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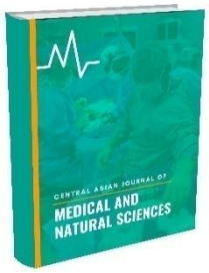

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The Use of Modern Technologies in the Diagnosis of Functional Disorders of the Temporomandibular Joint (Literature Review)

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Abstract: Dysfunction of the temporomandibular joint (TMJ) is characterized by a wide prevalence, polyetiology, progressive course and high frequency of relapses [1-5]. This set of features of this pathology puts it in a number of urgent problems of general medical importance [6, 7]. The variety of concepts and approaches to the analysis of the etiopathogenesis of TMJ dysfunction causes an increased interest in the search for highly informative diagnostic methods, especially at the stage of preclinical manifestations.

Key words: Modern Technologies, Temporomandibular Joint.

The purpose of the study. Analysis of the possibilities of modern technologies in the diagnosis of functional disorders of the temporomandibular joint.

Materials and methods of research. The study was conducted based on the search and study of original articles on the diagnosis of TMJ dysfunction in databases: eLibrary, PubMed, The Cochrane Library, Google Scholar. The main selection of materials was carried out by keywords.

The results of the study. Currently, clinical and instrumental, X-ray, graphic and functional methods are used to diagnose TMJ dysfunction, among which the most informative are the axiography system, electromyography, computer and magnetic resonance imaging [8-10].

One of the main etiological factors of TMJ dysfunction is a violation of occlusion [11-13]. A number of domestic and foreign authors recommend the need for the use of individually adjustable articulators in the diagnosis of occlusive disorders [14-17]. According to E.N. Pichugina et al., the analysis of collapsible plaster models in the articulator makes it possible to assess the contacts of individual teeth in dynamic occlusion, to identify the cause of the displacement of the lower jaw from the position of the central occlusion to the "habitual" [18]. Currently, computer diagnostics of occlusive disorders is in demand [19]. According to S. Y. Yo and S. Kadir, using the T-scan system, it is possible to obtain data on the density of occlusal contacts and the sequence of their appearance, the vector of the direction of force and the resultant occlusal forces [20, 21]. Research by R. Maganti et al. It has been shown that T-scan is a faster and more accurate alternative to occlusion analysis on jaw models in an articulator [22]. In the work of O. O. Yanushevich et al. of particular interest is the possibility to carry out a high-precision diagnosis of occlusion disorders, taking into account the biomechanics of the TMJ

and the aesthetics of the patient's face using scanned plaster models of the jaws in a virtual articulator [23]. Deformations and anomalies of the maxillary system play an important role in the etiopathogenesis of TMJ pathology [24]. A.V. Moskovsky et al. telerentgenography in direct projection revealed the presence of facial skeleton asymmetry associated with dental anomalies [25]. According to P.V. Ishmurzina et al., when deciphering telerentgenograms of patients with TMJ dysfunction, mandatory indicators are the facial and incline angles according to Schwartz, the angle of inclination of the occlusal plane, incline angles of incisors, angles characterizing the position of the chin and apical bases of the jaws, the angle of inclination of the mandible head in the sagittal plane and the ratio of the size of the branch and the body of the mandible [26]. Yu. G. Khudoroshkov et al. a comparative analysis of telerentgenograms in lateral projection in patients with TMJ dysfunction and its absence revealed predictors of articulation disorders of the mandible.

Among them, there is a pronounced sagittal occlusal Spee curve, a multidirectional change in the upper and lower occlusal angles, a tendency to “reset” the difference in the angles of the sagittal articular and incisive sagittal angles [27].

