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Assessing the Levels of Demands and Needs for Comprehensive Rehabilitation of Patients with Congenital and Acquired Maxillofacial Deformities

Ad.A Mamedov[1], A.M. Dybov[1], N.S. Morozova[1], V.V. Kharke[1], N.A. Byzov[2]
[1]I.M. Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russia
[2]Central Research Institute of Dentistry and Maxillofacial Surgery, Moscow, Russia
E-mail: ad.a.mamedov@yandex.ru
a.m.dybov@yandex.ru
natalia.morozova.76@list.ru
v.v.kharke@yandex.ru
n.a.byzov@yandex.ru

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ABSTRACT
The purpose of the research: to compare the levels of subjective demand and objective need of patients with congenital and acquired deformities of the maxillofacial area (CADMFA) in comprehensive pre- and post-treatment rehabilitation.
Materials and methods: We used the diagnostic findings of 39 CADMFA patients before and after they underwent a comprehensive rehabilitation. To assess the patients' objective need for treatment, the ICON index and the modified Helkimo index were used. To assess the patient's subjective demand for treatment, a modified Slavicek questionnaire and a numerical version of the visual analogue scale (VAS) were used. The average values of the pre- and post-treatment indicators, as well as the average values of the differences between them were calculated. A t-test was applied with a significance level of 0.05 for the pre- and post-treatment indicators to confirm the clinical efficacy of treatment. The Spearman correlation coefficient was calculated to establish the relationship between the results of various methods for assessing treatment demands and needs.
Results: The values of all the parameters used for assessing subjective demands and objective needs decreased after a comprehensive rehabilitation. The coefficient of correlation between the values of the modified Slavicek questionnaire and the Helkimo index was 0.73 and 0.51, before and after treatment, respectively.
Conclusion: Helkimo index and a modified Slavicek questionnaire can be used in clinical practice to compare the patients' real treatment need and demand.
Keywords: treatment need, treatment demand, maxillofacial deformities, comprehensive rehabilitation.
Correspondence:
N. S. Morozova
I.M. Sechenov First Moscow State Medical University, Sechenov University, Moscow, Russia
E-mail: Natalia.morozova.76@list.ru
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INTRODUCTION

The degree of satisfaction with the final result of treatment consists of the correlation between the subjective level of the patient's treatment demand, his objective treatment need, and the compliance rate. This aspect becomes especially relevant in complex clinical cases requiring an interdisciplinary approach to treatment. In light of the duration and complexity of approaches to the comprehensive rehabilitation of patients with congenital and acquired deformities of the maxillofacial area (CADMFA), the ratio of these factors is one of the defining features of its success.

Interdisciplinary rehabilitation of patients affects both functional and aesthetic parameters, thus solving the patient's main complaint is far from a trivial task. In this vein, the demand and the need for future treatment should be distinguished.

The individuals' treatment demand, as well as their expectations for the rehabilitation outcome, is often based on their personal ideas of their condition. According to previously published studies, their psycho-emotional state, socio-economic status, educational level and cultural peculiarities influence the formation of the patient's demands for the result of comprehensive rehabilitation [1]. The parameters listed above are individual in each particular case; thus, the same anomaly can be regarded as a serious problem by one patient and cause only some discomfort for another [2].

In turn, the treatment need is determined by the attending physician on the basis of the diagnostic findings. During the examination, the doctor compares the clinical picture with the anatomical and physiological norms, and also assesses the possible risks associated with the proposed rehabilitation plan.

Patient satisfaction with the treatment outcome depends not only on the achieved goals set by the doctor, but also on the dominant motivating factor of the patients and their own expectations from the rehabilitation [3]. Thus, a team of specialists should strike a balance between the subjective needs of patients and the real possibilities of comprehensive rehabilitation.

In the context of long-term treatment, the value of treatment in the patients' eyes decreases; they get used to the diagnosis and the idea of the impossibility of a full recovery [4]. If the patients' expectations do not correspond to the objective clinical picture, their level of compliance can rapidly decrease, which may lead to conflict situations and will inevitably affect the quality of the final result. Dissatisfaction with the treatment outcomes may also be associated with unrealistic representations of patients [5].

Thus, formulating an objective determination of the personality characteristics of CADMFA patients, their internal demands and expectations before starting treatment, in comparison with their objective need, is an urgent task. However, there are currently no clear protocols governing the methods for assessing these parameters, which leads to an underestimation of the patient's psychological state prior to the planned intervention.

In view of the fact that the proposed rehabilitation of CADMFA patients requires unconditional cooperation and an understanding of the objective limitations during complex bone-reconstructive interventions, the primary

task is to determine the true motivation of the patient at the initial consultation stage.

