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Paper Accepted*

ISSN Online 2406-0895

Original Article / Оригинални рад

Bojana Milekić[1,2,†], Dario Ćatović[3], Tatjana Puškar[1,2], Milica Jeremić-Knežević[1], Daniela Đurović-Koprivica[1], SanjaVujkov[1,2]

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

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

[1]University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia;
[2]Dentistry Clinic of Vojvodina, Novi Sad, Serbia;
[3]Institute for the Health Care of Workers of Serbian Railways, Novi Sad, Serbia

Received: June 13, 2019
Revised: November 14, 2019
Accepted: November 17, 2019
Online First: November 26, 2019
DOI: https://doi.org/10.2298/SARH190613122M

*__Accepted papers__ are articles in press that have gone through due peer review process and have been accepted for publication by the Editorial Board of the *Serbian Archives of Medicine*. They have not yet been copy-edited and/or formatted in the publication house style, and the text may be changed before the final publication.

Although accepted papers do not yet have all the accompanying bibliographic details available, they can already be cited using the year of online publication and the DOI, as follows: the author's last name and initial of the first name, article title, journal title, online first publication month and year, and the DOI; e.g.: Petrović P, Jovanović J. The title of the article. Srp Arh Celok Lek. Online First, February 2017.

When the final article is assigned to volumes/issues of the journal, the Article in Press version will be removed and the final version will appear in the associated published volumes/issues of the journal. The date the article was made available online first will be carried over.

†**Correspondence to:**
Bojana MILEKIĆ
Dentistry Clinic of Vojvodina, Hajduk Veljkova 12, 21000 Novi Sad, Serbia
E-mail: **bojana.milekic@mf.uns.ac.rs**

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SUMMARY

Introduction/Objective The most frequent clinical presentation of myofascial pain (MFP) include 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 aim 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 gender and age. The RDC/TMD diagnostic protocol was applied, within which the numeric scale of pain, digital palpation, graded chronic pain scale, the VAS, and algometry were used.

Results The CPI 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 a 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

САЖЕТАК

Увод/Циљ Најчешћа клиничка презентација миофасцијалног бола (МФБ) укључује присуство дубоке мишићне боли, лимитиран 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 мултимензионално 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, *VAS* и алгометрија.

Резултати Вредности *CPI* су статистички значајне и у негативној корелацији са алгометријским мерењима (од -0.48 до -0.59) и позитивној, статистички значајној корелацији са вредностима *VAS* (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 *VAS* и алгометрија објективније и прецизније методе мерења интензитета бола него мануелна палпација.

Кључне речи: миофасцијални бол; дијагностички инструменти; *VAS*; алгометар; мануелна палпација

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 the 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 includes the presence of a 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 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.

The aim 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, in accord with standards of the institutional committee on ethics, involved 60 subjects divided into two groups stratified by their gender 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, in control group subjects were excluded if they had masticatory myofascial pain, TMJ 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 3 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.

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 first and 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/CMD 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 line that is 10 cm long, 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 mm [1].

The algometric measurement was conducted with a digital algometer (Wagner Instruments CT, FPIX 10, the USA, 2007, dimensions 23/4'' WX'' HX 1 1/4''d.). 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 in 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 (the 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 5 minutes.

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

The basic measurements and statistical analyses were used for the establishment of 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 significant level of relevance considered if $p < 0.05$.

RESULTS

During palpation of the anterior fibers of 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 the side (Table 1). During palpation of masseter muscle, the worse (severe) pain patients experienced in the lower and middle portions of the muscle at the right side, and in the upper portions at 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. The subjects considered that their pain had the average value on the scale of 7.24 cm.

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

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 masseter muscle was -0.50 and -0.64, and for temporal muscle -0.42 and -0.38). 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 masseter muscle and CPI was statistically significant (0.50), while for temporal muscle, it was not (0.18). It was established that in subjects with a higher level of disability, lower pressure conducted with the algometer caused pain, i.e. that they were in negative, statistically significant correlation with the values of algometric measurements on both muscles (Table 6).

DISCUSSION

Chronic myofascial pain is often non-recognized in clinical practice. That is the reason why it is important to have precise and complete observation of the pain characteristics and

intensity for its diagnostics, which should be founded on the manifold methodological approaches and usage of different instruments for measuring pain intensity.

