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Comprehensive Treatment of Patients with Dislocation of the Articular Disc of the Temporomandibular Joint with Different Types of Occlusal Splints

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Abstract--- *The paper presents the results of treatment of patients with disc dislocation of the temporomandibular joint (TMJ) by using occlusion splints. At the initial stage, distraction splints were used, and at the second stage, when signs of reposition appeared, the distraction splints were modified to uncoupling splints by means of an increase in the number and area of occlusal contacts. In the manufacture of splints, two techniques were used: first (classical) method when the gypsum splint model was formed using the mechanical face articulator; second, CAD/CAM technology. At the preliminary stage of treatment, all patients were diagnosed using the optical axiograph. The results of axiography were used for manufacturing of distraction splints. Axiography was also carried out every three weeks at all the treatment stages. An algorithm of treatment was developed, which implies the treatment of patients with internal TMJ disorders caused by articular disc dislocation is based on the of results of the optical axiography. Treatment monitoring and correction of occlusal splints are also carried out using optical axiography. In patients with articular disc dislocation, it is advisable to use distraction splints with their subsequent upgrade to uncoupling splints after signs of reposition occur. The main purpose of using uncoupling splints at the second stage of treatment of the patients with dislocation of the articular disc is the stabilization of the new position of the lower jaw to expand the joint space. The study has not revealed differences in the effectiveness of treatment with distraction splints manufactured by various methods. In the absence of positive dynamics, a combination of conservative (uncoupling splints) and surgical (intra-articular injections, arthroscopy) treatment is recommended.*

Keywords--- *Internal TMJ Disorders, Magnetic Resonance Tomography, Axiography, Mechanical Face Articulator, Virtual Articulator.*

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I. INTRODUCTION

Disorders of the lower jaw articulation associated with dysfunction of the temporomandibular joint (TMJ) are a common pathology in dental practice [1; 2]. One of the main reasons for the development of dislocations is internal TMJ disorders [3; 4], which include various types of clinical and morphological changes in the joint, among which the most common pathology is dislocation and subluxation of the joint disk [5].

With dislocation or subluxation, the articular disk is in an inappropriate position relative to the mandible head, being located in front of it [6].

The selected therapy at the initial stage of treatment of internal TMJ disorders is the use of occlusal splints [7; 8; 9]. In case of pain, additional drug therapy is carried out [10; 11].

Most often, with the conservative treatment of internal TMJ disorders, the following occlusal splints are used: uncoupling; protrusive; distraction; myorelaxing; stabilizing [12; 13].

There are certain difficulties in determining the type of the most effective occlusal splints during conservative treatment of internal TMJ disorders. However, there is no consensus on the tactics of treatment and the choice of one or another type of occlusal splint in patients with this joint pathology. The present study is focused on the effectiveness of the comprehensive treatment of dislocation of the TMJ articular joint using various types of occlusal splints. The paper proposes the use of optical axiography to monitor the treatment and objectively evaluate its results.

The purpose of the present work is to evaluate the possibilities and effectiveness of the comprehensive treatment with distraction and uncoupling occlusal splints in patients with dislocation of the articular disc using different manufacturing techniques, the classical method and the milling method.

II. MATERIALS AND METHODS

50 patients with internal TMJ disorders caused by dislocation of the articular disc were examined, of which 41 were women and 9 were men. The age of patients ranged from 23 to 39 years. All patients complained of pain in the TMJ area and of difficulty in opening the mouth. During a clinical examination, articular murmurs were absent during palpation and movements of the lower jaw; a decrease in the amplitude of mouth opening was determined in 46 patients.

All patients underwent examination with the following additional instrumental methods: axiography, ultrasound, MRI, CBCT. Based on the data obtained during additional research methods, all patients were diagnosed with articular disc dislocation.

Analysis and registration of articular and incisive trajectories during movements of the lower jaw were performed for all patients using an optical axiograph Dentograf, Prosystom (Fig. 1). Axiograms of all patients during functional tests ("opening and closing the mouth", "forward movement" and "lateral left and right movements of the lower jaw") revealed pathological articular and incisive trajectories and signs characteristic of ventral dislocation of the articular disk without reposition.

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Figure 1: Dentograf (Prosystom) Optical Axiograph.

At the first stage of treatment, all patients with the dislocation of the articular disc were provided with distraction splints in order to expand the joint gap and create the necessary space to return the joint disk to its physiological position above the articular head of the lower jaw at rest and when opening the mouth.

In 26 patients, distraction splints were modeled using Artex CR (Girrbach) mechanical articulator, and in 24 patients, they were modeled by the milling method using an Imes icore 350 milling machine. The mechanical and virtual articulators in which the distraction splints were modeled were adjusted according to individual parameters based on optical axiography data.

