Received: October 18, 2022
Accepted: November 2, 2022

Acad Med J 2022;2(2):128-134
UDC: 616.724-009.7
DOI:10.53582/AMJ2222128s
Original article

VISUAL ANALOG SCALE FOR PAIN ANALYSIS IN PATIENTS WITH TEMPOROMANDIBULAR DYSFUNCTION

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Abstract

Temporomandibular dysfunction (TMD) implies a wider spectrum of functional disorders involving the temporomandibular joint and the masticatory muscles. The dysfunction of these structures is associated with general symptoms such as: pain, limited movement, muscle spasm, ankylosis of the joints. As a pain syndrome, it usually affects the head and face but 75% of the population will experience at least one general symptom of TMD by the time they reach old age. The prevalence of the disease is highest in people aged 20-50 years, but the female population is twice likely to be affected.

For the purposes of this study, 30 subjects (18 women and 12 men) aged between 20 and 50 years were included. The criterion for selecting the candidate for the study was that he/she had symptoms of TMD confirmed by a clinical examination, as well as a completed questionnaire.

In all patients who were part of this study, an improvement in the clinical features was observed. This was proven by the repeated survey questionnaire and VAS scale 30 days after the treatment. The Student's T-test proved that there was a statistically significant difference in the VAS scale for pain in the examined patients before and after therapy of temporomandibular disorder.

Keywords: electromyography, temporomandibular dysfunction, Visual analog scale, muscular pain

Introduction

In the last decade we have witnessed a constant trend of increasing awareness of personal health, both physical and mental. A flawless and healthy smile is only one part of the perception of health and well-being. In clinical practice, we often encounter patients suffering from myofunctional disorders. Some of them get the disorder as a result of parafunction or bruxism. Other patients get occlusal disorders iatrogenically as a result of inadequate prosthetic restoration.

Temporomandibular dysfunction involves medical conditions that affect the masticatory muscles and the temporomandibular joint. All of these structures can be associated with common symptoms such as pain, limited movement of the joint, muscular spasm, induced trajectory of mandibular movement, painful mastication.

The pain syndrome associated with the TMD usually affects the head, neck and face[1]. By the time the population reaches old age, nearly 75% will experience at least one

general symptom of TMD. The prevalence of the disease is highest in people aged 20-50 years, but the female population is twice likely to be affected[2].

The main symptoms of TMD are muscle pain, pain in the temporomandibular joint, the disruption of its function, limitation in the mobility of the mandible followed by pain. Very often, the pain is transmitted to the surrounding parts of the body, ears, shoulders, neck and back[3]. A very common symptom is mandible deviation and a disturbed trajectory of movement. With this deviation, the masticatory function deteriorates, and hence, the patient has difficulties when chewing. This phenomenon simply leads to a decline in the quality of life.

There are many etiological causes of TMD involving sociological, biological and emotional.On the other hand, as an additional complication of the clinical condition, there is psychological tension, loss of teeth, occlusal obstacles, disturbance of muscle activity, incorrect posture, as well as variation in the structures of the joint itself. All these symptoms can be directly or indirectly connected to TMD.

If there is an anatomical disorder of the joint structures, X-ray, magnetic resonance, and computed tomography are used as diagnostic tools[4].

Of all imaging technologies, magnetic resonance is the best diagnostic method for comprehensive assessment of a patient with symptoms of TMD. On the other hand, this method is not easily available due to the higher price, and consequently its use is limited.
In addition to the technologies for visualization of the state of the temporomandibular joint, condylography, electromyography[5] and ultrasonography may be used as well. Sforza *et al.* confirmed condylography and electromyography as relevant diagnostic methods in the treatment of TMD[5].

Electromyographic analysis does not receive the attention it deserves in clinical dental practice. However, it is a reliable method for indirect measurement of muscle activity, the application of which helps a lot in the correction of jaw relations as well as in diagnosis and treatment of TMD[6,7].

One of the shortcomings of this method is the lack of a significant difference in muscle activity in patients with TMD pain and patients without pain. This was confirmed in a study by Mnfredini *et* al[8].

