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CLINICAL EFFECTIVENESS OF OCCLUSAL SPLINTS IN PATIENTS WITH FUNCTIONAL OCCLUSAL PROBLEMS

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ABSTRACT — Occlusal disorders caused by missing teeth and without timely and proper treatment, lead to poorly diagnosed pathology of the masticatory muscles and the temporomandibular joint. Our study included 31 patients with dental defects, impaired canine guidance, and TMJ pathology. With a specifically developed computer program we accomplished the differentiation of various degrees of muscle and joint dysfunction in the temporomandibular joint. The results obtained by examining the patients prior to, and after the treatment, provide evidence to the effect that the modified occlusal splint has on the upper jaw.

KEYWORDS — muscle and joint dysfunction, temporomandibular joint, canine guidance.

INTRODUCTION

A common dental pathology affecting adult population involves functional occlusal disorders, the prevalence of which reaches 40–70% in Russia. Most often, it is the first lower permanent molars that are removed, and their share in the entire pool of all removed teeth is 9.38% [4, 13]. Occlusal disorders affect the lower jaw biomechanics, while the front teeth – given the loss of the lateral ones – have to compensate for a function that is not conventional in this case, namely, a masticatory function. Long-term occlusion defects lead to change in the functional and static occlusion, which comes along with disturbed canine guidance or the teeth group contact on the working side [5, 11, 12, 17–19, 22].

Occlusal interferences caused by missing teeth is accompanied by an increase in the number of chewing movements and the time that a single act of chewing takes, the result of that, in turn, being compensatory contraction and hyperactivity of the chewing muscles,

followed by poor metabolism and the muscle pain syndrome [1, 6, 7, 10, 21, 23].

Comprehensive treatment offered duly to patients with occlusal defects helps relieve the symptoms of the TMJ muscle-and-joint dysfunction, which has already been proven through numerous studies, held both nationally and internationally [2, 3, 8, 9, 14–16, 20].

Aim of study:

to improve the treatment effectiveness in patients with lateral occlusion interferences complicated by the temporomandibular joint dysfunction, as well as by disturbed canine guidance.

MATERIALS AND METHODS

To achieve the goal set for the study, 31 patients suffering from lateral occlusion defects, disturbed canine guidance and symptoms of the temporomandibular joint dysfunction were examined at the Department of Orthopedic Dentistry of the Saratov State Medical University. The main group included 16 (51.61%) females and 15 (48.39%) males. The control group consisted of 30 patients (19 females and 11 males) featuring orthognathic occlusion, intact dentition, and no symptoms of muscle-and-joint dysfunction. A written voluntary consent to participate in the study was obtained from each of the patients.

The planning and selection of rational treatment methods were carried out based on the data obtained from the outcomes of the basic and special examination methods. The severity of the temporomandibular joint dysfunction was identified using specifically developed software — Program for Identifying the Degree of Muscle-and-Joint Dysfunction (Certificate of Official Registration for Software, #2016614212 from 04/18/2016). The functional status of the masticatory and temporal muscles was evaluated using the surface electromyography method.

While aiming at restoring the occlusal contact and canine guidance, the comprehensive treatment relied on an occlusal splint was fixed on the upper jaw, whereas the splint was modified following some specific features proposed by the authors (Utility Model Patent #175428).

The statistical analysis was performed using the Statistica 6.0 and Microsoft Office Excel 2016

software, whereas the Student's parametric t-test was employed to determine the significance of the difference between the two averages.

RESULTS AND DISCUSSION

All the patients in the main group had uni- and bilateral occlusal interferences as well as terminal defects of the lateral guidance, including disturbed canine guidance and symptoms of the muscle-and-joint dysfunction in the temporomandibular joint.

External examination of the patients belonging to the main group with their teeth closed in the conventional occlusion, allowed identifying facial asymmetry in 61.29% of the cases. Restricted vertical movements in the lower jaw were observed in 77.42% of the patients, while lateral and anterior movements accounted for 74.19% of the patients. Premature contacts in the static and dynamic occlusion were observed in 70.97% of the patients. Besides, all the patients featured disturbed canine guidance.

