

# Study of the Clinical Efficiency of an Interdisciplinary Approach to the Treatment of Orofacial Pain and Temporomandibular Joint Disorders in Patients with Complete or Partial Edentulism

Fatima Dzalaeva<sup>1</sup> Sergey Chikunov<sup>1,2</sup> Marina Bykova<sup>2</sup> Mikhail Deev<sup>2</sup> Mariami Okromelidze<sup>1</sup>

<sup>1</sup>Department of Prosthodontics, First Moscow State Medical University, Moscow, Russian Federation

<sup>2</sup>Department of Prosthodontics, Peoples' Friendship University of Russia (RUDN University), Moscow, Russian Federation

**Address for correspondence** Fatima Dzalaeva, PhD, Department of Prosthodontics, First Moscow State Medical University, Bol'shaya Pirogovskaya Street, 19c1, Moscow, 119146, Russian Federation (e-mail: dzalaevafati@rambler.ru).

Eur J Dent:2020;14:657–664

## Abstract

**Objective** The aim of this study is to improve the safety and efficiency of prosthodontic treatment of patients with dental defects. It is necessary to perform a comprehensive assessment of the dentofacial system disorders, including the analysis of the features of pain manifestations. This study also supports to improve the efficiency of prosthodontic rehabilitation of patients with complete dental reconstruction on the basis of an assessment of the severity of orofacial pain manifestations.

**Materials and Methods** The study was a single-site prospective open nonrandomized study with the examination and treatment of 452 patients (age =  $44.3 \pm 15.2$  years, including 282 men and 170 women) with partial or total edentulism. The patients were divided into two groups: group 1 (control) of 218 patients treated with a standard prosthodontic approach and group 2 (study) of 234 patients treated which the proposed interdisciplinary approach to prosthodontic rehabilitation.

**Results** The study establishes higher safety and clinical efficiency of the proposed interdisciplinary approach. The patients undergoing full-mouth reconstruction with the use of the interdisciplinary approach demonstrated statistically significant decrease in the rate of pain in muscles of the maxillofacial area on palpation, pain, and spasms in the neck area, statistically significantly less frequent pains in the temporomandibular joint (TMJ) during chewing, pain during opening and closing the mouth.

**Conclusion** The application of the developed comprehensive approach to prosthodontic rehabilitation planning makes it possible to improve essentially the results of treatment at the expense of reduction of pain manifestations in the area of maxillofacial muscles and pain sensations associated with functioning of the TMJ.

## Keywords

- ▶ prosthodontic treatment
- ▶ maxillofacial muscles
- ▶ orofacial pain
- ▶ temporomandibular joint
- ▶ clinical efficiency

## Introduction

In recent decades, there have been increasing reports of about the necessity to assess such pathologic features as orofacial pain, temporomandibular joint (TMJ) dysfunction and

occlusion changes when examining patients with edentulism in need of dental treatment and prosthodontic rehabilitation. The role of TMJ dysfunction in the development of occlusion disorders has been shown. It is very important to take into account these pathological manifestations when planning



treatment and rehabilitation measures in this category of patients. According to the data of different authors, 27 to 76% of dental patients complain about dysfunction and pains in the TMJ area.<sup>1,2</sup>

Orofacial pain is defined as “pain localized to the region above the neck in front of the ears and below the orbitomeatal line, as well as pain within the oral cavity, including pain of dental origin and TMJP.”<sup>3,4</sup> In turn, TMJP is defined as “conditions that contribute to the incomplete or impaired function of the temporomandibular disorders and/or muscles of mastication.” The occlusion is defined as “statistical relationship between the incisal and/or masticatory surfaces of teeth of the upper and lower jaw.”<sup>1</sup>

The types of edentulism, anatomical, and functional features of the dental system that occur after the loss of teeth, determine the choice and use of methods of treatment and rehabilitation practices with the use of dentures of various shapes, sizes, and design. According to the analysis of literature data, the efficiency of treatment is determined not so much by the type and brand of products used, but by a differentiated approach involving a rational selection of the dentures' design, their proper manufacture, and fixation.<sup>2</sup> At the same time, regardless of the purpose of treatment, specialists should minimize the impact of the installed dentures on the condition of the central nervous system (CNS) of the patients. Such influences can be caused, in particular, by violations of occlusal relations contributing to the manifestations of orofacial pain and temporomandibular disorders.<sup>3,5</sup> However, there are very few works in the available literature investigating different aspects of these pathological manifestations, peculiarities of their diagnostics, and treatment.