On the other hand, the initial tests performed by Ferrario *et al.* introduced the concept of muscle stability related to dental occlusion[9].

The aim of this study was to verify if there was a statistically significant difference in the VAS (visual analog scale) pain scale, as one of the main symptoms, in the examined patients diagnosed with TMD before and after therapy.

This study is connecting the two components necessary for the normal functioning of the masticatory system, the temporomandibular joint and the masticatory muscles.

Materials and methods

For the purposes of the study, 30 subjects (18 women and 12 men) aged between 20 and 50 years were included. The criteria for involvement of the candidates for the study was that each subject had symptoms of TMD confirmed by a clinical examination, as well as a completed questionnaire. To diagnose temporomandibular joint (TMJ) dysfunction, a questionnaire was used in which patients, using the Visual Analog Scale (VAS), described the cardinal symptoms: pain in the region of the TMJ, painful and limited movement of the lower jaw, crepitations of the temporomandibular joint and disrupted mastication, pain in the masticatory muscles, as well as pain in the neck muscles[4]. Of course, auxiliary diagnostic tools were also used: x-ray antero-posterior (AP) and lateral (LAT) exposure; the device that was used was Gendex Gx Dp-700 orthopantomograph. MRI was additionally performed in 3 patients using General Electrics MRI device.

Patients who were excluded from the study were those currently undergoing orthodontic therapy, patients with mental disorders, neurological diseases, or patients who had trauma to the head and neck region over the last 12 months.

Before the examination of the selected patients, a written signed consent was obtained. The consent was to familiarize the patient with the examination procedure, the analyses that would be performed as well as the plan of the therapy that would follow.

Each patient had to fill out an ethical questionnaire and a TMD survey questionnaire in which they subjectively described their symptoms.

The muscle activity analysis of *m. masseter* and *m. temporalis* was measured using an electromyographic device, Dental Afference Quantifier - Easy Myo T.F.R Technology[10]. The position of the mandibular condyle and its trajectory was registered with an Arcus Digma condylograph[11].

Procedure

Each patient, following the clinical examination, filled out a questionnaire regarding his/her condition. The questionnaire contains VAS (Visual analog scale) - a scale according to which the patient should describe the perception of pain intensity, starting from 1 in case there is no pain, to 5showing that the patient does not need to consume painkillers. Starting from 6 to 10, the pain intensity is so high that patients need to use painkillers. At the scale of 10, the pain is so intense that even the use of painkillers does not reduce the pain. Patients fill in the values for perception of pain on different body parts such as the head, jaws, ear, body, as well as symptoms origin from eventual injuries in the past. (questions with confirmation and negation) (Attachment 1).

With the help of the VAS scale and the questionnaire, we obtained numerical pain ratings of patients' subjective feeling. The muscle activity was measured using a myograph, Dental afference Quantifier – Easy MYO T.F.R.[12,13].

The study used a four-channel analysis system, for left and right *m. temporalis* and left and right *m. masseter*. Registration was carried out in two stages:

First stage of registration, the patient bites on thicker soft cotton rolls, at this moment the muscles contract with maximum activity due to the fact that there is no proprioceptor interference, the occlusal contact reflex is inactive. The patient is repeating this procedure three times.

Second stage of registration, the patient bites/clenches to teeth or to prosthetic restoration. In this case, the occlusal proprioceptors are active and modify the muscle activity. The patient repeats this procedure three times.

POC - The final result is the overlap coefficient between the first and second stage; this overlap is expressed in percentages (POC- percentage overlapping coefficient). This percentage serves as a comparison between the registration of muscle activity in the acute phase of TMD and the registration of muscle activity after the bite is reconstructed. For example, 100% overlap was noted in the case of equal muscles activity during the first and second registration.

The measurements also provide data on **asymmetry** (ASY) – it is a symmetry coefficient; **activation** (ACT) – compares the influence of occlusal tooth contact on masseteric and temporal muscle activity; **torque** (TC) – an index that is related to lateral deviation, **impact** (IMP) – muscle activation compared to maximum voluntary contraction (MVC) over cotton rolls.

The obtained data from the test is presented in figure 1.