A number of authors believe that the telerentgenogram gives an idea of the magnitude of the movement of teeth, the curvature of the occlusal surface of the dentition, allows you to compare the dental alveolar height with the height of the alveolar part, determine the thickness of the layer of dental tissues to be sanded, and also construct a proper occlusal plane [28, 29]. I. V. Petrikas et al. it was also proved that telerentgenography contributes to the decision on the possibility of increasing the interalveolar height with the calculation of the mouth guard [30]. However, the images in telerentgenography are summative and two-dimensional, and strict observance of the position of the head is also necessary when performing the study [31]. Recent studies by domestic and foreign authors have emphasized the expediency of using the registration of mandibular movements for the diagnosis of TMJ dysfunction [32-34]. According to O. I. Arsenina et al., using the method of electronic axiography, it is possible to reproduce the trajectory of the articular path on the display online. Axiography allows us to evaluate the qualitative and quantitative characteristics of movement in the TMJ, to determine the position of the articular disc with a reciprocal click [35]. According to M.M. Antonik and Yu. A. Kalinin, the displacement of the head of the lower jaw when opening and closing the mouth is recorded in the form of a curve, convex downwards. The curvature of the trajectory of movement is a sign of displacement of the articular disc and deformation of the articular surfaces, and the distance of 0.5 mm between the "opening—closing" curves serves as a marker of discoordination of the muscular apparatus [36]. T.N. Lenko's work shows that when comparing the clinical manifestations of TMJ dysfunction with the results of MRI and axiography, curves corresponding to certain functional disorders were obtained. This method is one of the most informative and visual for the primary diagnosis of TMJ dysfunction, as well as monitoring of treatment [37]. In the research of D. V. Crumbs and co. the registration of temporal indicators of the movement of the mandible was carried out using an electronic gnatograph. An increase in the duration of the phases of opening and closing the mouth, the phase of occlusion of the dentition in patients with TMJ dysfunction was revealed [38]. The method of choice for studying the function of the neuromotor apparatus and evaluating the coordination of the masticatory muscles is electromyography (EMG) [39-42]. Global EMG by means of surface electrodes makes it possible to register the total bioelectric activity of the muscle, characterized by the amplitude and frequency of potentials [43]. According to O.G. Bugrovetskaya et al., in healthy individuals at rest, the masticatory musculature has symmetrical spontaneous electrical activity. Patients with signs of TMJ dysfunction are characterized by a decrease and asymmetry of the values of this indicator [44]. The bioelectric activity of the muscle during functional tests gives an idea of the degree of violation of the muscular apparatus in the active phase.

However, with regard to the study of the lateral pterygoid muscle due to its anatomical features, the possibilities of global EMG are limited [45]. At the same time , in the studies of L. P. Gerasimova et al. assessed the bioelectric activity (BEA) of the lateral pterygoid muscle using a device containing an impression spoon and surface electrodes. On the tangent surfaces of the individual impression spoon to the site of the lateral pterygoid muscle, semilunar cutouts are made, in which two electrodes are installed. The surface electrodes are fixed on the skin of the face in the projection of the zygomatic bone. According to the authors, with TMJ dysfunction, the values of the amplitude of the lateral pterygoid muscle increase [46]. At the same time, with the help of this technique, it is not possible to isolate the action potential of individual motor units (PDE) of the muscle. According to a number of authors, the analysis of the amplitude, duration and number of phases of the PDE reflects changes in the structural units of the muscle locally, and also determines the stage of the denervation-reinnervation process in it. This function can be performed only with the help of local electromyography with concentric electrodes [47, 48]. K. Ronkin's work describes the possibility of using stimulating EMG to diagnose disorders of the neuromuscular apparatus at the level of transmission of an electric pulse, in particular, for the diagnosis of bruxism [49]. Therefore, EMG allows you to register changes in the neuromuscular apparatus - an important link in the pathogenesis of TMJ dysfunction. One of the precision methods for diagnosing TMJ dysfunction is cone-beam computed tomography (CBCT), which is characterized by high sensitivity and specificity, low radiation load on the patient (up to 50 mSv) [50-52]. In the studies of E.V. Shelomentsev and T.A. Larheim, it was indicated that the diagnostic information obtained with the help of CBCT is limited by morphostructural changes in the hard tissues of the TMJ [53, 54]. P.N. Geletin et al. We have proposed an algorithm for visualization and analysis of TMJ, which allows us to standardize the methodology of TMJ research and the interpretation of the results obtained. With its help, an isometric image of the studied area was obtained in three projections with the required thickness of the selected layer. In accordance with the reformats, the authors proposed a list of quantitative (angular and linear) and qualitative (position and contours of the mandibular head, height and symmetry of the articular gap, the presence of signs of osteoarthritis) characteristics for the analysis of changes in the TMJ.