Acute and chronic manifestations of orofacial pain syndrome are divided into the three main categories: somatic, neurogenic, and psychogenic.<sup>6-8</sup> Acute pain in the maxillofacial area is often manifested, for example, in conditions such as aphthous ulcers and pulpitis and is relatively easy to relieve. At the same time, chronic pain tends to be refractory, which makes it difficult to treat the manifestations of this syndrome. Somatic pain (in the soft or hard tissue area) is usually characterized as dull, painful, pulsating, and thermally sensitive.

Neuropathic pain (often resulting from nerve damage) is described as burning or stabbing pain. Psychogenic pain (especially somatoform pain) is not caused by any somatic pathology but is usually associated with emotional disorders, mood changes, and cognitive impairment. Patients with maxillofacial disorder often show two or three of the above major types of orofacial pain.<sup>9</sup>

Neuroplasticity of human CNS contributes to its sensitization, strengthening, or weakening of regulatory effects, which in particular may take place through the activation of glial cells.<sup>10,11</sup> Nociceptive signals can be transmitted to the CNS from tooth pulp (cracked tooth syndrome, odontoblast excitation, and pulp pathology), which is an example of central neuroplastic disorders with associated physiological and clinical presentation.<sup>8,11</sup>

To date, a large number of different pathological reciprocal influences and pathogenetic mechanisms in the CNS caused by nociceptive impact from the head and neck area has been described, which causes rather often observed incorrect interpretations of clinical presentations of the pathology by medical practitioners and erroneous diagnoses when treating patients with edentulism.<sup>12</sup> Therefore, it is necessary for dentists to have a clear understanding of the pathogenesis of orofacial pain, disorders in the TMJ, and the need to look at the whole maxillofacial area during dental and prosthodontic treatment. It seems optimal to use a multidisciplinary approach for treatment of these manifestations.

The multifactorial approach determines the planning of prosthodontic rehabilitation. As part of comprehensive interdisciplinary approach to diagnostics, it is necessary to use diagnostic techniques with the corresponding evidence base to verify the prevalence of neuromuscular or occlusive and articular pain syndromes as well as to evaluate their systemic influence on the biomechanics of the musculoskeletal system.

As of today, several conservative methods of pain syndrome treatment in combination with correction of anatomical disorders and dysfunction of the TMJ are proposed. Treatments actively used in clinical practice include selective grinding, acupuncture, therapeutic gymnastics, autogenic training, and physiotherapeutic procedures.<sup>2,13,14</sup> Together with other specialists, patients are prescribed medication therapy such as analgesics, sedatives, antidepressants, and myorelaxants. In addition to reduction of pain, the use of these drugs helps to reduce emotional discomfort and the severity of spasm of the masticatory muscles.<sup>15-17</sup> Application of such approach determines the necessity to apply methods of functional and imaging diagnostics, making it possible to perform quantitative and qualitative analysis of systems involved in the pathological process and develop a system of treatment and rehabilitation with subsequent quantitative and qualitative analysis of its effectiveness.<sup>4,18</sup>

Thus, the problem of improving the results of rehabilitation of patients with various types of occlusion problems becomes highly relevant. At the same time, function of the masticatory system is an essential component of proper quality of human life. This problem poses a challenge that requires an interdisciplinary approach and a collaboration of doctors of different fields for the purpose of comprehensive assessment of the clinical situation, development of the best possible algorithm of diagnosis, and treatment. Nevertheless, existing publications on comprehensive study of this problem are poorly systematized.

The study objective is to improve the efficiency of prosthodontic rehabilitation in patients with complete dental reconstruction on the basis of an assessment of the severity of orofacial pain.

Working hypothesis: Application of the interdisciplinary approach to diagnostics and planning of prosthodontic rehabilitation makes it possible to improve the treatment results significantly due to reduction of pain in the area of muscles of the maxillofacial joint and the TMJ.

## Materials and Methods

### Study Design

In 2017 to 2019, a single-center open prospective nonrandomized study was conducted at the premises of the Department of prosthodontics of the Sechenov University, clinics of JSC "Medicine," clinics "ART ORAL Sergey Chikunov," involving examination, and treatment of 452 patients. The follow-up of the patients included in the study was maintained for 3 years, the studied indicators were assessed before the prosthodontic treatment, as well as 1 and 3 years after it.

