DOI: https://doi.org/10.2298/SARH190613122M
UDC: 616.742:616.8-009.7

ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Applicability of the instruments for measuring pain intensity in persons with masticatory myofascial pain

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SUMMARY

Introduction/Objective The most frequent clinical presentation of myofascial pain (MFP) includes the presence of a deep local muscle pain, limited level of movements, heterotopic pain of trigger points in the referent zones, and the loss of the major symptoms by anesthetizing these points. The only manner to objectively and comprehensively evaluate pain, as a multidimensional experience, is by applying multiple methods in its diagnostics.

The objective of this paper was to corelate diagnostic possibilities of different quantification instruments for the assessment of pain intensity in persons with masticatory MFP.

Methods The study involved 60 subjects, divided into two groups stratified according to their sex and age. The Research Diagnostic Criteria for Temporomandibular Disorders diagnostic protocol was applied, within which the numeric scale of pain, digital palpation, graded chronic pain scale, the Visual Analogue Scale (VAS), and algometry were used.

Results The cardiac power index values are statistically significant and in negative correlation with the algometric measurements (from -0.48 to -0.59) and in positive, statistically significant, correlation with the VAS values (0.71).

Conclusion The results of studies we obtained lead us to the conclusion that there is an interdependence of these instruments for the measurement of pain intensity in persons with masticatory MFP and that the VAS and algometry are more objective and precise methods than the manual palpation.

Keywords: myofascial pain; diagnostics instruments; VAS; algometer; manual palpation

INTRODUCTION

The problems related to the etiology, occurrence, and particularly the diagnostics of the myofascial pain dysfunction syndrome (MPDS) in the head and neck region, due to a multitude of unknowns, have been the subject of a number of scientific discussions. The existing theories on the mechanisms of pain occurrence include local muscle hypoxia, centrally indicated sensitization, and neurogenically stimulated secretion of substances that cause the occurrence of pain in sensitive places [1].

The most frequent clinical presentation myofascial pain (MFP) includes the presence of deep local muscle pain and suffering, limited level of movements, heterotopic pain from the so-called trigger points in the referent zones, and the loss of major symptoms by anesthetizing these points [2]. It is a known fact that the diagnostic possibilities of quantification and characterization of the chronic MFP are definitely hardly feasible. That is why the precise diagnostic of these painful conditions is not always straightforward.

The only manner to objectively and comprehensively evaluate pain, as a multidimensional experience, is by applying multiple methods in its diagnostics. It is, therefore, not surprising that there is a multitude of studies that deal with this topic and confirm the positive correlation and interdependence of different instruments for the measurement of pain intensity [3–6].

In clinical practice, the manual muscle palpation is established as the "gold standard" and is still the most frequently applied method for examination of muscle sensitivity [7, 8]**.** However, the attitude that it is exclusively sufficient for diagnosing the masticatory MFP can mostly be found in older papers and, nowadays, it is considered outdated. Some of the main issues with this method are certainly the impossibility to sufficiently standardize the procedure, as well as different interpretations of a patient's reactions during its performance. That is exactly why other instruments for measuring pain intensity have been introduced. The Visual Analogue Scale (VAS) is one of the most frequently used unidimensional scales for the assessment of the pain threshold [9]. Algometry is a more objective, precise, standardized, repeatable, and valid method [10, 11]. The measurement of pain intensity and the documentation of its values are the basis of the proper and efficient treatment.

Received • Примљено: June 13, 2019
Revised • Ревизија: November 14, 2019
Accepted • Прихваћено: November 17, 2019
Online first: November 26, 2019

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The objective of this paper was to correlate diagnostic possibilities of different quantification instruments for the assessment of pain intensity in persons with masticatory MFP.

METHODS

The study, conducted at the Clinic for Dentistry of Vojvodina, Faculty of Medicine in Novi Sad, Serbia, in accord with standards of the institutional committee on ethics, involved 60 subjects divided into two groups stratified by their sex and age. The study group comprised 30 subjects with the diagnosis of MFP (16 men and 14 women) with the average age of 42.77 ± 11.57 years, while the control group comprised 30 healthy subjects without any signs and symptoms of MFP.