This research is aimed at conducting a comparative analysis of numerical indicators characterizing the subjective level of a CADMFA patient's treatment and his/her objective need for comprehensive rehabilitation at the time of treatment initiation and after its completion.

MATERIALS AND METHODS

The research was hosted by the orthodontic department of the Central Research Institute of Dental and Maxillofacial Surgery, Ministry of Health of the Russian Federation in accordance with the standards of Good Clinical Practice and the principles of the Helsinki Declaration. The research protocol was approved by the ethics committee of this institution.

For the purposes of the research, diagnostic findings of 39 CADMFA patients (19 women and 20 men aged 18 to 35 years) were randomly selected; the patients had completed a comprehensive rehabilitation course, which includes the following stages: orthodontic and orthopedic preparation for oral surgery, surgical osteo-reconstructive intervention, postoperative orthodontic management and the final orthopedic correction of the osteo-reconstructive intervention outcomes.

The values of the ICON index[6] and the modified Helkimo index[7] were analyzed before and after the comprehensive rehabilitation of CADMFA patients to objectively determine the dynamics of complex rehabilitation according to clinical examination data.

The ICON index questionnaire presented in Figure 1 can be conventionally divided into two parts: aesthetic and anatomical. The aesthetic component is based on the aesthetic scale of the IOTN index[8]. The dentist, together with the patient, determines the overall attractiveness of appearance from the ten photographs shown in Figure 2. The scale has values from 1 to 10, where "1" is the most attractive appearance, and "10" is the least attractive. Next, a certain indicator of the aesthetic component is multiplied by 7.

The anatomical components are described by the doctor during a clinical examination. Each component is assigned corresponding score depending on the nature of its manifestation, after which the indicators are multiplied by certain coefficients.

After the examination, the values of all components are summed up. The interpretation of ICON index values is shown in Figure 3.

The questionnaire for the modified Helkimo index is presented in Figure 4. This index reflects the functional state of the temporomandibular joint (TMJ) based on clinical examination data. The degree of manifestation of symptoms is characterized by the respective digital values "0", "1" and "5". After the examination, these values are summed up.

Subjective treatment demand was assessed using a modified Slavicek questionnaire [9] and a numerical version of the visual analogue scale (VAS) [10].

The modified Slavicek questionnaire is based on the list of parameters shown in Figure 5. The patient must evaluate each of them on a scale from 0 to 3. After that, the sum of the points received is calculated.

VAS is a horizontal line 10 cm long with the numbers from 0 to 10 on it, where "0" shows the absence of a treatment demand and "10" determines a vital need for rehabilitation. Demand to improve the overall aesthetics of the face and the subjective functionality of the dentition were evaluated separately according to the questionnaires presented in Figure 6.

The findings were analyzed to identify the interdependence between subjective demand and objective need from an aesthetic, occlusal, and functional points of view.

Statistical data processing was performed on the basis of the "R" software (version 3.6.0). For each method of assessing the objective necessity and subjective demand, average pre- and post-treatment values were calculated; the computation of average values of differences between them, and the corresponding standard deviation (SD) values was made as well. To confirm the clinical efficacy of treatment, Student's t-test was applied with a significance level of 0.05 for the values of the pre- and post-treatment indicators (Table 1). The difference between the pre- and post-treatment results for each assessment method was statistically significant (p-value <0.05). To determine the relationship between the results of various techniques of assessing subjective demand and objective need, Spearman's rank correlation coefficient was calculated (Table 2). The values of Spearman's correlation coefficient were interpreted according to Schober et al [11].

RESULTS

Our findings are presented in Tables 1 and 2. The individual functional demand on the VAS scale after treatment was significantly reduced by 3.54 ± 1.80 and made on average 1.59 ± 0.64. When determining the individual aesthetic demand on the VAS scale, it was found that the average pre-treatment indicator was 5.87 ± 0.89 points. After a comprehensive rehabilitation, the VAS scale aesthetic demand significantly decreased by 4.23 ± 1.13 and amounted to 1.64 ± 0.67.

At the same time, the rehabilitation need determined by the aesthetic component of the ICON index was 47.74 ± 10.64 prior to the treatment. At the end of the rehabilitation, the indicator decreased to 1.97 ± 3.19, that is, by 45.77 ± 9.75 points. The objective need index in terms of the occlusal component significantly decreased by 43.56 ± 7.15 points from 44.18 ± 6.89 to 0.62 ± 1.35. The aggregate ICON index of need, which averaged 91.92 ± 12.02 points prior to the treatment, decreased to 2.59 ± 3.26, that is, by 89.33 ± 10.96 points.