The possibility of comparing the results of the 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 [17], which we also noticed in our study.

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 irradiates 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 for 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 represent 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 with the MFP patients than with the 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% of 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 right and necessary choice in the so-called auxiliary diagnostics of MFP. Based on our research, we concluded that there is a mutual 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.

REFERENCES

1. Sharav Y, Benoliel R. Orofacia pain and Haedache, 2nd Edition. Quintessence Publishing USA; 2015. ISBN: 978-0-86715-680-5
2. Fernández-de-las-Peñas C, Dommerholt, J. International consensus on diagnostic criteria and clinical considerations of myofascial trigger points: a Delphi study. Pain Med. 2017; 19(1):142-50. PMID: 29025044 DOI: 10.1093/pm/pnx207
3. Więckiewicz W, Woźniak K, Piątkowska D, Szyszka-Sommerfeld L, Lipski M. The diagnostic value of pressure algometry for temporomandibular disorders. Biomed Res Int. 2015; 2015:575038. PMID: 25883964 DOI: 10.1155/2015/575038
4. Herpich CM, Gomes CAFP, Dibai-Filho AV, Politti F, Souza CDS, Biasotto-Gonzalez DA. Correlation Between Severity of Temporomandibular Disorder, Pain Intensity, and Pressure Pain Threshold. J Manipulative Physiol Ther. 2018; 41(1):47-51. PMID: 29249414 DOI: 10.1016/j.jmpt.2017.08.001
5. Wagemakers SH, van der Velden JM, Gerlich AS, Hindriks-Keegstra AW, van Dijk JFM, Verhoeff JJC. A Systematic Review of Devices and Techniques that Objectively Measure Patients' Pain. Pain Physician. 2019; 22(1):1-13. PMID: 30700064
6. Sanches ML, Juliano Y, Novo NF, Guimarães AS, Rodrigues Conti PC, Alonso LG. Correlation between pressure pain threshold and pain intensity in patients with temporomandibular disorders who are compliant or non-compliant with conservative treatment. Oral Surg Oral Med Oral Pathol Oral Radiol. 2015; 120(4):459-68. PMID: 26188733 DOI: 10.1016/j.oooo.2015.05.017
7. Bernhardt O, Schiffman EL, Look JO. Reliability and validity of a new fingertip-shaped pressure algometer for assessing pressure pain thresholds in the temporomandibular joint and masticatory muscles. J Orofac Pain. 2007; 21(1):29-38. PMID: 17312639
8. Herpich CM, Gomes CAFP, Gloria IPS, Amaral AP, Amaral MFRS, Herpich G, et al. Evaluation of pain threshold upon palpation of the masticatory muscles in women with temporomandibular disorder according to the Research Diagnostic Criteria of Temporomandibular Disorders. Rev. CEFAC. 2018; 20(2):175-181. DOI: 10.1590/1982-021620182028616
9. Cheatham SW, Kolber MJ, Mokha M, Hanney WJ. Concurrent validity of pain scales in individuals with myofascial pain and fibromyalgia. J Bodyw Mov Ther. 2018; 22(2):355-60. PMID: 29861234 DOI: 10.1016/j.jbmt.2017.04.009
10. Đorđević I, Todorović A, Lazić V, Obradović-Đuričić K, Milekić B, Stamenković D. Occlusal appliances – an alternative in temporomandibular disorders' pain treatment. Srp Arh Celok Lek. 2019; *in press* DOI: 10.2298/SARH190118064D
11. Andersen S, Petersen MW, Svendsen AS, Gazerani P. Pressure pain thresholds assessed over temporalis, masseter and frontalis muscles in healthy individuals, patients with tension-type headache, and those with migraine-a system review. Pain. 2015; 156(8):1409-23. PMID: 25955963 DOI: 10.1097/j.pain.0000000000000219
12. Schiffman E, Ohrbach R, Truelove E, Look J, Anderson G, Goulet JP, et al. Diagnostic criteria for Temporomandibular disorders (DC/TMD) for clinical and research applications: recommendations of the International RDC/TMD Consortium Network and Orofacial Pain Special Interest Group dagger. J Oral Facial Pain Headache. 2014; 28(1):6-27. PMID: 24482784 DOI: 10.11607/jop.1151
13. Dworkin SF, LeReschDwe L. Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord. 1992(4); 6:301–55. PMID: 1298767
14. Chantaracherd PJ, Hodges JS, Schiffman EL. Temporomandibular joint disorders' impact on pain, function, and disability. J Dent Res. 2015; 94(3):79S–86S. PMID: 25572112 DOI: 10.1177/0022034514565793
15. Santos Silva RS, Conti PC, Lauris JR, da Silva RO, Pegoraro LF. Pressure pain threshold in the detection of masticatory myofascial pain: an algometer-based study. J Orofac Pain. 2005; 19(4):318-24. PMID: 16279483