In the first group, in all 26 patients (52.0%), distraction splints were modeled using a mechanical articulator (Fig. 2). After removing the two-layer silicone impressions, gypsum models were made using a mechanical facial arc. The articulator (articular mechanisms and a programmable table) was adjusted according to individual data obtained during optical axiography, as well as, in the case of using a virtual articulator, according to CBCT data using a special CT module.

Fig. 2: Mechanical Articulator

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For 24 patients (48.0%) of the second group, distraction splints were modeled in a virtual articulator (Fig. 3). After removing the two-layer silicone impressions and casting the gypsum models, a scan was made. Using a special CT module, taking into account the processed CBCT data, the models were placed in the space of the virtual articulator, which made it possible to reproduce in the software environment in three-dimensional space the position of the virtual dentition relative to the mandibular axis and the incisor stop [14]. After that, the values of the angles of movement of the lower jaw (Bennett angles), the articular path, immediate lateral shift, protrusion, retrusion and lateral movements (laterotrusion) of the lower jaw, which were determined on the basis of optical axiography, were entered into the program for each patient.

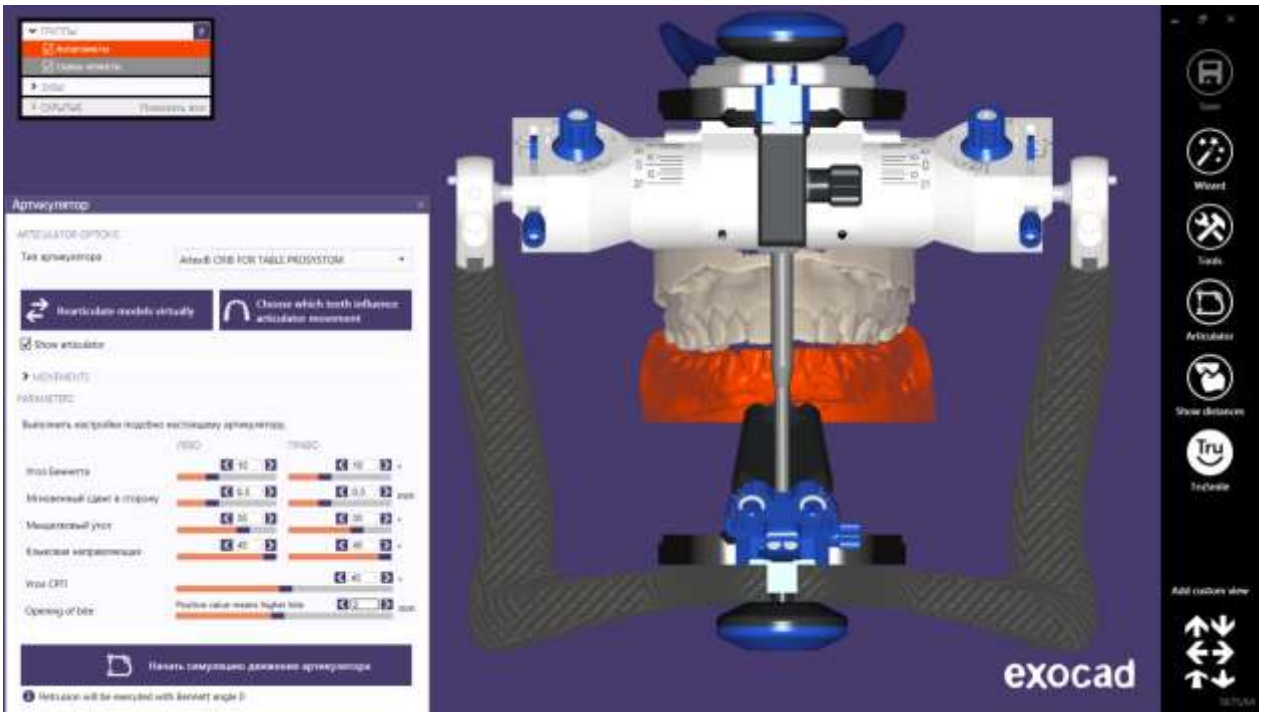

Figure 3: Virtual Articulator

The next axiographic studies were performed every three weeks to assess changes in the articulation of the lower jaw and possible movements of the articular disc. If necessary, the thickness of the occlusal splint was adjusted; in case of appearance of axiographic signs of repositioning of the articular disk with a click, the distraction splint was adjusted, and in case of complete reposition of the articular disks, the second stage of treatment was started: the distraction splint was remodeled into the uncoupling (positioning) splint.