Moreover, after rehabilitation the index of the subjective functional state according to the Slavicek questionnaire was significantly reduced by 20.82 ± 6.31 points and averaged 4.41 ± 1.57 compared to the same indicator prior to the treatment, which was at the level of 25.23 ± 6.14. The Helkimo index also consistently decreased by 18.49 ± 7.84 points and amounted to 4.72 ± 1.89 after treatment.

The coefficient of correlation between the subjective aesthetic demand on the VAS scale and the objective aesthetic need according to ICON was 0.31, which indicates

a weak positive correlation between the demand and need for upcoming treatment in terms of the aesthetic criterion. At the same time the post-treatment value of this coefficient was 0.57, reflecting a moderate positive relationship between these two parameters.

In addition, the pre-treatment value of the coefficient of correlation between the subjective functional demand according to the VAS and the objective need according to the occlusal component of the ICON index was -0.04, and post-treatment value was -0.002, which indicates the actual absence of correlation.

The correlation between the level of individual functional demand according to the VAS and the subjective assessment of the TMJ functional state, according to the modified Slavicek questionnaire, was 0.40 prior to treatment. Whereas when comparing the examination results to those obtained after rehabilitation, the coefficient of correlation between these indicators was 0.43. This result may be indicative of the moderate positive relationship between these methods for describing a patient's subjective state.

At the same time, the coefficient of correlation between the occlusal component of the ICON index and the TMJ state, as determined by the modified Helkimo index, was -0.06 prior to the treatment and 0.002 after the treatment.

Along with the above, the pre-treatment coefficient of correlation between the data of the subjective assessment of the functional state of the dentition, determined by the modified Slavicek questionnaire, and the objective assessment by the Helkimo index was 0.73, which indicates a strong relationship between these parameters at the beginning of rehabilitation. After treatment, the correlation coefficient for these parameters decreased to 0.51, indicating an average degree of a positive relationship.

DISCUSSION

According to clinical examination methods, the comprehensive rehabilitation of CADMFA patients contributed to a persistent decrease in both the subjective demand and objective need according to aesthetic, occlusal and functional criteria of the TMJ condition.

The post-treatment decrease in individual functional and aesthetic demands according to the VAS indicates a positive subjective assessment of the patient's treatment outcomes.

According to the ICON index, the magnitude of benefit in the patient's condition was on average 81.56 ± 13.19 points, which corresponds to significant improvement. These data reliably confirm a decrease in the patient's overall need by the aesthetic-functional occlusal criterion.

Changes in the values of the Helkimo index and the modified Slavicek questionnaire indicate a persistent improvement in the functional state of TMJ by subjective and objective clinical criteria, which indicates a positive outcome of comprehensive rehabilitation in terms of the analyzed parameters.

A subjective assessment of the aesthetic demand in complex rehabilitation may depend on the psycho-emotional status of each individual patient, and on the level of his/her trust in the doctor conducting the clinical examination. The value of the coefficient of correlation between the subjective aesthetic demand on the VAS scale and objective aesthetic need in terms of the ICON aesthetic component by the time the treatment completion increases from mild to moderate, which is explained by an increase in the degree of cooperation between the patient and the doctor during the long-term rehabilitation.

Based on the above, it is advisable to conduct a pair assessment of the visual aesthetic self-esteem and IOTN index data before a comprehensive rehabilitation with the purpose of revealing the compliance with an individual demand and objective need according to an aesthetic criterion. However, in view of the weak interdependence between their values, these data can only be indicative and require a clear clarification of the qualitative component of the aesthetic complaint. In the event of a clear discrepancy, a more detailed clarification of the patient's prevailing complaint with possible consultation of a clinical psychologist is recommended.

An insignificant correlation between the subjective assessment of the functional demand according to the VAS and the ICON occlusal component, which characterize the functional state of the dentition both before and after the complex rehabilitation, may be associated with the patient's insufficient knowledge in this area and, accordingly, the inability to correctly interpret the clinical picture in the oral cavity.

The available positive correlation between the pre- and post-rehabilitation values of the functional demand according to the VAS and the modified Slavicek questionnaire, in our opinion, is conditioned by the fact that these parameters primarily reflect the patients' subjective perception of their condition. The average degree of correlation between these characteristics can be caused by a difference in the principles for assessing patient complaints. In most cases, by putting a mark on the VAS scale, the subjects try to express their ideas of dentition functioning; whereas while answering the questions of the modified Slavicek questionnaire the patients are more immersed in the analysis of specific functions of this system and are able to relate certain complaints with maxillofacial pathology.