### Study Subjects

The study enrolled 452 patients with the mean age of  $44.3 \pm 15.2$  years, including 282 males and 170 females. The criteria for inclusion in the study were as follows:

- Patient age from 20 to 75 years
- Partial or total edentulism
- Presence of signs of increased teeth abrasion
- Occlusion problems after prior incorrect prosthodontic treatment
- Presence of the necessity of dental restoration due to functional and aesthetic indications

Exclusion criteria:

- Presence of severe somatic pathology or severe chronic diseases
- Lack of an informed consent for inclusion in the study signed by the patient
- Patients were randomized into two groups:
  - Group 1 (control): 218 patients treated with standard prosthodontic practices
  - Group 2 (study): 234 patients treated with the involvement of the proposed interdisciplinary approach to prosthodontic rehabilitation

### Methods of Patient Treatment and Rehabilitation

Both groups of patients were given prosthodontic treatment: the control group received conventional prosthodontic treatment based on the average anatomical parameters of the patient with the use of metal ceramic fixed dentures and without taking into account the individual characteristics of the patient, such as centric relation, therapeutic position, individual hinge and orbital axis, occlusal plane, inclination of the central incisors, and bite height.

It should be noted that there are no standard protocols of diagnostic, therapeutic, and rehabilitation measures in patients with edentulism and the need for full-mouth reconstruction.

We have developed a rehabilitation system based on an interdisciplinary approach, used in the course of treatment, and rehabilitation of patients of the study group (2). In the course of implementing this system, we take into account results of physical examination of patients to plan bite correction. These data were obtained using a set of diagnostic methods to assess the condition of various systems of the body (respiratory, central nervous, cardiovascular, and musculoskeletal).

The patients were treated using the following methods:

- Sprint therapy
- Mounting casts in an articulator
- Wax-up of teeth
- Installation of long-term temporary crowns
- Installation of implants
- Fabrication of the final restorations

The follow-up checking of the treatment results was performed with the use of methods of palpation of muscles of the maxillofacial area, condylography and cephalometry, analysis of models, brux checker tool, and occlusiography.

To ensure the stability of the dental range, the methods of selective grinding of dental hard tissues, temporary and permanent splinting, and ceramic restorations in a new therapeutic position were used. Acrylic crown dentures or bridgework were used for temporary restorations.

To implement the treatment plan with interdisciplinary approach, the anatomical and functional characteristics of the dental system were studied, with special attention paid to the assessment of manifestations of muscle pain syndrome, in particular, the severity of pain with palpation associated with the TMJ dysfunction.

Examination of the patients' anamnesis involved revealing and analysis of major errors in prior prosthetic dentistry in full-mouth reconstruction patients and specifying the causes of complications of prosthodontic treatment. Specialists in related fields (otorhinolaryngologist, neurologist, psychologist, speech therapist, and osteopathic physician, cosmetologist) are consulted.

Results of aesthetic, clinical functional, and instrumental analysis performed in the course of diagnostics using the methods of condylography and cephalometry make it possible to determine the centric relation when the models are mounted into the articulator. To achieve this, Gamma Dental software functionality is used to analyze the occlusion model. The interdisciplinary approach provides for taking into account and timely correcting functional and aesthetic disorders associated with an incorrect bite in patients undergoing full-mouth reconstruction.

In the study group of patients, treatment was performed with permanent ceramic restorations. Fabrication of the dentures was performed with the use of adjustable Gamma articulators, the advantages of which include casts mounting along a customized hinge axis, occlusal plane measurement, and  $\gamma$  rotation evaluation. At the same time, wax modeling with subsequent disconnection makes it possible to obtain high functional and aesthetic results of prosthodontic rehabilitation of patients in need of full-mouth reconstruction (► Fig. 1).

### Study Methods

► Table 1 lists the stages of prosthodontic rehabilitation of patients including diagnostics and full-mouth reconstruction on the basis of individual anatomical, functional, and clinical characteristics of the TMJ.

Clinical examination involved palpation of all groups of muscles of the maxillofacial area, head, and neck. Individual thresholds of pain sensitivity of each patient were taken



Fig. 1 Occlusion simulation using Gamma Dental software.

**Table 1** Stages of prosthodontic rehabilitation of patients in need of full-mouth reconstruction

Item no.	Rehabilitation stage	Methods of treatment and diagnostics
1.	Clinical functional analysis	Medical history Muscles palpation Brux checker Occlusiography Dental history Cast analysis
2.	Clinical instrumental analysis	Condylography Cephalometric Analysis Cast analysis for the centric relation CPM Variator $\geq$ mandibular position indicator
3.	Clinical investigations using imaging methods	Cone-beam computed tomography MRI of the TMJ Panoramic radiograph + CT of the maxilla and the mandible

Abbreviations: CPM, continuous passive motion; CT, computed tomography; MRI, magnetic resonance imaging; TMJ, temporomandibular joint.

into account during the palpation, with the force of pressure being varied as appropriate.

The patient was questioned about the presence of pain during chewing and opening the mouth. We also performed subjective assessment of joint pain in patients using a 10-point visual analog scale (VAS).