Painless palpation of the masticatory muscles was observed in 64.52%, and the temporomandibular joint — in 61.29% of the patients. The TMJ palpation resulted in unpleasant sensations in 25.81% of the patients, causing pain in 12.90% of the cases. Painful palpation of the masticatory muscles was observed in 35.48% of the patients involved in the study. Following the auscultation results, joint noise was detected in 61.29% of the patients.

The software used to detect the degree of the muscle-and-joint dysfunction reported mild dysfunction symptoms in 35.48% of the patients of the main group; moderate symptoms in 38.71% of the patients and severe symptoms in 25.81%.

The occlusiogram index determined subject to the method by N. Khamitova (1986) in patients with mild muscle-and-joint dysfunction was 76.89%; with an average degree of the dysfunction it was 68.28%, and in cases of a severe degree of the dysfunction the index value was 54.86%.

Spontaneous activity of the masticatory muscles remaining in a state of relative physiological rest, according to the electromyographic study (EMG), was observed in 6.45% of the patients, and reached 85 μ V; in 9.68% of the patients — 170 μ V. All the patients revealed a significant ($p < 0.001$) decrease in the bioelectric activity of the masticatory and temporal muscles if compared with the control group (see Table 1).

The treatment of patients with lateral occlusion defects, disturbed canine guidance and symptoms of the muscle-and-joint dysfunction included two stages. At Stage 1 (preparatory), a modified splint for the upper jaw was used to restore occlusal relationship and canine guidance. After the masticatory muscles and

the temporomandibular joint adjustment (based on the electromyography data), all patients underwent rational prosthetics using removable and non-removable dentures.

Upon analyzing the data on the time of the occlusal splint being used by the patient, a conclusion was made that the time of getting adjusted to the restored occlusal dentition relationship in patients with a mild muscle-and-joint dysfunction was significantly shorter compared to patients with moderate and severe degrees, and averaged 27.27 ± 4.29 days. In patients with a moderate degree of the TMJ dysfunction, adjustment took an average of 35.50 ± 8.23 days; in cases of a severe degree — 81.75 ± 14.12 days.

Following the treatment, the TMJ muscle-and-joint dysfunction symptoms disappeared in 48.39% of the patients. The number of patients with mild dysfunction went down by 3.22%, which could be explained by the shifting from a moderate to a severe degree. During that, the number of patients with a moderate TMJ dysfunction decreased by 22.58%, with a severe degree — by 22.59% of the cases observed.

After the treatment, a reliably significant ($p < 0.001$) increase in the average action potential amplitude of the masticatory and temporal muscles was detected subject to the electromyographic data (see Table 1). The obtained data had normal indicators and revealed no significant differences when matched against the same indicators for the patients in the comparison group.

Following the rational comprehensive treatment, the occlusiogram index rose from $67.87 \pm 2.09\%$ to $86.15 \pm 1.51\%$ ($p < 0.001$).

Matching the data from the respective literature focusing on this pathology treatment terms, while using occlusal splint, against the results of our own research as described above, allows concluding that the proposed modification of the occlusal splint is more effective if compared to its counterparts.

CONCLUSION

When examining patients with occlusion defects, it is not enough to identify signs of the TMJ muscle-and-joint dysfunction alone, yet special attention should be paid to the severity of these symptoms, as well as they are to be taken into account when designing a comprehensive treatment plan. The degree of the TMJ dysfunction symptoms severity can be identified employing the software that has been developed specifically for this purpose.

The study outcomes provide the evidence of the efficacy of the modified occlusal splint installed on the upper jaw thus to restore the canine guidance and treat the TMJ muscle-and-joint dysfunction in patients

Table 1. Functional specifics of masticatory and temporal muscles, before and after the treatment, EMG data, μV