III. RESEARCH RESULTS

In the surveyed group of 50 patients, the distribution by gender was as follows: 41 women (82.0%) and 9 men (18.0%); the ratio by gender (women: men) was 4.6: 1. The age of patients is from 23 to 39 years, the average age is 31 years. The main complaints were pain and discomfort in the TMJ area during movements of the lower jaw (opening and closing of the mouth, pushing the lower jaw forward and its lateral movements), detected in all

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patients, and headaches - 24 people (40.0%); difficulties in mouth opening of varying severity was noted in all patients, and a decrease in the amplitude of mouth opening to 2.0-3.5 cm was noted in 46 patients (92.0%).

According to the results of ultrasound, MRI, CBCT, all patients showed signs of dislocation of the articular disc.

Axiograms in all patients showed a shortening of the articular and incisive trajectories on the side where there was a displacement of the articular disc. The characteristic signs of changes in the trajectories of motion of the articular heads during dislocation of the articular discs were the following: when the mouth was opened, the articular trajectory was not concave, as when the TMJ was normal; the pathological trajectory was flattened, with many small deviations. The movements of the mandible heads in most cases were not synchronous. With a unilateral dislocation of the articular disk, the movement, as a rule, began from the affected joint; in addition to shortening and flattening of the articular trajectory, there was a shift in the lower jaw towards the affected area when opening the mouth and protrusion.

At the first stage of treatment, distraction occlusal splints were made for all patients (Fig. 4). When modeling distraction splints, contacts were formed only in the area of the last molars that the splint covers; all other teeth were in a state of disocclusion. In the area of contact with the teeth, deep contacts were formed on the splint in order to keep the lower jaw closed.

Fig. 4: Distraction Occlusal Splint

Axiographic control was performed every 3 weeks for patients of both subgroups to assess the effectiveness of treatment with distraction splints (Fig. 5,6). The identification of reposition (click) of a dislocated articular disc on axiograms in the form of zigzag distortions was considered a sign of the effectiveness of using distraction splints. In the absence of positive dynamics on axiograms, the thickness of the distraction splint was changed until a stable disocclusion position was reached.

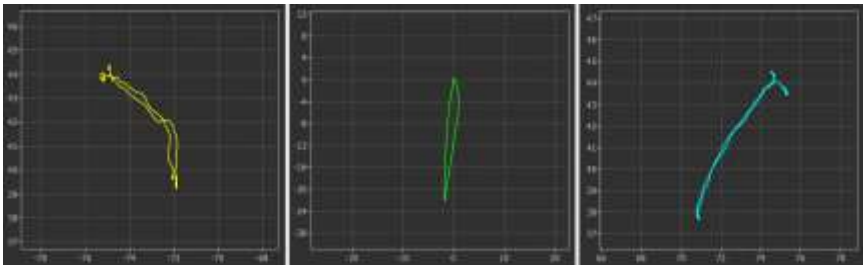

Fig. 5: Bilateral Ventral Dislocation of the Articular Disc without Reposition (Axiogram before Treatment with a Distraction Splint)

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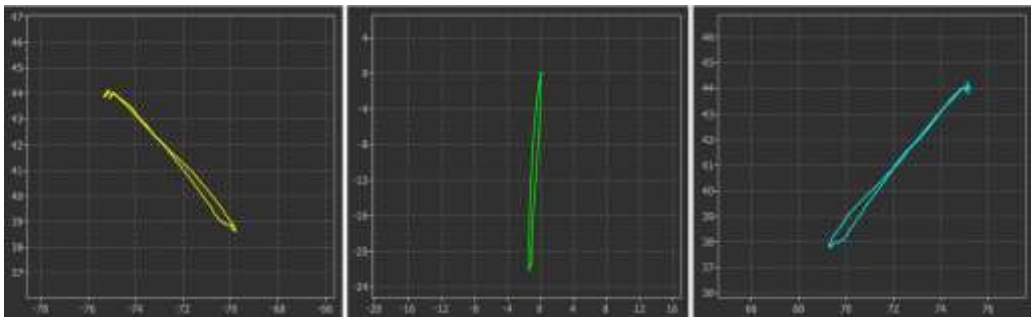

Fig. 6: Reposition of a Dislocated Articular Disc During Treatment with a Distraction Splint (Axiogram During Treatment)

Another objective sign of reposition was the data of ultrasound studies, which showed the expansion and normalization of the shape of the articular disc (Fig 7. A, B, 8 A, B).