Orthopantomography and condylography methods were used to diagnose the state of the dental and mandibular system. The study of the TMJ condition was performed with the purpose of detection of painful joint dysfunction or other TMJ disorders caused by long-term presence of occlusal disorders and teeth alignment defects in the patient. In addition, the presence of pain when chewing was also assessed.

Assessment of the treatment results was performed during the examination of patients immediately after the comprehensive treatment in 1 and 3 years.

The results obtained with this method were analyzed by summing up qualitative and quantitative indicators, and the final assessment of “improvement,” “deterioration,” or “no change” was made by summing up the characteristics for the corresponding study period.

Statistical analysis: The analysis of the study results was performed using Statsoft software packages STATISTICA 10 and Microsoft Excel 2016. The selection of the main attributes and statistical criteria for their comparison was made after studying the distribution of each attribute and its comparison with a Gaussian distribution by using Kolmogorov–Smirnov’s test. Due to the fact that the total sample amount exceeded 200 subjects and the number of patients in each group exceeded 100, intergroup comparisons for quantitative indicators were made using the Student’s *t* test for unrelated samples. Qualitative parameters were presented in the form of attribute occurrence rates as percentages of the total number of patients in the respective groups. Chi-squared test was used to analyze differences in qualitative parameters. The differences were considered statistically

significant when the *p*-value was under the threshold value of statistical significance level of the null hypothesis ( $\alpha$ ) of 0.05.

### Results

Pain assessment during palpating *m. masseter superficialis* in patients included in the study demonstrated that all patients of both groups had pain prior to the commencement of treatment. After the end of treatment, the absolute majority of patients of the study group (98.3%) demonstrated an improvement in the form of a decrease of pain sensations. At the same time, the fraction of such patients was statistically significantly ( $p < 0.05$ ) lower in the control group, only 42.3% (►Table 2).

Follow-up examinations showed that after 1 and 3 years the above ratio remained: the decrease or absence of pain sensations in this muscle area was also observed in 97.4% of patients, while the absence of changes or deterioration was noted only in single cases.

The severity of pain with palpation of other muscles such as *m. masseter deep part*, *m. pterygoideus medialis*, and *lateralis* was at the similar level.

Pain in *m. temporalis medialis* experienced with palpation was also high in all patients in need of prosthodontic rehabilitation, while 97.9% of patients of the study group showed a decrease in the severity or absence of pain after the treatment (►Table 3). At the same time, pain on palpation were much more frequent in the control group, their reduction, that is, improvement was statistically significantly ( $p < 0.05$ ) less frequent and found only in 54.1% of patients. At the same time, in one third of patients of this group, no changes were registered, and in 13.8% of cases pain with palpation

**Table 2** Changes in pain on palpation of *m. masseter superficialis*

Condition	Group 1 (control) (n = 218)		Group 2 (study) (n = 234)	
	abs.	%	abs.	%
After the treatment				
Improvement	92	42.3	230	98.3 <sup>a</sup>
No change	86	29.5	4	1.7 <sup>a</sup>
Worsening	40	18.3		
After 1 year				
Improvement	90	41.3	228	97.4 <sup>a</sup>
No change	73	33.5	4	1.7 <sup>a</sup>
Worsening	55	25.2	2	0.9
After 3 years				
Improvement	40	18.3	228	97.4 <sup>a</sup>
No change	151	69.3	1	0.5 <sup>a</sup>
Worsening	27	12.4	5	2.1

Abbreviation: abs, absolute.

<sup>a</sup>The difference is statistically significant ( $p < 0.05$ ) relative to the corresponding indicator in group 1 using the Chi-square test.

increased while in group 2 (study), these manifestations were not observed. It should be noted that the changes of pain with palpation was similar for other muscles in this area: *m. masseter deep part*, *m. pterygoideus medialis*, *m. pterygoideus lateralis*, *m. temporalis anterior*, *m. temporalis posterior*, *m. mylohyoideus*, and *m. digastricus*.

Pretreatment pain when chewing was observed with a similar frequency in both groups, in 83.5 to 88.9% of patients (►Table 4). However, after 1 year, this sign was found in the control group in 77.1% of cases, while in the study group it was 8.6% ( $p < 0.0001$ ). After 3 years, 69.7% of the patients in Group 1 reported pains when chewing, while in Group 2 it was reported by only 7.7% of the patients ( $p < 0.001$ ).