A slight correlation between the pre- and post-treatment occlusal component of the ICON and the Helkimo indices, in our opinion, indicates the absence of a relationship between the severity of occlusion anomalies and the TMJ state.

Comparison of the Helkimo index and the modified Slavicek questionnaire in our patient sample showed a strong Spearman correlation prior to the rehabilitation start, and moderate correlation at the time of its completion, which indicates the potential use of this pair of characteristics in the complex rehabilitation of the CADMFA patients.

The correlation between the objective and subjective characteristics of the patient's condition is a relevant topic among publications in the specialized literature. Over the past three years, many studies have been published that are devoted to the analysis of the corresponding characteristics [12–15].

Nevertheless, most of these publications focus on the analysis of data obtained before the rehabilitation of patients. As part of our research, we took advantage of the

opportunity to assess the relationship between objective and subjective parameters of the patients' conditions both prior to the rehabilitation and at the time of its completion.

CONCLUSION

The subjective assessment of aesthetic parameters by the patient was more consistent with the objective clinical picture than the assessment of the subjective functional state according to the occlusal criterion. Moreover, the subjective assessment of the TMJ functional state was close to the objective clinical picture.

The visual scale of functional self-assessment by the VAS together with the modified Slavicek questionnaire and Helkimo index allows us to identify the compliance with the upcoming treatment demands and needs. In case of obvious deviations, a more detailed clarification of the patients' complaints and possible consultation of the dentist-neurologist together with the clinical psychologist are required to identify comorbid conditions and exclude psychosomatic pathologies.

The available strong correlation between the Helkimo index and the modified Slavicek questionnaire allows them to be used directly in clinical practice to compare the patients' actual need for the planned rehabilitation and their demand for it. In addition, this pair of indicators can reflect the dynamics and outcomes of the treatment, taking into account the objective clinical picture and the patients' subjective perception of their condition.

Nevertheless, given the limited volume of clinical cases under consideration, this topic requires further research on a larger sample of patients.

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CONFLICT OF INTEREST

Conflict of interest is not declared.

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TABLES

Table 1: Diagnostic findings prior to and after a comprehensive rehabilitation

	Prior to	After	Difference	P-value*
VAS of aesthetic demand	5.87±0.89	1.64±0.67	4.23±1.13	2.2e-16
VAS of functional demand	5.13±1.75	1.59±0.64	3.54±1.80	7.225e-16
ICON aesthetic component	47.74±10.64	1.97±3.19	45.77±9.75	2.2e-16
ICON occlusal component	44.18±6.89	0.62±1.35	43.56±7.15	2.2e-16
ICON index	91.92±12.02	2.59±3.26	89.33±10.96	2.2e-16
Magnitude of benefit	81.56±13.19			
Modified Slavicek questionnaire	25.23±6.14	4.41±1.57	20.82±6.31	2.2e-16
Helkimo index	23.21±7.44	4.72±1.89	18.49±7.84	2.2e-16

*level of statistical significance

Table 2: Values of Spearman correlation coefficient

	Pre-treatment	Post- treatment
VAS of aesthetic demand/ ICON aesthetic component	0.31	0.57
VAS of functional demand / ICON occlusal component	-0.04	-0.002
VAS of functional demand/ modified Slavicek questionnaire	0.40	0.43
ICON occlusal component / Helkimo index	-0.06	0.002
Modified Slavicek questionnaire / Helkimo index	0.73	0.51

FIGURE CAPTIONS

Index components		Points						Coefficient
		0	1	2	3	4	5	
1	Assessment of aesthetics	Points from 1 to 10 (on the IOTN aesthetic scale)						7
2	Tooth crowding of the upper jaw	<2mm	2.1-5mm	5.1-9mm	9.1-13mm	13.1-17mm	>17mm	5
	Gaps between the teeth of the upper jaw	<2mm	2.1-5mm	5.1-9mm	>9mm		Impacted teeth	5
3	Crossbite occlusion	No	Yes					5
4	Open occlusion	Direct incisal contact	<1mm	1.1-2mm	2.1-4mm	>4mm		4
	Descending occlusion	Overlap less than 1/3	Overlap from 1/3 to 2/3	Overlap from 2/3 to complete one				4
5	Cusp-to-fissure relationship of the lateral group of teeth	Multiple cusp-to-fissure contacts of the lateral group of teeth	Violation of cusp-to-fissure contact of the lateral group of teeth, excluding direct cuspal interference	Direct cuspal interference				3