16. Woźniak K, Lipski M, Lichota D, Szyszka-Sommerfeld L. Muscle fatigue in the temporal and masseter muscles in patients with temporomandibular dysfunction. Biomed Res Int. 2015; 2015:269734. PMID: 25883949 DOI:10.1155/2015/269734
17. Fricton JR, Sheldon GG. Muscle disorders. In: Pertes RA, Sheldon GG, editors. Temporomandibular disorders and orofacial pain. Chicago: Quintessence Publishing Co; 1995. p. 91–108. ISBN-10: 0867152982 ISBN-13: 978-0867152982
18. Palacios-Ceña M, Wang K, Castaldo M, Guillem-Mesado A, Ordás-Bandera C, Arendt-Nielsen L, et al. Trigger points are associated with widespread pressure pain sensitivity in people with tension-type headache. Cephalalgia 2018; 38(2):237-45. PMID: 27919024 DOI: 10.1177/0333102416679965
19. Do TP, Heldarskard GF, Kolding LT, Hvedstrup J, Schztz HW. Myofascial trigger points in migraine and tension-type headache. J Headache Pain. 2018; 19(1):84. PMID: 30203398 DOI: 10.1186/s10194-018-0913-8
20. Goncalves MC, Chaves TC, Florencio LL, Carvalho GF, Dach F, Fernández-De-Las-Penãs C et al. Is pressure pain sensitivity over the cervical musculature associated with neck disability in individuals with migraine? J Bodyw Mov Ther. 2015; 19(1):67-71. PMID: 25603745 DOI: 10.1016/j.jbmt.2014.02.007
21. Ghurye S, McMillan R. Orofacial pain – an update on diagnosis and management. Br Dent J. 2017; 223(9):639-47. PMID: 29074941 DOI: 10.1038/sj.bdj.2017.879
22. Ayouni I, Chebbi R, Hela Z, Dhidah M. Comorbidity between fibromyalgia and temporomandibular disorders. A systematic review. Oral Surg Oral Med Oral Pathol Oral Radiol. 2019; 128(1):33-42. PMID: 30981530 DOI: 10.1016/j.oooo.2019.02.023
23. Cheatham SW, Kolber MJ, Mokha M, Hanney WJ. Concurrent validation of a pressure pain threshold scale for individuals with myofascial pain syndrome and fibromyalgia. J Man Manip Ther. 2018; 26(1):25-35. PMID: 29456445 DOI: 10.1080/10669817.2017.1349592
24. Fricton J. Myofascial pain: mechanisms to management. Oral Maxillofac Surg Clin North Am. 2016; 28(3):289-311 PMID: 27475508 DOI: 10.1016/j.coms.2016.03.010
25. Lorusso L, Salerno M, Sessa F, Nicolosi D, Longhitano L, Loreto C, et al. Autoalgometry: An Important Tool for Pressure Pain Threshold Evaluation. J Clin Med. 2018; 7(9): 273. PMID: 30213091 DOI: 10.3390/jcm7090273
26. Linde DL, Kumbhare DA, Joshi M, Srbely JZ. The Relationship between Rate of Algometer Application and Pain Press Assessment of Myofascial Trigger Point Sensitivity. Pain Pract. 2018; 18(2):224-29. PMID: 28440895 DOI: 10.1111/papr.12597

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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% confidence interval	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% confidence interval	Min.	Max.
CPI	60.78 ± 15.80	54.88–66.68	30	90

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