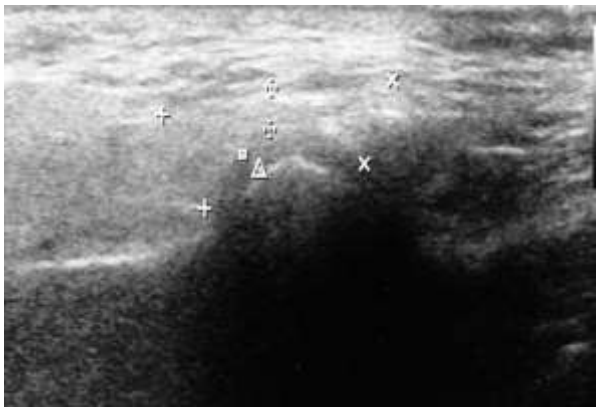

Fig. 7A: Ultrasound Image of the Articular Disc Before Treatment; the Boundaries of the Disc are Indicated by Dots

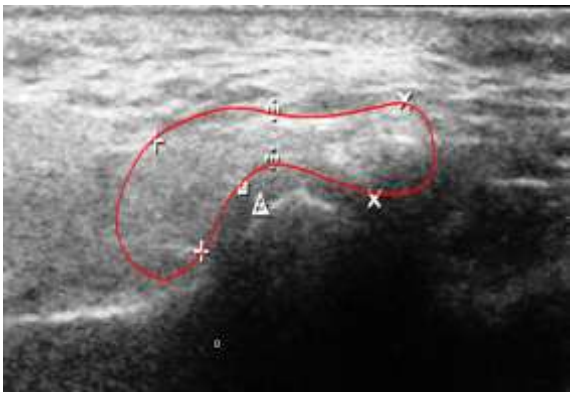

Fig. 7B: Ultrasound Image of the Articular Disc before Treatment; the Boundaries of the Disc are Indicated by Dots and Contours

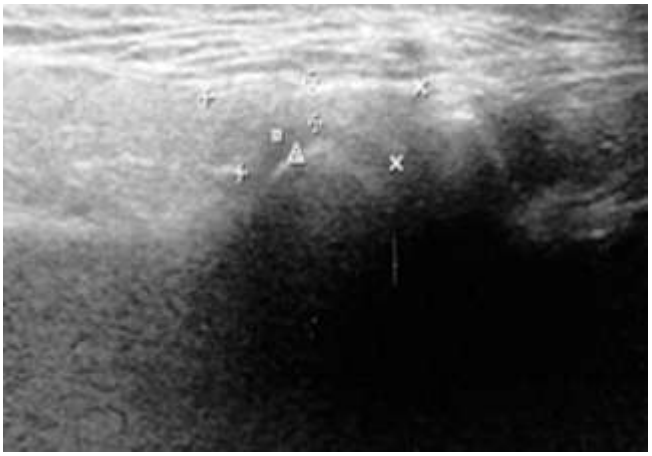

Fig. 8A: Ultrasound Image of the Articular Disc before Treatment with Distraction Splints; the Boundaries of the Disc are Indicated by Dots

Fig. 8B: Ultrasound Image of the Articular Disc after Treatment with Distraction Splints; the Boundaries of the Disc are Indicated by Dots and Contours

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Reposition (signs of a click on axiograms) during treatment by distraction splints was determined in 29 patients out of 50 (58.0%). Reposition during therapy with distraction splints modeled in a mechanical articulator was diagnosed in 15 of 26 patients of the first group (57.7%) and 14 of 24 patients of the second group who used splints modeled in a virtual articulator (58.3%) Adjustment of distraction splints was performed in 8 patients (30.8%) of the first group and in 7 patients (29.2%) of the second group. An indication of the need for the occlusal adjustment of the distraction splint, namely its growth (increase in height), was a decrease in the height of the disocclusion in the front sections of the splint or the appearance of new balancing occlusal contacts in the position of the closed dentition during the patient's use of the splint, revealed during the next axiographic study (3 weeks later).

At the second stage of treatment, 29 patients who, during the treatment with distraction splints, had a reposition of the TMJ articular disc, the splints used in the first stage were remodeled into disconnecting (positioning) splints with tight contacts. In a dynamic axiographic study, a positive treatment result — restoration of the physiological position of the TMJ articular disc — was detected in 21 out of 29 patients (72.4%).

IV. DISCUSSION

The emergence of modern highly informative diagnostic methods (magnetic resonance imaging, ultrasound, axiography) makes it possible to identify various TMJ disorders at an early stage of their development [15; 16; 17]. At the initial stages, an effective and affordable method of conservative treatment of internal TMJ disorders is the use of various types of occlusal splints [18; 19]. Occlusion therapy comprehensively affects all TMJ structures, as well as chewing muscles and teeth [20; 21]. Currently, there are more than 40 types of splints that differ in the mechanism of action, localization, and the material from which they are made [22; 23]. Since internal TMJ disorders are not a single pathology, it is important to develop objective criteria for choosing the most suitable occlusal splint for effective conservative therapy.

