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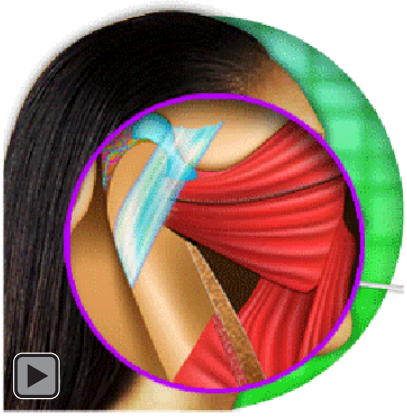
# Pressure Pain Threshold of the Lateral Pterygoid Muscles in TMD Patients and Controls

Youssef S. Abou-Atme, DDS, MS; Marcello Melis, DMD, Rpharm; Khalid H. Zawawi, BDS, DSc



## Abstract

**Objectives:** The aim of this experiment was to detect pressure pain threshold (PPT) differences on intra-oral palpation of the lateral pterygoid muscle (LPM) between subjects diagnosed with temporomandibular disorders (TMD) and controls.

**Methods:** Thirty-one consecutive female TMD patients and 31 age and gender matched controls underwent palpation of the LPM using an algometer made with a queue-tip connected to a digital scale, and PPT was measured.

**Results:** Mean PPTs of the right and left LPM of the controls were respectively 191g (49KPa) and 200g (51KPa), and mean PPTs of the right and left LPM of TMD patients were respectively 245g (62KPa) and 256g (63KPa). ANOVA between the four PPT measurements showed significant difference only between the PPT readings of the right LPM of the controls and the left LPM of the patients ($p<0.05$).

**Conclusions:** The findings of this study suggest that PPT measured by means of the described algometer is not decreased in TMD patients as compared to control subjects.

**Keywords:** Pressure pain threshold, algometer, lateral pterygoid, temporomandibular disorders

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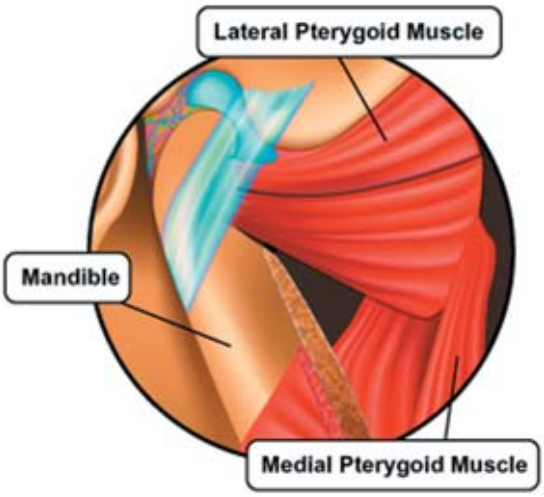
## Introduction

Muscle palpation is considered a mean for evaluating muscle tenderness in patients affected by temporomandibular disorders (TMD).[1-5] In fact, subjects suffering from myofascial pain and temporomandibular joint dysfunction frequently report pain on palpation of the masticatory muscles.[5-7] In particular, palpation of the lateral pterygoid muscle (LPM) has been shown to be one of the most painful sites in patients with face pain.[5, 6, 8-14] On the other hand the possibility of correct palpation of this muscle has been questioned. The reasons are that the two bellies of the muscle are unreachable by either an extraoral or an intraoral access[15-19], the difficulty of isolating the muscle to palpate due to overlap of the medial pterygoid and temporalis muscles[15, 16], and poor inter-individual reliability of the exam.[16, 17, 20] Still, some authors supported the role of palpation of the LPM in the clinical examination of the stomatognathic system for diagnosing TMD.[21-24]




The use of an algometer allows increase in the reliability of muscle palpation, because deep sensation can be measured and compared using a defined value.[22] List et al.[25] validated the use of the algometer as a mean to measure facial pain threshold, but till today, no study has ever tried to measure LPM sensitivity using an algometer, knowing that the diameter of palpation of these instruments varies between 0.5 and 1 $cm^2$. These diameters make almost impossible the use of these devices in narrow spaces like the LPM insertion.

Therefore, the purpose of this study was to compare intraoral pressure pain threshold (PPT) of the LPM in a group of orofacial pain patients with a control group.