Pretreatment pains when opening the mouth were found in more than half of patients in both groups, in 54.1 to 55.1% of patients (►Table 5). After 1 year, this sign was found in 45.0% of cases in the control group, while in the study group

**Table 3** Changes in pain on palpation of *m. temporalis medialis*

Condition	Group 1 (control) (n = 218)		Group 2 (study) (n = 234)	
	abs.	%	abs.	%
After the treatment				
Improvement	118	54.1	229	97.9 <sup>a</sup>
No change	70	32.1	5	2.1 <sup>a</sup>
Worsening	30	13.8		
After 1 year				
Improvement	121	55.5	320	98.7 <sup>a</sup>
No change	69	31.7	4	1.3 <sup>a</sup>
Worsening	28	12.8		
After 3 years				
Improvement	114	52.3	227	97.0 <sup>a</sup>
No change	72	33.0	7	3.0 <sup>a</sup>
Worsening	32	14.7	–	–

Abbreviation: abs, absolute.

<sup>a</sup>The difference is statistically significant ( $p < 0.05$ ) relative to the corresponding indicator in group 1 using the Chi-square test.

**Table 4** Pain during chewing

Condition	Group 1 (control) (n = 218)		Group 2 (study) (n = 234)	
	abs.	%	abs.	%
Prior to the treatment	182	83.5	208	88.9
After 1 year	168	77.1	20	8.6 <sup>a</sup>
After 3 years	165	69.7	18	7.7 <sup>a</sup>

Abbreviation: abs, absolute.

<sup>a</sup>The difference is statistically significant ( $p < 0.05$ ) relative to the corresponding indicator in group 1 using the Chi-square test.

**Table 5** Pain during opening the mouth

Condition	Group 1 (control) (n = 218)		Group 2 (study) (n = 234)	
	abs.	%	abs.	%
Prior to the treatment	118	54.1	129	55.1
After 1 year	98	45.0	17	7.3 <sup>a</sup>
After 3 years	82	37.6	15	6.4 <sup>a</sup>
After 5 years	79	36.2	14	6.0 <sup>a</sup>
After 7 years	70	32.1	12	5.1 <sup>a</sup>

Abbreviation: abs, absolute.

<sup>a</sup>The difference is statistically significant ( $p < 0.05$ ) relative to the corresponding indicator in group 1 using the Chi-square test.

the level of this indicator was statistically significantly lower, being 7.3% ( $p < 0.01$ ).

After 3 years, 37.6% of the patients in Group 1 reported having pain sensations when opening the mouth, while in Group 2 only 6.4% of the examined patients reported having pains ( $p < 0.05$ ).

Periodic neck pains and spasms were reported by patients with similar frequency in both groups, in 82.6 to 82.9% of cases (► **Table 6**). However, after 1 year, this sign was found in the control group in 77.5% of cases, while in the study group the level of this indicator decreased to 15.0% ( $p < 0.0001$ ). After 3 years, 71.6% of patients in Group 1 reported pain sensations in this area, while in Group 2 the level of this indicator was statistically significantly lower, being 8.6% ( $p < 0.001$ ).

It should be noted that a pronounced pain with palpation was found in postural muscles such as m. suprahyoideale, m. infrahyoideale, m. omohyoideus, and m. sternocleidomastoideus during the initial examination.

► **Table 7** shows the figures of pain assessment by patients. As it can be seen, VAS score levels prior to the treatment did not differ in the two study groups. After 1 year, there was a statistically significant decrease of this indicator in the study group and the value of VAS score was lower than in group 1 ( $p = 0.007$ ).

After 3 years, the severity of pain decreased in both groups of patients, and in patients who were exposed to our proposed multidisciplinary approach to prosthodontic rehabilitation, the level of this indicator was statistically significantly lower than in the group where standard rehabilitation methods were used ( $p = 0.012$ ).

## Discussion

The necessity of an interdisciplinary approach in prosthodontic rehabilitation requires, first and foremost, thorough and comprehensive examination of patients with orofacial pain.<sup>15,16</sup>

The disadvantages of the traditional method of management of patients in need of full-mouth reconstruction should include the use of average anatomical parameters of dentures without taking into account the patient's individual characteristics (centric relation, therapeutic position, individual hinge axis, occlusal plane, inclination of the central incisors, and occlusal dimension), lack of attention to the condition

**Table 6** Pains and spasms in the neck

Condition	Group 1 (control) (n = 218)		Group 2 (study) (n = 234)	
	abs.	%	abs.	%
Prior to the treatment	180	82.6	194	82.9
After 1 year	169	77.5	35	15.0 <sup>a</sup>
After 3 years	156	71.6	20	8.6 <sup>a</sup>

Abbreviation: abs, absolute.

<sup>a</sup>The difference is statistically significant ( $p < 0.05$ ) relative to the corresponding indicator in group 1 using the Chi-square test.