Muscle functional status	EMG period	Masticatory muscle		Temporal muscle	
		right	left	right	left
Contraction	Before treatment	248.93 \pm 13.17	244.96 \pm 12.49	277.96 \pm 14.28	296.54 \pm 14.05
	After treatment	325.61 \pm 13.74	325.96 \pm 13.86	359.83 \pm 12.26	359.80 \pm 11.92
Chewing	Before treatment	425.25 \pm 14.98	423.45 \pm 14.51	344.45 \pm 14.44	342.38 \pm 14.18
	After treatment	499.61 \pm 13.61	504.77 \pm 13.59	406.64 \pm 12.28	405.67 \pm 12.26

with disturbed lateral occlusal surfaces. The adjustment of the masticatory muscles to the new functional context has been proven through a changed action potential amplitude of the masticatory, temporal, and supra-lingual muscles on the electromyograms. During that, the masticatory muscles adjustment occurred within a shorter time in patients with a mild degree of the temporomandibular joint dysfunction rather than in patients suffering from moderate and severe degrees of the issue.

REFERENCES

1. **DOMENYUK D. A.** Anatomical and topographical features of temporomandibular joints in various types of mandibular arches. *Medical News of North Caucasus*. 2019;14(2):363–367. DOI – <http://dx.doi.org/10.14300/mnnc.2019.14089> (In Russ.)
2. Interdisciplinary aspects of rehabilitation of patients with functional disorders of the temporomandibular joint / V.I. Shemonaev, T.N. Klimova, T.B. Timacheva, N.N. Klimova, V.A. Stepanov, D.A. Matveeva // *Pacific Medical Journal*. – 2020. – No. 2 (80). – S. 52–55. – DOI: 10.34215 / 1609-1175-2020-2-52-55.
3. The role of dynamic electroneurostimulation in the complex treatment of muscular-articular dysfunction in patients with deformities of the dentition and occlusion / D.Kh. Razakov, V.V. Konnov, A.R. Arushanyan, E.N. Pichugina, E.S. Popko // *Modern problems of science and education*. – 2015. – No. 6. – P. 199.
4. **FILIMONOVA O.I., PLYUKHIN D.V.** Population appeal for dental care in non-governmental institutions // *Problems of dentistry*. – 2011. – No. 4. – S. 68–70.
5. The effectiveness of orthopedic methods of treating patients with dentition defects complicated by distal occlusion depending on the topographic features of the temporomandibular joint / V.V. Konnov, E.N. Pichugina, A.R. Arushanyan, A.A. Bizyaev, V.A. Mikailova // *Modern orthopedic dentistry*. – 2017. – No. 28. – P. 39–41.
6. **KONNOV V. V., PICHUGINA E. N., ARUSHANYAN A.R., KHODORICH A. S., KONNOV S.V., DOMENYUK D.A., KONDRATYEVA T.A.** Electromyographic study of neuromuscular coordination of chewing muscular at the stages of protetic treatment. *Medical alphabet*. 2020; (12):43–48. <https://doi.org/10.33667/2078-5631-2020-12-43-48>.
7. **EDELHOFF D., AHLERS M.O.** Occlusal onlays as a modern treatment concept for the reconstruction of severely worn occlusal surfaces // *Quintessence International*. – 2018. – Vol. 49, No. 7. – P. 521–533. – DOI: 10.3290/j.qi.a40482.
8. Dynamic electrical neurostimulation in comprehensive treatment of temporomandibular joint pain syndrome in patients with occlusion issue / V. Konnov, D. Razakov, E. Pichugina, A. Vedyeva, V. Mikailova, A. Bizyaev, S. Salnikova, E. Popko // *Archiv EuroMedica*. – 2018. – Vol. 8, No. 2. – P. 115–120.
9. **IVANYUTA O.P., AL-HARASI G., KULESHOV D.A.** Modification of the dental arch shape using graphic reproduction method and its clinical effectiveness in patients with occlusion anomalies // *Archiv EuroMedica*. 2020. Vol. 10; 4: 181–190. <https://dx.doi.org/10.35630/2199-885X/2020/10/4.42>
10. Psychosocial aspects and temporomandibular disorders in dental students / C. Oliveira de M. Rocha, R.F. Peixoto, C.M. Bastos Machado de Resende, A. Cesar de M. Alves, A. Giuseppe Roncalli da Costa Oliveira, G. Augusto S. Barbosa // *Quintessence International*. – 2017. – Vol. 48, No. 3. – P. 241–249. – DOI: 10.3290/j.qi.a37128.
11. **SHEMONAEV V.I., MASHKOV A.V., PATRUSHEV A.S.** Circadian dynamics in the functional interaction of the lateral teeth occlusal surfaces' relief // *Indian journal of dental research*. – 2020. – Vol. 31, No. 3. – P. 363–367. – DOI: 10.4103 / ijdr.IJDR_792_18.
12. The functional status of masticatory muscles at displaced mandible based on electromyographic data / S. Konnov, A. Arushanyan, E. Pichugina, N. Bulkina, V. Konnov, M. Vorobyeva // *Archiv EuroMedica*. – 2018. – Vol. 8, No. 2. – P. 101–103.
13. **YADAV K., PRAKASH S.** Dental caries: a microbiological approach // *Journal of Clinical Infectious Diseases & Practice*. – 2017. – Vol. 2, No. 1. – DOI: 10.4172/2476-213X.1000118.
14. **DMITRIENKO S.V.** Enhancement of research method for spatial location of temporomandibular elements and maxillary and mandibular medial incisors. *Archiv EuroMedica*. 2019. T. 9. № 1. P. 38–44. <https://doi.org/10.35630/2199-885X/2019/9/1/38>
15. **DMITRIENKO T.D.** Connection between clinical and radiological torque of medial incisor at physiological occlusion. *Archiv EuroMedica*. 2019. Vol. 9. № 1. P. 29–37. <https://doi.org/10.35630/2199-885X/2019/9/1/29>