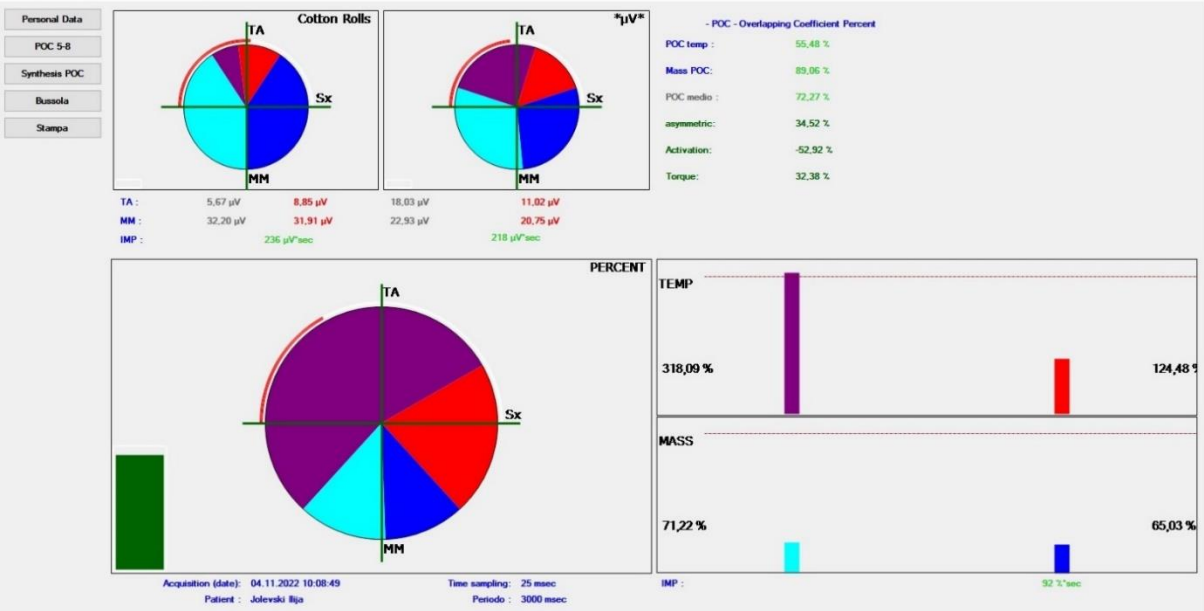

Fig.1. Graphical presentation of data

After the first set of testing, patients were treated in compliance with the protocols for occlusion correction, bite reconstruction, and temporomandibular joint repositioning. Since the symptoms were eliminated, a new registration of muscle activity followed. Three measurements were done again, and the average value was compared to that obtained during the first session of testing (before the treatment) in the acute phase[13].

Results

In this study we analyzed the VAS pain scale and the parameters obtained for POC.

The obtained numerical values were then processed using the Student's t-test (Paired values and "Two tailed" analysis) to determine if there was a statistically significant difference in the VAS pain scale of the examined patients before and after therapy.The same method was used for the second POC parameter – the coefficient before therapy and 30 days after therapy. The results are shown in tables (Tables 1 and 2).

Table 1. VAS analysis of pain before and after therapy

VAS before therapy			VAS after therapy	
Pain during mastication	**Temporomandibular joint pain**		**Pain during mastication**	**Temporomandibular joint pain**
7.2333	8.9666	main	3	3.9333
5,2601E-12	1,03864E-14	T - test	5,2601E-12	1,03864E-14

P<0.05

Table 2. POC analysis before and after therapy

POC before therapy		POC after therapy
68.649	main	81.76967
	T - test	1,39134E-07

P<0.05

Discussion

The purpose of this study was to compare the muscular activity in patients with TMD in the acute phase (presence of pain) with the muscular activity in the same patients after occlusal treatment (elimination of pain).