Figure 1: ICON Index calculation table

Figure 2: Photographs included in the aesthetic component of the IOTN index

Interpretation of the ICON index before rehabilitation

Degree of treatment complexity	ICON index value
Light	<29
Moderate	from 29 to 50
Medium	from 51 to 63
Severe	from 64 to 77
Very severe	>77

Interpretation of the ICON index after rehabilitation

Degree of improvement	ICON index value
Substantial improvement	>-1
Significant improvement	from -25 to -1
Moderate improvement	from -53 to-26
Minimal improvement	from -85 to -54
No improvement	< -85

Figure 1: Interpretation of the ICON index values

Helkimo Index			
Parameter	**0**	**1**	**5**
Amplitude of vertical movements of the lower jaw	unlimited (mouth opening by 38-56 mm)	slightly limited (mouth opening by 25-37 mm)	strongly limited (mouth opening less than 25 mm)
Amplitude of lateral movements of the lower jaw	unlimited (lateral movements to 10-15 mm)	slightly limited (lateral movements to 5-9 mm)	strongly limited (lateral movements less than 5 mm)
Lower jaw protrusion	unlimited (5-7 mm)	slightly limited (3-4 mm)	strongly limited (less than 3 mm)
Symmetry of the lower jaw movements when opening the mouth	The lower jaw movement along the midline (lateral displacement at the end of the mouth opening no more than 2 mm)	Deviation - the lower jaw movement with a lateral displacement at the beginning and a return to the midline in the middle 2	Deflection - the lower jaw movement with a lateral displacement at the end of mouth opening to more than 2 mm
Pain in the temporomandibular joint during the lower jaw movements	absent	pain with one movement of the lower jaw	pain with two or more movements of the lower jaw
Pain in the masticatory muscles during the lower jaw movements	absent	pain with one movement of the lower jaw	pain with two or more movements of the lower jaw
Palpation of the temporomandibular joint	painless palpation	palpation causes discomfort	painful palpation
Palpation of the masticatory muscles	painless palpation	one to three muscles are painful on palpation	four or more muscles are painful on palpation
Determination of articular noise during the lower jaw movements	articular noise is not detected	articular noise is detected by auscultation	articular noise is detected by ear
TOTAL			

Figure 4

Parameter	Assessment (0-3)
Do you have any problems while chewing food?	
Do you notice any problems with articulation?	
Are you trying to find the most comfortable position of the lower jaw?	
Do you have hypersensitivity in the area of any teeth?	
Do you feel muscle fatigue in your lower jaw?	
Do you have difficulty while opening your mouth?	
Do you feel the lower jaw blocking while opening your mouth?	
Do you experience pain in the joint or lower jaw muscles?	
Do you experience pain while moving your lower jaw?	
Do you have spontaneous mandibular dislocations?	
Do you have problems with posture?	
Do you notice extraneous sounds while moving your lower jaw?	
Are you often tormented by headaches, pains in the neck or back?	
Do you grate your teeth or clench them at night or in the afternoon?	
Does it happen that you snore at night?	
Do you often wake up at night?	
TOTAL	

Figure 5: Questions of the modified Slavicek questionnaire

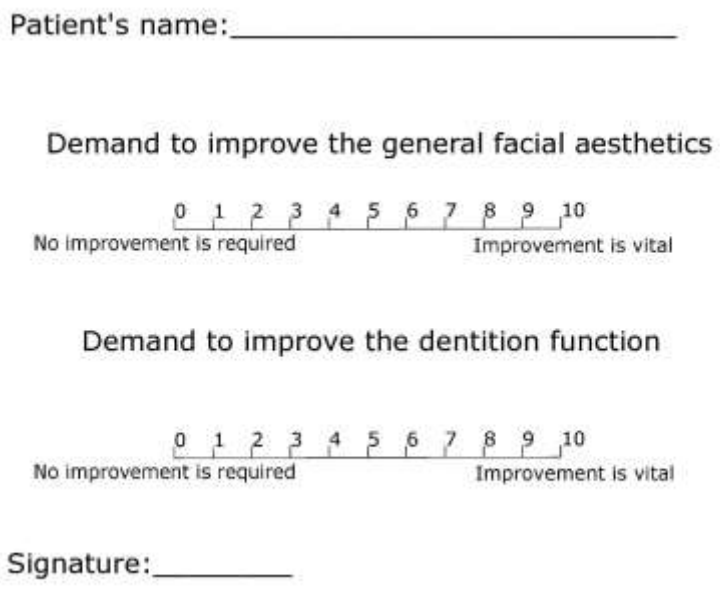

Figure 6: Numeric version of the visual analogue scale (VAS) used