16. **DOMENYUK D.** Structural arrangement of the temporomandibular joint in view of the constitutional anatomy. *Archiv EuroMedica*. 2020. Vol. 10. № 1. P. 126–136. <https://doi.org/10.35630/2199-885X/2020/10/37>
17. **KONDRATYEVA T.** Methodological approaches to dental arch morphology studying. *Archiv EuroMedica*. 2020. Vol. 10; 2: 95–100. <https://dx.doi.org/10.35630/2199-885X/2020/10/2.25>
18. **KOROBKEEV A. A.** Morphological features of the maxillofacial region in patients with full secondary adentia and variations of the constitution. *Medical News of North Caucasus*. 2020;15(4):539–543. DOI – <https://doi.org/10.14300/mnnc.2020.15127> (In Russ.)
19. **LEPILIN A.V., SHKARIN V.V., AL-HARAZI G. A.** A biometric approach to diagnosis and management of morphological changes in the dental structure. *Archiv EuroMedica*. 2020. Vol. 10; 3: 118–126. <https://dx.doi.org/10.35630/2199-885X/2020/10/3.30>
20. **LEPILIN A.V., FOMIN I.V.** Diagnostic value of cephalometric parameters at graphic reproduction of tooth dental arches in primary teeth occlusion. *Archiv EuroMedica*, 2018. Vol. 8. № 1. P. 37–38. DOI: [10.35630/2199-885X/2018/8/1/37](https://doi.org/10.35630/2199-885X/2018/8/1/37)
21. **SHKARIN V.V., GRININ V.M., KHALFIN R.A.** Specific features of transversal and vertical parameters in lower molars crowns at various dental types of arches. *Archiv EuroMedica*. 2019. Vol. 9; 2: 174–181. <https://doi.org/10.35630/2199-885X/2019/9/2/174>
22. **KONNOV V.V., HARUTYUNYAN M.R., VOROBIEVA M.V., KHODORICH A.S., MUKHAMEDOV R.N.** Clinical efficiency of orthopedic treatment of dental defects by arc prostheses with polyoxymethylene frame. *Medical alphabet*. 2020; (3):29–34. <https://doi.org/10.33667/2078-5631-2020-3-29-34>
23. **KONNOV V.V., PICHUGINA E.N., ARUSHANYAN A.R., BIZYAEV A.A., KHODORICH A.S., KONNOVA K.A.** The role of terminal dental defects in the development of temporomandibular joint dysfunction (literature review). *Medical alphabet*. 2020; (35):39–43. <https://doi.org/10.33667/2078-5631-2020-35-39-43>