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DETERMINATION OF FUNCTIONAL CAPACITY OF DENTOALVEOLAR APPARATUS IN DENTAL PATIENTS WITH TEMPOROMANDIBULAR JOINT DYSFUNCTION

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Abstract

This paper presents data on functional state of masticatory muscles in dental patients with temporomandibular joint dysfunction. Total 128 dental patients with clinical signs of temporomandibular joint dysfunction have been examined using a visual analog scale, the Helkimo clinical index and the magnetic resonance imaging. The paper describes a functional test with the use of surface electromyography of masticatory muscles, laser Doppler flowmetry and fluorescence diagnostics. The evaluation criteria of functional capacity of the dentoalveolar apparatus have been suggested.

Keywords: Dentistry, Temporomandibular joint dysfunction, Masticatory muscles, Surface electromyography, laser Doppler flowmetry, Laser fluorescent diagnostics.

Introduction

Problems of the diagnostics of functional state of the dentofacial apparatus (DFA) has attracted the attention of researchers [1, 2]. Patients with primary disorders in the temporomandibular joint (TMJ), as a rule, have a dysfunction of the masticatory muscles, and patients with primary pathology of the masticatory muscles may have pathological changes in the TMJ. In these circumstances, it is problematic to determine the cause-and-effect relationships [3]. According to some researchers having studied the decline in the efficiency of the masticatory muscles, the leading formation mechanism of stable pathological state is a dysfunction of the masticatory muscles [4-7]. These neuromuscular disorders may be caused by deviations in the psychic, somatic, endocrine and other spheres [8]. An important component of the functional state of the dentofacial apparatus (DFA) is the microcirculation that determines the trophic processes in the masticatory muscles. Laser Doppler flowmetry and fluorescent diagnostics

have been used to assess the status of the capillary blood flow and allowed detecting the signs of interstitial hypoxia [9, 10]. To develop a differentiated therapeutic approach to dental patients, it is necessary to assess the functional state of the muscular component of DFA and determine the functional potential of dentofacial apparatus.

Methods

Total 128 dental patients with clinical signs of TMJ dysfunction were under our supervision; 18 of them were men (14%) and 110 (86%) women aged 27-56 years. The implemented clinical-diagnostic algorithm included:

- Anamnestic study with a visual analog scale (VAS) and a Helkimo clinical index;
- Magnetic resonance imaging (MRI) of the TMJ. The TMJ study was carried out on high-field (3.0 T) MRI tomograph Signa Excite HDx (USA), in two steps, the first of which was in the habitual occlusion position, and the second - with open mouth.
- Surface electromyography (SE) with the hardware-software complex "Miocom", consisting of a computer, eight-channel electromyograph with remote amplifying sensors, and «StabMed 2" analysis software (Russia).
- Assessment of regional blood flow of the oral mucosa (OM) by laser Doppler flowmetry (LDF) and laser fluorescence diagnosis (LFD) with the use of multifunctional laser diagnostic complex "LAK-M" (Russia).

The functional test included the determination of the initial state by surface electromyography of masticatory muscles, laser Doppler flowmetry and laser fluorescence diagnostics of the oral mucosa. Thereafter, the patient had a silicone dental splint applied for 20 minutes followed by similar evaluation of the neuromuscular state.

Stages of the functional test:

1. During SE, bioelectrical muscle activity has been recorded in the specific non-function phase (rest state) for 5 minutes. The bioelectrical activity of chewing, temporal, sternoclavicular-mastoid and trapezius muscles have been assessed.

Electromyographic study was followed by LDF and LFD. We used a wavelet transformation to calculate the amplitude-frequency oscillation spectrum and to estimate the contribution of neurogenic and myogenic components of microvascular tone, as well as respiratory and cardiac rhythms. Neurogenic activity range - 0.023-0.046 Hz. Myogenic activity range - 0.05-0.145 Hz. The higher the myogenic oscillation amplitude, the lower the peripheral resistance. A decreasing vasomotor amplitude causes increase in muscle resistance, and thus decrease in the nutritional blood flow. The relation of the above rhythmic components in dopplerograms objectively reflects the state of hemodynamics in the microvasculature. A secondary radiation spectrum of the tissue upon its probing with laser at

630nm wavelength for porphyrins, and 560 nm for lipofuscin was measured by LDF-spectrophotometry using the laser fluorescence diagnostics. Tissue hypoxia has been detected at a coefficient of the lipofuscin and porphyrins fluorescent contrast less than 0.9.

2. The next stage was the installation of a customized silicone dental splint for 20 minutes.

3. Re-registration of bioelectrical muscle activity in the specific non-function phase (rest state) for 5 minutes, with further assessment of microcirculation status by LDF and LFD.

Based on the results of functional test, the degree of disturbance of the bioelectric activity of masticatory muscles and neck muscles in the absence of a specific function was assessed, as well as their changes caused by the restructuring of periodontal-muscular response to changes in the jaws relation after applying the silicone dental splint. The status of the microvasculature nutritional component was also assessed upon changes in the jaws relation.

The analysis of the state of muscle complex and microcirculation allows evaluating the rehabilitation potential of the patient's DFA. Pathological changes identified by SE, LDF and LFD at first examination were compared with the results of re-examination carried out after unloading the muscular-articular complex after the 20-minute application of the silicone splint. If the results of re-examination correspond to physiological norm than the state of preserving rehabilitation potential is confirmed. Upon partial normalization of indicators, its decline is observed. In the absence of positive dynamics, a sharp decline in the state of rehabilitation potential is observed.