In addition, control group subjects were excluded if they had masticatory MFP, temporomandibular joint arthralgia, degenerative joint disease, and/or disc displacement without reduction, as well as if they complained of frequent and/or persistent pain in any bodily part, fibromyalgia syndrome, self-reported psychogenic illness, and the female subjects were not pregnant.

The basic criterion for patients to be involved in the study was the occurrence of pain in *m. masseter* and/or *m. temporalis* of longer than three months duration. The subjects did not experience neurological disorders, atypical pain, infections of the surrounding structures, acute pain caused by dental disorders, neuropathies, chronic immune-deficiency, neoplasms, and the female subjects were not pregnant.

The diagnosis was established using the detailed history, with a particular emphasis on the pain anamnesis, as well as clinical examination, performed by standardized procedures of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) protocol [12].

The MFP diagnosis was obtained on the basis of data processing conducted in the first and the second part of the clinical protocol, primarily from the positive results of the palpatory pain in three or more points, with or without functional limitation in the opening of the mouth [13]. Monitoring of the pain intensity was also performed by applying different instruments: the Graded Chronic Pain Scale (GCPS), the numeric pain rating scale 0–3 during palpation, VAS, and algometry.

The patients provided answers to palpation and graded the feeling of pain in the numeric rating scale (0 – no pain, 1 – mild pain, 2 – moderate pain, 3 – severe pain). The grades were added, and the overall sensitivity sum was obtained. The GCPS is a scale within the second part of the RDC/TMD protocol and its result is the value that is called the Characteristic Pain Intensity (CPI) [14]. The VAS was applied as a unidimensional scale for measuring intensity of the subjective feeling of pain prior to examination of the pressure pain threshold. The scale consists of one straight 10-cm-long line, the beginning of which is marked by 0, which is a numerically expressed value for the patient signifying the absence of pain, all the way to the end of the scale marked by 10, signifying that the pain is unbearable. The subject needed to express the point that correlates best with the intensity of experienced pain sensation. It is expressed in millimeters [1].

The algometric measurement was conducted with a digital algometer (FPIX 10, 2007, dimensions 23/4" WX" HX 1 1/4" d; Wagner Instruments, Riverside, CT, USA). The measuring locations were the precisely determined points on the masseter and temporal muscles on both sides [15]. The measuring was performed by applying a rubber probe with a certain intensity on the surface of 1 cm^2. The device has the capacity to render the calibration values into kgf/cm^2 – N, Ibf, and Ozf. The testing was conducted in the identical space and time conditions. The subjects were requested to inform us when they start experiencing pain (pressure pain treshold – PPT) and when that pain becomes unbearable (pain tolerance threshold – PTT). That moment was registered at the algometer display. The testing was repeated three times with rest phases in the duration of five minutes.

Before the beginning of the research, all the subjects had been familiarized with the experimental procedures and they gave their voluntary compliance with the signed consent for participating. The research was approved by the Ethics Committee of the Faculty of Medicine in Novi Sad.

The basic measurements and statistical analyses were used for establishing basic conclusions. The distributions of normal values were tested, the average and mean values of measurements, as well as the standard deviation were analyzed, while more thorough testing was checked with the t-test. Moreover, the Spearman's rank correlation coefficient for different variables was used for the detection of the connection of diagnostic methods. The level of relevance was considered significant if $p < 0.05$.

RESULTS

During palpation of the anterior fibers of the temporal muscle, as much as 40% of the study group subjects experienced severe pain on palpation of anterior fibers at the right side and 23.33% on the left side, while 10% of the subjects felt no pain on either side. Generally, patients experienced less pain on palpation of middle and posterior fibers of the temporal muscles, regardless of the side (Table 1). During palpation of the masseter muscle, patients experienced the worse (severe) pain in the lower and middle portions of the muscle on the right side, and in the upper portions on the left side (Table 1).

The values of algometric measurements for both muscles (masseter and temporal), in both groups of subjects, are shown in Tables 2 and 3. There were statistically significant differences in mean values of algometric measurements in both muscles between the two groups of subjects (Student's t-test). Statistically significant differences were noted between the values of the pain threshold and the pain tolerance threshold for both muscles (Tables 2 and 3).