Among the quantitative characteristics, the thickness and densitometry of the cortical plates of the elements of the TMJ, the angle of the mandible, the coronal process; the size of the heads of the mandible, the articular gap; the angle between the long axis of the right and left heads and the mid-sagittal plane were noted [55]. A.Ya. Vyazmin et al., examining the TMJ in pain dysfunction syndrome, showed the presence of morphological changes on CBCT, which were expressed by a decrease in the relative optical density of the bone tissue of the mandibular head as a result of a decrease in its functional load. At the same time, they showed an increase in the relative optical density in the area of the articular tubercle and the cortical bone of the anteroposterior part of the mandibular head, which indicated calcification of fibrous cartilage [56]. Currently, the issue of the relationship between the position of the mandibular head and TMJ dysfunction remains debatable. Thus, M. Paknahad et al. when performing TMJ CT in patients with TMJ dysfunction and in healthy individuals, no statistically significant differences were found in relation to the position of the mandibular heads [58]. E.N. Zhulev et al. Using CBCT, correlations between the position of the mandibular head in the joint and the type of bite were evaluated in patients with musculoskeletal TMJ dysfunction. The highest frequency of distal displacement of the mandibular heads in patients with TMJ dysfunction was detected with distal or deep bites [59]. Unlike CBCT, the method of multispiral computed tomography (MSCT) makes it possible to obtain simultaneous images of both elements of the temporomandibular joint and masticatory muscles on both sides; quantitative information about the size of bone and soft tissues of the TMJ [60-62]. K.Yu. Zadilskoy et al. MSCT has been successfully applied in assessing the location of the TMJ articular disc [63]. However, there is information in the literature about the insufficient "distinguishability" of soft tissue structures of the TMJ when using CT

[64]. The generally recognized "gold standard" in the diagnosis of pathological changes in the TMJ is magnetic resonance imaging [65, 66]. The validity and effectiveness of MRI in the diagnosis of TMJ dysfunction have been confirmed in in-depth studies of domestic and foreign authors [67, 68].

The main tasks of the radiation diagnosis of TMJ disorders, according to A. P. Dergileva et al., are visualization of the disc, determination of its shape and position relative to the head of the mandible and articular tubercle in different phases of movement, identification of violations of the bilaminar zone and the integrity of the posterior intra-articular ligaments. Taking into account the fact that the anterior displacement of the articular disc is the most common in TMJ dysfunction, the authors used MRI with the synthesis of tomograms in the oblique planes. Dystrophic changes of the articular disc on MRI were visualized as microparticles of a moderately hyperintensive signal on T1-weighted images; pathological changes in the bilaminar zone — in the form of heterogeneity of its structure, decrease or increase in volume [69]. In the works of A.V. Butova [70] and V. Stelzenmuller [71] reflects the possibilities of MRI to visualize the masticatory muscles throughout with the determination of their morphological changes. In particular, in patients with clinical manifestations of musculoarticular dysfunction in the structure of the pterygoid and masticatory muscles proper, areas with a hypointensive signal were identified on the T1-weighted image. Ya. L. Manakova et al. noted the possibility on MR-tomograms to assess the shape, size of the mandibular head, its position in the mandibular fossa of the temporal bone, the structure of the spongy substance and the thickness of the cortical layer [72]. Conclusions the review of literature sources on the problem of diagnosis of TMJ dysfunction has shown a scientifically-based range of diagnostic capabilities of modern dentistry, a trend towards the development of highly informative digital technologies for diagnostic purposes. Due to the variety of etiopathogenetic mechanisms of the development of this disease, the prospect for further in-depth study of this issue is justified.

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