Main Part

According to the results of clinical and anamnestic studies, 87 (68%) patients had TMJ dysfunction of moderate severity according to Helkimo index, and 41 (32%) had severe dysfunction. According to the magnetic resonance imaging, 37 (29%) patients had dislocation of the articular disk without reposition, 48 (38%) patients had dislocation of the articular disc with reposition, and 43 (33%) patients had dislocation of the articular disc determined. The results of the functional tests revealed the state of preserving rehabilitation potential in 35 (27%) patients, decreased rehabilitation potential in 52 (41%), and sharply decreased - in 41 (32%) patients.

The proposed method of assessing the rehabilitation potential can be illustrated by the following clinical example.

Patient A., age 37. Hotel administrator (high speech and stress load at the work, disturbance of circadian rhythms).

Complaints of pain in the left TMJ during mandibular movement, limited mouth opening during one month. Before pain, the patient had clicks in the TMJ on both sides at wide mouth opening for two years. Anamnesis: hyperthyroidism, bruxism, sleep disorders.

Objectively: no tooth 15, 16, 26, 35, 36, 46 (class III on Kennedy classification). The upper jaw dentition defects have been reconstructed with the porcelain-fused-to-metal bridges. Orthognathic occlusion. Mouth opening - 25 mm. Lower jaw deflection to the left. Pain upon palpation in the left TMJ and in the masticatory muscles right, the range of motions of the lower jaw head left is reduced in comparison with the right side. Abnormal noise in the TMJ right. Severe degree of dysfunction D III (19 points) according to Helcimo index.

According to visual analog scale: minimally expressed pain in the temporomandibular joint right (2 points); severe pain in the TMJ left (8 points); minimal pain in the masticatory muscles right (3 points); moderate pain in the masticatory muscles left (6 points). According to the TMJ magnetic resonance imaging - articular disc dislocation left without reposition. For more accurate rehabilitation prognosis and determination of the DFA rehabilitation potential, the proposed functional test was carried out.

The functional test has revealed:

- Disturbance of the bioelectric activity of masticatory muscles in the absence of specific functions (rest state) is expressed in the form of registration of pathologic electromyographic phenomena. Upon transformation of the periodontal-muscular response to changes in the jaws relation, occurred after the application of silicone dental splint, a decrease in the severity of pathological phenomena has been recorded;
- The state of nutritional component of the oral mucosa microcirculation is initially characterized by the increased neurogenic and reduced myogenic tone and by the presence of tissue hypoxia. Upon assessment of the periodontal-muscular response to the silicone splint, an increased neurogenic tone is preserved, and the normalization of myogenic tone and decrease in the severity of tissue hypoxia are observed. Thus, we have revealed a reduction in the DFA rehabilitation potential due to a disturbed regional microcirculation and metabolic disorders of the masticatory muscles on the background of thyroid disease.

Rehabilitation prognosis: complete functional rehabilitation is possible, the planned treatment duration - 6 months.

Treatment algorithm:

1. Normalization of interposition of TMJ elements and reduction of the masticatory muscles tone in the splint with its mandatory correction 1-2 times a week, as well as neurologic and endocrinologic treatment.
2. Two months after the functional re-test, the preservation of the initially recorded electromyographic phenomena and normalization of neurogenic microvascular tone upon assessing the periodontal-muscular response to the effect of the silicone dental splint were observed.

Thus, we have revealed a slight reduction in the DFA rehabilitation potential due to a disturbed regional microcirculation and metabolic disorders of the masticatory muscles on the background of thyroid disease, which allows us to pass to the next stage of treatment.

3. Restoration of dentition defects with the temporary plastic bridges. Indication for functional therapy regulating the behavior and chewing mode, as well as individual miogymnastics.

4. One month after the temporization, the results of functional tests revealed: isolated electromyographic phenomena and the absence of tissue hypoxia according to data of laser fluorescence diagnostics.

The conducted functional test allowed us after the restoration of dentition defects to determine the state of the DFA preserving rehabilitation potential with the insignificant influence of thyroid pathology on the metabolism of the masticatory muscles. The results obtained allow us to conclude about the completion of the treatment.

Conclusion

Upon restoration of the preserving state of rehabilitation potential, the prosthetics was conducted with the use of porcelain-fused-to-metal bridges, a night splint was designed, and a regular medical check-up of neurologist and endocrinologist was recommended. Full-scale mouth opening and mandibular motions. No pain upon palpation in the TMJ chewing muscles. The range of motions of the lower jaw head left is reduced in comparison with the right side. No abnormal noise in the TMJ region. Mild dysfunction D I (1 point) according to Helcimo index.

According to visual analog scale: minimal pain in the TMJ region: right (0 points); left (1 point). Minimal pain in the chewing muscles right: right (1 point); left (1 point).

At the re-examination after 3 months the patient noted improvement in general condition, normalization of sleep, lack of discomfort while eating. No complaints of pain in the muscle-joint complex or of limited mouth opening. The patient is followed up by the endocrinologist for hyperthyroidism and has a regular medical check-up of the neurologist.

Thus, the diagnosis of the functional state of the masticatory muscles and determination of the DFA rehabilitation potential allows choosing the adequate trajectory of consultation and treatment by an endocrinologist and a neurologist, as well as making the best treatment plan for the patient, which will ensure a stable clinical effect.

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