The values of measuring the pain intensity using the VAS scale with the study group subjects are shown in Table 4.

Table 1. The numeric rating scale of pain during the application of manual pressure on masseter and temporal muscles

Muscle		Position	No pain	Mild pain	Moderate pain	Severe pain
			n (%)	n (%)	n (%)	n (%)
Temporal muscle	Right	Posterior	13 (43.33)	13 (43.33)	4 (13.33)	0
		Middle	10 (33.33)	2 (6.67)	11 (36.67)	7 (23.33)
		Anterior	3 (10)	8 (26.67)	7 (23.33)	12 (40)
	Left	Posterior	19 (63.33)	8 (26.67)	3 (10)	0
		Middle	10 (33.33)	7 (23.33)	10 (33.33)	3 (10)
		Anterior	3 (10)	9 (30)	11 (36.67)	7 (23.33)
Masseter muscle	Right	Upper portion	3 (10)	10 (33.33)	14 (46.67)	3 (10)
		Mid-belly	4 (13.33)	9 (30)	7 (23.33)	10 (33.33)
		Lower portion	6 (20)	7 (23.33)	7 (23.33)	10 (33.33)
	Left	Upper portion	2 (6.67)	8 (26.67)	9 (30)	11 (36.67)
		Mid-belly	3 (10)	7 (23.33)	14 (46.67)	6 (20)
		Lower portion	7 (23.33)	7 (23.33)	10 (33.33)	6 (20)

Table 2. The differences in the t-test values of algometric measurements of *m. masseter* and *m. temporalis* on both sides between the two groups of subjects

Muscle	Control group	Study group	t	p
	$\bar{x} \pm SD$	$\bar{x} \pm SD$		
Right masseter muscle PPT	4.87 ± 0.92	2.02 ± 0.69	13.54*	0.000000*
Right masseter muscle PTT	6.63 ± 0.77	2.95 ± 0.69	19.47*	0.000000*
Left masseter muscle PPT	4.94 ± 0.97	2.09 ± 0.58	13.86*	0.000000*
Left masseter muscle PTT	6.55 ± 0.89	2.97 ± 0.65	17.82*	0.000000*
Right temporal muscle PPT	5.24 ± 1.14	2.36 ± 0.68	11.88*	0.000000*
Right temporal muscle PTT	6.59 ± 1.16	3.33 ± 0.79	12.76*	0.000000*
Left temporal muscle PPT	5.17 ± 1.24	2.55 ± 0.58	10.48*	0.000000*
Left temporal muscle PTT	6.38 ± 1.23	3.47 ± 0.61	11.61*	0.000000*

PPT – pressure pain threshold; PTT – pain tolerance threshold

Table 3. The differences in the t-test values of algometric measurements (pressure pain threshold and pain tolerance threshold) of *m. masseter* and *m. temporalis* between the two groups of subjects

Muscle	Control group	Study group	t	p
	$\bar{x} \pm SD$	$\bar{x} \pm SD$		
Masseter muscle PPT	4.91 ± 0.91	2.05 ± 0.60	14.29*	0.000000*
Masseter muscle PTT	6.59 ± 0.76	2.96 ± 0.61	20.36*	0.000000*
Temporal muscle PPT	5.21 ± 1.15	2.46 ± 0.51	11.97*	0.000000*
Temporal muscle PTT	6.48 ± 1.14	3.40 ± 0.59	13.15*	0.000000*

PPT – pressure pain threshold; PTT – pain tolerance threshold

Table 4. Descriptive statistics for the visual analogue scale (VAS) in the study group

Study group	n	$\bar{x} \pm SD$	95% CI	Min.	Max.
VAS	30	7.24 ± 1.40	6.719–7.767	4.8	9.5

Table 5. The values of the characteristic pain intensity (CPI), measured with the Graded Chronic Pain Scale in the study group

Study group	$\bar{x} \pm SD$	96% CI	Min.	Max.
CPI	60.78 ± 15.80	54.88–66.68	30	90

The subjects considered that their pain had the average value on the scale of 7.24 cm.

