i zhevatelnaya effektivnost. Stomatolog Info. 2016; 11-12:12–3. [in Russian].

10. Ma FF, Hu XL, Li JH, Lin Y. Normal occlusion study: using T-Scan III occlusal analysis system. Zhonghua Kou Qiang Yi Xue Za Zhi (Chinese journal of stomatology) [Internet]. 2013 Jun [cited 2013 Oct 13]; 48(6):363-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24120007 DOI: 10.3760/cma.j.issn.1002–0098.2013.06.011

11. Ritter A., Boushell L., Walter R. Sturdevant's art and science of operative dentistry. 7th ed. Mosby; 2018. Chapter 1, Clinical significance od dental anatomy,histology,physiology, and occlusion; p. 39–40.

Стаття надійшла 30.04.2020 р.