In patients with dislocation of the articular disc at the first stage of treatment, distraction occlusal splints were used within the current study. The effectiveness of conservative treatment was evaluated on the basis of the analysis of articular and incisive trajectories during movement of the lower jaw according to axiography data. Distraction splints were modeled in two types of articulators - mechanical and virtual, followed by a comparative analysis of the treatment results to determine the most effective splint manufacturing technique.

The purpose of the application of distraction splints was to expand the joint gap, its front and upper sections, by moving the joint down.

With the expansion of the TMJ cavity, the articular disc, that is impaired between the mandible head and the articular fossa of the temporal bone, is released and its mobility is restored. On axiograms, the appearance of active disk movements was determined in the form of characteristic axiographic signs of a click - zigzag distortions of the articular trajectory.

In the present study, the efficiency of the use of distraction splints did not depend on the method of their manufacture and was achieved in 58% of cases, which is explained by the presence of severe pathology in patients in the form of dislocation of the joint disk with a change in the function of all intra-articular structures and chewing

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muscles, in particular the external pterygoid muscle. Of great importance in assessing the effectiveness of treatment and determining further treatment tactics was the conduct of a dynamic axiographic study. In 30% of cases, after a preliminary analysis of articular trajectories using optical axiography, adjustment of distraction splints was performed. Moreover, in the subgroup where the splints were made using a virtual articulator, the percentage of occlusal splints adjustment was slightly lower than in the group with a mechanical articulator (22.2% and 30.8%, respectively). The optimal algorithm for repeated axiographic examination is every three weeks.

In the present study, no significant differences were found in the efficiency of distraction splints manufactured using a virtual articulator and splints modeled in a mechanical articulator.

This can be explained by the fact that special guides for the lower jaw are not modeled on the distraction splint, since this splint is made to shift it down to expand the narrowed joint gap. Also of great importance is the fact that in each case we used an optical axiograph, which made it possible to record individual features of the articulation of the lower jaw (Bennett angle, incisal angle). The data obtained were used to configure both mechanical and virtual articulators, therefore, regardless of the manufacturing method, the same information was used in the occlusal splint.

Given that the modeling of splints using a mechanical articulator is technically simpler and more affordable than using a virtual one, it is advisable for patients with dislocation of the articular disc to model distraction splints in a mechanical articulator.

The second stage of treatment was carried out for patients with positive results of treatment with distraction splints in the form of a reposition in the TMJ articular disc. at this stage, the previously used splints were remodeled into disconnecting (positioning) splints by increasing the number of occlusal contacts and their area. Uncoupling splints were used to consolidate the effect obtained at the first stage, and, subsequently, to move the articular disc to its usual physiological position. At the second stage, the effectiveness of treatment with uncoupling splints was 72.4% (21 out of 29 patients).

In the absence of the effect of the use of distraction splints (according to axiography), surgical treatment in the form of intra-articular injections or arthroscopy is prescribed [24; 25]. It should be noted that the combined use of occlusal splints and surgical intervention (hydraulic pressing method, arthroscopy) increases the effectiveness of treatment [26; 27].

Thus, for the treatment of dislocation of the articular disc, the following algorithm of complex therapy with occlusal splints is proposed:

- Initial examination and repeated dynamic axiographic examination to monitor and evaluate the effectiveness of therapy every three weeks
- At the first stage, treatment with distraction splints made in a mechanical articulator is performed
- Appearance of signs of repositioning of the TMJ joint disk according to axiography should be considered a positive result of treatment with distraction splints

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- Patients with the successful use of distraction splints are treated with the second stage of treatment with uncoupling splints to stabilize the new position of the lower jaw and restore the physiological position of the articular disc.
- In the absence of a positive effect of distraction splint therapy, surgical treatment is indicated (intra-articular injection, arthroscopy)

V. CONCLUSIONS

At the first stage of treatment, distraction splints are prescribed for patients with articular disc dislocation. The efficiency of treatment with distraction splints is 58%, which is due to the presence of severe pathology in patients. The method of manufacturing distraction splints (classical and CAD / CAM methods) does not affect the results of therapy. At the second stage of treatment, it is advisable to use uncoupling splints to stabilize the new position of the lower jaw and return the articular disc to its physiological position. The efficiency of uncoupling splints is 72.4%. Treatment monitoring at all stages and adjustment of distraction splints should be carried out on the basis of axiographic data every three weeks.

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