The values of the graded chronic pain scale are shown in Table 5. The mean values of the characteristic pain intensity (CPI) were between 54.88 and 66.68 in the 96% confidence interval.

The obtained algometric values (the PPT and the PTT) for both muscles and the values of the VAS measurements were in a reverse correlation concerning statistical significance (the correlation coefficient for the masseter muscle was -0.50 and -0.64, and for the temporal muscle -0.42 and -0.38, respectively). The correlation coefficient was negative, considerable, and strong. The manual pressure values were in negative correlation with the values of algometric measurements and in positive correlation with the values measured with the VAS, but with no statistical significance. The CPI values were statistically significant and in negative correlation with algometric measurements (from -0.48 to -0.59) and positive, statistically significant correlation with the VAS values (0.71). The correlation of the palpation values of the masseter muscle and CPI was statistically significant (0.50), while for the temporal muscle it was not (0.18). It was established that in subjects with a higher level of disability, lower pressure induced by the algometer caused pain, i.e. they were in negative, statistically significant correlation with the values of algometric measurements on both muscles (Table 6).

DISCUSSION

Chronic MFP is often non-recognized in clinical practice. This is the reason why it is important to have precise and complete observation of the pain characteristics and intensity for its diagnosis, which should be founded on the manifold methodological approaches and use of different instruments for measuring pain intensity.

Table 6. Spearman's rank correlation coefficient for different variables

Variables	Manual palpation		Masseter muscle		Temporal muscle		VAS	CPI
	Temporal muscle	Masseter muscle	PPT	PTT	PPT	PTT		
Palpation of temporal muscle	1.00	0.05	-0.35	-0.35	-0.2	-0.32	0.12	0.18
Palpation of masseter muscle	0.05	1	-0.28	-0.35	-0.22	-0.28	0.34	0.50*
Masseter muscle PPT	-0.35	-0.28	1	0.95*	0.53*	0.62*	-0.54*	-0.50*
Masseter muscle PTT	-0.35	-0.35	0.95*	1	0.49*	0.61*	-0.60*	-0.59*
Temporal muscle PPT	-0.20	-0.22	0.53*	0.49*	1	0.91*	-0.42*	-0.48*
Temporal muscle PTT	-0.32	-0.28	0.62*	0.61*	0.91*	1	-0.38*	-0.49*
VAS	0.12	0.34	-0.54*	-0.60*	-0.42*	-0.38*	1	0.71*
CPI	0.18	0.50*	-0.50*	-0.59*	-0.48*	-0.49*	0.71*	1

PPT – pressure pain threshold; PTT – pain tolerance threshold; CPI – characteristic pain intensity; VAS – Visual Analogue Scale

The possibility of comparing the results of MPDS studies is additionally complicated due to insufficient standardization, inadequate controllability, application of different clinical and diagnostic criteria, incomplete observation, and diverse interpretation of diagnostic results.

It is clear that comprehensive and completely objective assessment and measurement of pain, as a multidimensional and multifactorial subjective phenomenon, does not exist. That is precisely the reason why the self-assessment of pain intensity is, *inter alia*, a foundation for pain management. The subjects with MFP usually and most often experience pain, i.e. sensitivity, of the masseter and/or temporal muscles. These two muscles are most frequently used in the studies measuring the orofacial muscle pain threshold. The highest number of neuromuscular filaments, conductivity, and physiological and anatomic domination make these two muscles completely representative for testing and diagnosing these disorders [1, 16]. Some authors obtained the values according to which they distinguished the anterior bundle of *m. temporalis* as the most certain and representative for the MFP measurement. According to them, there was a linearly proportional correlation between the applied pressure on trigger points and the caused pain. With healthy muscles, this correlation was not linearly proportional, which we also noticed in our study [17].

The MFP patients exhibit greater muscle sensitivity than the healthy subjects in the control group [15]. We have emphasized that a sensitivity to various types of pressure (manual and algometric) in the region of masseter muscles is one of the most significant features of the MFP and is applied as a criterion to distinguish it from other forms of painful conditions in the head and neck region [18, 19, 20]. The relation of trigger points and referent zones where the pain occurs is constant and significant for their detection and diagnostics [21].