**Table 7** Changes in the 10-point visual analog scale assessment

Condition	Group 1 (control) (n = 218)	Group 2 (study) (n = 234)
Prior to the treatment	8.72 ± 0.45	8.54 ± 0.51
After 1 year	8.06 ± 0.32	5.84 ± 0.42 <sup>a</sup>
After 3 years	7.87 ± 0.28	4.25 ± 0.36 <sup>a</sup>

<sup>a</sup>The difference is statistically significant ( $p < 0.05$ ) relative to the corresponding indicator in group 1 using the Student's *t* test.

and evaluation of the severity of the TMJ dysfunction, and absence of diagnostics of muscles of the maxillofacial area and posture muscles.

In this connection, we proposed a new approach to the management of patients with edentulism in need of full-mouth reconstruction, which is based on the consideration of individual anatomical and physiological characteristics of the patient, providing for a thorough clinical examination using a wide range of methods, including palpation of the head and neck muscles, subjective assessment of pain, and the use of instrumental methods to assess the state of the TMJ, in particular, condylography and computed tomography.

It should be noted that in spite of the fact that currently used methods of X-ray diagnostics applied to establish the TMJ condition have good sensitivity, their specificity is relatively low with respect to long-term prognosis of development of the TMJ dysfunction.<sup>17</sup> TMD manifestations may be assessed via other techniques such as imaging test and laboratory methods (e.g., C-reactive protein test, interleukin-6 test, rheumatoid factor, and antinuclear antibody tests). It is also proposed to evaluate the quality of sleep obstructive sleep apnea using appropriate questionnaires.<sup>18</sup>

The results of the study, as well as the data presented in the works of other authors, confirm the necessity to assess local pain in the muscles by using myofascial trigger points and also assess the severity of central indirect myositis. It is necessary to provide a favorable environment for the dental treatment, taking into account the diagnosis and special features of therapeutic and rehabilitation actions (treatment of acute pain, elimination of aberrant nociceptive effects on the CNS that may be caused by changes in dental occlusion, the presence

of prosthodontic solid acrylic resins, special stents, and topical drugs). Complex orthodontic, prosthodontic, and restorative treatment should be considered as secondary to adequate treatment of the patient's discomfort and dysfunction of the maxillofacial system and the body as a whole.

Drug treatment, including the use of preventive analgesia methods, should be prescribed on the basis of consultations with all specialists.<sup>19</sup> In several studies, high effectiveness of magneto-laser therapy in the elimination of pain syndrome and normalization of the functional state of the masticatory muscles was demonstrated. Analgesic effect of laser radiation relieves the patients of emotional stress and anxiety, which also positively affects the treatment process.<sup>3,5</sup>

The TMJ dysfunction is positively influenced by prosthodontic and orthodontic treatment.<sup>15</sup> In several studies, the effectiveness of splint therapy combined with prosthodontic and physiotherapeutic methods in treatment of pain syndrome with occlusive disorders in the TMJ has been confirmed. It has been shown that occlusal splints change the character of teeth occlusion, influence the periodontium, masticatory muscles, and the TMJ.<sup>11</sup>

An important element of the comprehensive treatment of myofascial pain syndrome (MPS) is the methods of orthodontic treatment aimed at the elimination of bite disorders. Tecco et al.<sup>20</sup> made an attempt to analyze the features of MPS in the process of orthodontic treatment of patients. They analyzed the records of 91 Caucasian patients who were undergoing orthodontic treatment of various bite disorders.<sup>20</sup> MPS was initially diagnosed in 37 patients. Of these, orthodontic treatment was given to 30 patients (study group). After determining the class of correction and alignment of teeth, the manifestations of MPS were assessed. In seven patients comprising the control group, no MPS treatment was performed. At examination of patients of the study group after the treatment given, there was statistically significant decrease in the rate of the TMJ disorders (in particular, clicking). There was also a significant decrease in the severity of pain sensations in the area of the jaws, TMJ, facial muscles. At the same time, the authors noted a significant improvement in the quality of life of these patients.<sup>20</sup>

Several patients showed signs of depression at the beginning of the follow-up observation, followed by a decrease in the manifestation of these symptoms, with most patients reporting an improvement in their subjective assessment. A statistically significant decrease of pain during the palpation (when assessed using the VAS) found in the area of the temporal muscles, masticatory, and posterior cervical muscles. After the treatment, a significant decrease in the number of patients with pain in the area of temporal and masticatory muscles was observed in the study group. Similar changes were also found in patients with similar pain in the m. digastric and sternocleidomastoid muscles.<sup>20</sup>

Diseases and injuries of the TMJ are often combined with dental system and face deformities. At the same time, there is a link between this pathology and bite disorders and development of mandibular disorders. Over the recent years, specialists have increasingly come to the understanding that comprehensive dental, prosthodontic, and osteopathic treatment is the most effective when treating temporomandibular

disorders.<sup>21,22</sup> There is a category of patients in which other factors are also prove to be of great importance, in particular, the psychological factor. In such cases, the stability of positive effect after diagnostics and treatment is often rather low, and there is an increase in the rate of recurrence of orofacial pain and manifestations of the TMJ dysfunction.<sup>4,23,24</sup>