Mapeli *et al.* [13] in 2016 conducted an examination in patients with TMD in whom the intensity of muscle activity was not disrupted. A modification in the degree of reflex contraction was observed in patients with TMD. Ardizone in his study examined the muscle activity in *m. masseter* and *m. temporalis* in patients with TMD. These muscles maximized their activity during voluntary contraction despite the presence of pain. Peck *et al*. in 2007 demonstrated an obvious change in the trajectory movement of the mandible and a longer period of muscular contraction due to the presence of pain and muscle tension.

Measuring muscle activity is only one diagnostic tool in treatment of patients with TMD. Several authors have indicated myography as an authoritative diagnostic protocol (Mapeli, Sforza)[14,15]. Muscle activity is directly connected to the process of mastication and controlled by neurosynaptic proprioceptor reflex from the teeth. On the other hand, pathological disorders of the temporomandibular joint as well as infectious and traumatic conditions of the teeth alter the degree of contraction of the masseteric muscles[16].

Conclusion

In all patients who were part of this study, an improvement in the clinical features was observed at the end of the treatment. This was proven by the questionnaire and VAS performed 30 days after treatment. The Student's t-test showed a statistically significant difference in the VAS scale for pain in the examined patients before and after therapy of temporomandibular disorder.

The analysis of the POC coefficient and the muscle activity showed that the percentage of overlap of the masticatory muscles after therapy was higher than the overlap before therapy. This indicated improved muscle activity and coordinated contraction of the masseter and temporal muscles after therapy and improved occlusion. This was accompanied by a reduction in pain in these patients, which coincided with the VAS analysis.

Attachment 1
MEDICAL – DENTAL QUESTIONNAIRE
--confidential--
Anamnesis questionnaire regarding orofacial pain and temporomandibular joint dysfunction
Please fill in the questionnaire correctly. Do not leave unanswered questions, even if you think the question is irrelevant
PLEASE BRING YOUR COMPLETE DOCUMENTATION WITH YOU TO THE EXAMINATION

Date: _____/_____/____	No. of health insurance card:	Male_ Female_
Name: Dr./Mr./Mrs./Miss		Date of birth: ____/____/____ day/month/year
Last name		Vocation:
Contact Information	Home phone no.:	Work phone no.:
	Mobile phone no.:	e-mail:
	Address:	Post code:

Please fill in the following fields with a number from one 1 (no pain at all) to five (5) (pain for which I would take a painkiller) to ten (10) (unbearable pain that does not go away despite receiving a painkiller).

		1-10		1-10
Head:	Headache		Migraine	
Jaws:	Jaw pain		Jaw locking	
	Clicking of jaws		Inability to open the mouth	
	Pain when chewing		Limited mouth opening	
Ear:	Ear pain		Ringing in the ears	
Face:	Facial pain		Difficulty in swallowing	
	Burning in the mouth/gums		Sore throat/obstruction	
	Eye pain			
Body:	**Neck pain**		Shoulder pain	
Other:				

Note: _____

ANAMNESIS OF HEAD, FACE AND TEMPOROMANDIBULAR JOINT

Is there a history of falling during childhood, an accident, or injury to your face or head?
____ YES ____NO

Have you had a recent injury to the face or head?
YES NO

Have you suffered from a blow or neck injury?
YES NO When?

Is there an activity that holds your head or jaw in an unusual position for a long period of time, for example playing a musical instrument, telemarketing, biting a pen, scuba diving?
YES NO

If YES, please describe_____

Do you suffer from jaw pain? *(Please circle the correct answer)*

When opening or chewing?	YES	NO	Right	Left	Both sides
When closing?		YES	NO	Right	Left Both sides
When chewing?	YES	NO	Right	Left	Both sides

Do you suffer from any of the following jaw syndromes? *(Please circle the correct answer)*

Jaws clicking?

YES NO Sometimes Right Left Both sides

Jaws locking when opening?

YES NO Sometimes Right Left Both sides

Jaws locking when closing?

YES NO Sometimes Right Left Both sides

Cracking or grinding sounds in your joints?

YES NO Sometimes Right Left Both sides

Limited mouth opening?

YES NO Sometimes

Do you: *(Please circle the correct answer)*

Grit your teeth?	YES	NO	Sometimes
Grind your teeth	YES	NO	Sometimes

Conflict of interest statement. None declared.

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