Frequently, the feeling of pain is increased during palpation, as well as during masticatory function. Typically, the MPDS is a localized, unilateral, painful syndrome, in which bilateral symptoms occur only when combined with generalized disorders, such as fibromyalgia [22]. The values of pain intensity on the VAS vary during the day, usually 3–5 cm, to as much as 10 cm [1]. According to pain quality, it is usually deep, penetrating pain that varies from sensitivity to severe, devastating pain [23]. In our research, the pain had lasted two years on average, it was unilateral, mostly periodical, and its intensity measured with the VAS was averagely 7.24 cm. It is of great importance to conduct different, manifold measurements of muscle pain. Even though the VAS is the most frequently used instrument for the assessment of pain quantity, in our research, as well as in many others, it was applied in combination with the examination of muscle sensitivity to palpation, and algometry [9, 24].

The algometer was applied in the examination of painful sensitivity and a multitude of studies present it as a reliable instrument in the assessment of the MFP intensity [11, 15]. It is easy to use and the validity and reproducibility of algometric measurements for clinical practice are evaluated through different parameters as good to excellent [25]. The application of a modern digital algometer of this performance ensured additional precision in measurement in comparison to other types of manual algometers. In respect to the differences in the pain threshold between the MFP patients and healthy persons, many studies have shown that the pain threshold is essentially lower in MFP patients than in healthy subjects in the control group [7]. Accordingly, our research also discovered significant differences in the PPT and MPT values in all measurements (on individual points, combined values for each muscle individually on both sides and as a whole) between the experimental and the control group of subjects with 95% confidence.

A frequent approach in the relevant literature concerning MFP diagnostics was application of the quantitative algometric pain measurement, with comparative VAS measurements [8, 17]. The algometry is warmly recommended as an examination method in different scientific studies. It is easy, simple to apply, and reliable in long-term studies [26]. A properly calibrated algometer, in combination with other instruments for pain assessment, is an absolutely appropriate and necessary choice in the so-called auxiliary diagnostics of MFP. Based on our research, we concluded that there is a connection between the VAS and algometry, and that they are more objective and precise methods than the manual palpation. Algometry was in the statistically significant, negative correlation with the VAS values in a high ranking.

In this respect, future research should be aimed at completing and developing uniform, generally accepted diagnostic protocols for these orofacial region disturbances.

Conflict of interest: None declared.

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Применљивост инструмената за мерење интензитета бола код особа са мастикаторним миофасцијалним болом

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САЖЕТАК

Увод/Циљ Најчешћа клиничка презентација миофасцијалног бола (МФБ) укључује присуство дубоке мишићне боли, ограничен ниво покрета, хетеротопни бол из *trigger* тачака у референтне зоне и губитак водећих симптома њиховим анестезирањем. Дијагностичке могућности квантификације и карактеризације хроничног МФБ често су тешко изводљиве. Једини начин да се бол, као мултидимензионално искуство, објективно и свеобухватно процени је примена вишеструке методологије у његовој дијагностици.
Циљ овога рада био је корелирати дијагностичке могућности различитих квантификационих инструмената за процену интензитета бола код особа са мастикаторним МФБ.

Методе Студија је обухватала 60 испитаника подељених у две групе стратификоване према полу и старости. Примењен је дијагностички протокол *RDC/TMD*, а коришћени инструменти за мерење интензитета бола били су: нумеричка скала бола, дигитална палпација, градуирана скала хроничног бола, визуелна аналогна скала (ВАС) и алгометрија.

Резултати Вредности индекса срчане снаге су статистички значајне, у негативној су корелацији са алгометријским мерењима (од -0,48 до -0,59) и позитивној, статистички значајној корелацији са вредностима ВАС (0,71).

Закључак Резултати овог истраживања наводе нас на закључак да између примењених инструмената за мерење интензитета бола код особа са мастикаторним МФБ постоји међузависност и да су ВАС и алгометрија објективније и прецизније методе мерења интензитета бола него мануелна палпација.

Кључне речи: миофасцијални бол; дијагностички инструменти; ВАС; алгометар; мануелна палпација