An increasing number of authors believe that introduction of diagnostics and treatment methods based on modern methodologies is important in the treatment of this category of patients.<sup>13,21</sup> This was confirmed by the results of our study, which have demonstrated that the application of the complex interdisciplinary approach to prosthodontic rehabilitation contributes to the fact that statistically significantly lower (relative to the control group) levels of severity of pain during palpation of muscles of the masticatory organs, pain during opening the mouth and chewing, as well as indicators of visual analogue scale of assessment of painful sensations are observed in full-mouth reconstruction patients 1 to 3 years after the treatment. These changes indicate that the rate of improvement of the TMJ dysfunction condition was higher in the study group in comparison with the corresponding rate for treatment using standard approaches to prosthodontic rehabilitation.

Management of patients with severe chronic pain syndrome with the TMJ and muscle dysfunction require participation of an orthodontist to correct bite disorder, as well as a neurologist to relieve local myofascial pain syndrome.<sup>25,26</sup>

We agree with the opinion of several authors that the combination of dental, prosthodontic, and osteopathic treatment is the most effective way to solve the problem of TMJ dysfunction. In some cases, psychodiagnostic methods have the highest priority.

Therefore, the relief of painful sensations and treatment of the TMJ disorders should be one of the key directions in rehabilitation of patients with full-mouth reconstruction. The key-point is a complete and consistent examination of full-mouth reconstruction patients. When solving the challenges faced by specialists in the course of planning the necessary therapeutic and rehabilitation measures, it is necessary—first and foremost—to assess myofascial pain, which requires palpation of all muscle groups of the maxillofacial area during the examination, as well as supplementing the traditional approach with diagnostics of several other disorders: sleep (snoring, bruxism, and apnea), aesthetic, and psychological problems. In the planning of prosthetic and prosthodontic treatment, it is necessary to establish cause-and-effect relationship of the above disorders with malocclusion and the TMJ pathology.

The introduction of the developed approach into clinical practice would result in significant reduction in the severity of functional disorders of various body systems after prosthodontic bite correction performed as part of an integrated approach to human diagnostics and treatment.

## Conclusion

In recent years, great achievements have been made in the development of dental prosthodontic treatment technologies, including treatment of orofacial pain, temporomandibular

disorders and malocclusion in the course orthodontic, prosthodontic, and restorative treatment. Interdisciplinary and multidisciplinary care has become a practical reality in the context of modern integrative health care.

The results of the study demonstrate high clinical efficiency of the interdisciplinary approach to prosthodontic rehabilitation of patients with full-mouth reconstruction. The accumulated data confirm the necessity to take into account the etiopathogenesis of pain in this category of patients, as well as their individual anatomical and physiological characteristics. To achieve this, it is necessary to carry out comprehensive diagnostics and further treatment with the involvement of specialists in various fields during the planning of therapeutic actions.

We make the following conclusions:

- Application of the proposed complex of prosthodontic rehabilitation measures contributes to the fact that patients with full-mouth reconstruction treated with the interdisciplinary approach demonstrated statistically significantly decrease in the rate of pain in muscles of the maxillofacial area on palpation (1.8–2.3 times), as well as pain and spasms in the neck area (5.2 times) as compared with the group where conventional rehabilitation was used.
- Patients treated with the interdisciplinary approach to diagnostics and prosthodontic rehabilitation have a more pronounced decrease in pain in the area of the temporomandibular; there is a statistically significant decrease in the rate of pains in the TMJ during chewing (eight to nine times), pains during opening and closing of the mouth (6.2 times), and significantly lower level of subjective assessment of pain on the VAS (1.4–1.9 times) than in the comparison group.
- The identified signs of improvement in the condition of the dental system are persistent and present 3 years after the set of treatment and rehabilitation actions.

#### Conflict of Interest

None declared.

#### References

- Ohrbach R, Dworkin SF. The evolution of TMD diagnosis: past, present, future. *J Dent Res* 2016;95(10):1093–1101
- Milosevic A. Abrasion: a common dental problem revisited. *Prim Dent J* 2017;6(1):32–36
- Yau HT, Yang TJ, Chen YC. Tooth model reconstruction based upon data fusion for orthodontic treatment simulation. *Comput Biol Med* 2014;48:8–16
- McSwiney TP, Collins JM, Bassi GS, Khan S. The interdisciplinary management of hypodontia patients in the UK: a national service evaluation. *Br Dent J* 2017;222(1):31–35
- Baad-Hansen L, Benoliel R. Neuropathic orofacial pain: facts and fiction. *Cephalgia* 2017;37(7):670–679
- Durham J, Raphael KG, Benoliel R, Ceusters W, Michelotti A, Ohrbach R. Perspectives on next steps in classification of oro-facial pain - part 2: role of psychosocial factors. *J Oral Rehabil* 2015;42(12):942–955
- Ghurye S, McMillan R. Orofacial pain - an update on diagnosis and management. *Br Dent J* 2017;223(9):639–647
- Merrill RL, Goodman D. Chronic orofacial pain and behavioral medicine. *Oral Maxillofac Surg Clin North Am* 2016;28(3):247–260
- Fishbain DA, Pulikal A, Lewis JE, Gao J. Chronic pain types differ in their reported prevalence of post-traumatic stress disorder (PTSD) and there is consistent evidence that chronic pain is associated with PTSD: an evidence based structured systematic review. *Pain Med* 2017;18(4):711–735
- Yu CY, Abbott PV. Responses of the pulp, periradicular and soft tissues following trauma to the permanent teeth. *Aust Dent J* 2016;61(1, Suppl 1):39–58
- Yumashev AV, Utyuzh AS, Volchkova IR, Mikhailova MV, Kristal EA. The influence of mesodiencephalic modulation on the course of postoperative period and osseointegration quality in case of intraosseous dental implantation. *Ind J Sci Tech* 2016;9:1–8
- Saeidi Pour R, Engler MLPD, Edelhoff D, Prandtner O, Frei S, Liebermann A. A patient-calibrated individual wax-up as an essential tool for planning and creating a patient-oriented treatment concept for pathological tooth wear. *Int J Esthet Dent* 2018;13(4):476–492
- de Barros Pascoal AL, de Freitas RFCP, da Silva LFG, Oliveira AGRC, Dos Santos Calderon P. Effectiveness of counseling on chronic pain management in patients with temporomandibular disorders. *J Oral Facial Pain Headache* 2020;34(1):77–82
- Hu JL, Dong Y. Research progress in occlusal splint therapy for disorders. *Zhonghua Kou Qiang Yi Xue Za Zhi* 2019;54(4):273–277
- Kretschmer WB, Baciut G, Baciut M, Sader R. Effect of bimaxillary orthognathic surgery on dysfunction of the temporomandibular joint: a retrospective study of 500 consecutive cases. *Br J Oral Maxillofac Surg* 2019;57(8):734–739
- Dolce MC, Aghazadeh-Sanai N, Mohammed S, Fulmer TT. Integrating oral health into the interdisciplinary health sciences curriculum. *Dent Clin North Am* 2014;58(4):829–843
- Bakke M, Petersson A, Wiesel M, Svanholt P, Sonnesen L. Bony deviations revealed by cone beam computed tomography of the temporomandibular joint in subjects without ongoing pain. *J Oral Facial Pain Headache* 2014;28(4):331–337
- Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y. High STOP-Bang score indicates a high probability of obstructive sleep apnoea. *Br J Anaesth* 2012;108(5):768–775
- Vadivelu N, Mitra S, Schermer E, Kodumudi V, Kaye AD, Urman RD. Preventive analgesia for postoperative pain control: a broader concept. *Local Reg Anesth* 2014;7:17–22
- Tecco S, Marzo G, Crincoli V, Di Bisceglie B, Tetè S, Festa F. The prognosis of myofascial pain syndrome (MPS) during a fixed orthodontic treatment. *Cranio* 2012;30(1):52–71
- Muñoz Lora VRM, Del Bel Cury AA, Jabbari B, Lacković Z. Botulinum toxin Type A in dental medicine. *J Dent Res* 2019;98(13):1450–1457
- Paço M, Chaves P, Pinho F, et al. Common symptoms of temporomandibular disorders do not mean same treatment plans: a case series. *Int Orthod* 2018;16(1):174–214
- Lai YC, Yap AU, Türp JC. Prevalence of temporomandibular disorders in patients seeking orthodontic treatment: a systematic review. *J Oral Rehabil* 2020;47(2):270–280
- Giacobbo LC, Guimarães LK, Fornazari IA, Meda EM, Tanaka OM. Achieving better function through combining orthodontics and restorative dentistry in the case of dental abrasions. *Case Rep Dent* 2019;2019:8137585
- Balaji SM. Bilateral pediatric mandibular distraction for micrognathia with temporomandibular joint ankylosis and sleep apnea. *Indian J Dent Res* 2017;28(5):588–591
- He H, Liu ZJ. [Risk of temporomandibular joint and its management in orthodontic treatment]. *Zhonghua Kou Qiang Yi Xue Za Zhi* 2019;54(12):808–814