## Materials and Methods

Thirty-one TMD female patients at Université Saint Joseph (Lebanon) were asked to enroll in the study in order of appearance. Equal number of asymptomatic age and gender matched controls volunteered to participate in the study. Mean age was 30.6 years (SD ± 11.1) for patients and 28.3 years (SD ± 8.8) for the controls. TMD patient inclusion criterion was myofascial pain of at least 3 months duration, evaluated by manual palpation of the masticatory muscles and patient report.[1] Palpation of the LPM was not performed because of its questionability.[16] Exclusion criteria included patients with a limited mouth opening (less than 35 mm), clinical history of acute disc displacement, presence of any systemic disease or psychiatric disorders, and pregnancy.[2]

Inclusion criteria for the control subjects were the following: good general health condition, no pain or tenderness in the masticatory muscles reported by the subjects and confirmed by manual palpation, mouth opening of at least 35 mm and no history or signs of disc displacement, no history of bruxism within the last 3 months reported by the subject, absence of systemic disease, psychiatric disorders and pregnancy.

At the time of measurement, neither patients nor controls were taking pain medications. A solar powered digital scale (Tanita® Model 1155, Japan) connected to a disposable 15 cm wooden cotton tip applicator (cotton end) was used as an algometer to measure PPT (Figure 1).

The digital scale had a measurement range of 0-999 grams and functioned as a sensor that detected pressure changes when different pressures were applied to it during palpation. This modified algometer was not affected by its inclination in the palm of the hand as weight changes were registered from its sensor-like tray. The tail of the queue-tip was positioned perpendicular to the surface of the measuring device (Figure 1). The cotton extremity was inserted through the lateral corner of the mouth,

**Figure 1.** Positioning of the cotton tip applicator with a semi-spherical cotton end and the digital scale during palpation.

along the lateral side of the alveolar ridge above the maxillary molars, moving distally, upward, and medially towards the ear. The choice of a queue-tip was made to give deeper access for palpation and to use it together with the digital scale. Since semi-spherical algometer probe endings are as reliable as the commonly used flat probe endings,[26] the end of the cotton queue-tips used in this study were also semi-spherical.

Evaluation of PPT was performed with the patients seated in a dental chair with their teeth slightly apart and the mandible in a relaxed position. Pressure to the queue-tip was slowly increased (about 10 grams per second) and the subject was instructed to make a sound when the sensation of pressure became pain, at that time the measurement was taken.

One trained examiner performed all the tests. Deep sensations in the areas of the right and left LPM insertions were alternatively tested three times with a one minute resting period for each site. To evaluate consistency and to calibrate the device, measurements for the left and right intraoral LPM insertions area and the adjacent area on the right of the middle maxillary labial frenum were recorded from 10 control subjects at two different times: the first during the morning and the second during the afternoon of the same day. The protocol was agreed on by the committee on research and ethics at Université Saint Joseph. In table 1, mean PPT was presented in grams as well as in Kilo Pascal (KPa) after estimating the surface of the queue tip contacting the soft tissue to be half a sphere. The formula used was Pressure=(mass*gravity)/($\pi$*(diameter)$^2$/2) Pa.

***Statistics:*** Analysis of variance (ANOVA) was performed to evaluate significant differences between both groups for the PPT of the right and left LPM readings. Student's t-tests were performed where appropriate. To correct for type-I error, the Bonferroni method was used. The results are expressed as mean ± standard deviation (SD). Statistical analysis of the data was made using Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL).

## Results

An independent sample t-test showed that age in both groups was not significantly different, mean age was 30.6 years (SD ± 11.1) for patients and 28.3 years (SD ± 8.8) for the controls, $t_{df=57} = 0.93$, $p>0.1$. To evaluate consistency and to calibrate the device, measurements were obtained from 10 control subjects. ANOVA between the four PPT measurements of the right and left LPM showed that the measurements were not significantly different ($F_{df=3} =0.03$, $p>0.1$). The area adjacent to the maxillary frenum was used as another control, paired sample t-test showed that both measurements for this area were also not significantly different (21.6 ±12.8 and 18.6 ± 13.8, $t_{df=9} = 1.3$, $p>0.1$).

Mean PPTs of the right and left LPM of all the controls were respectively 191g (49KPa) and 200g (51KPa), and mean PPTs of the right and left LPM of TMD patients were respectively 245g (62KPa) and 256g (63KPa).

**Table 1. Summary of mean PPT in grams and Kilopascals for the right and left LPM and area on the right of the maxillary frenum in TMD patients and in controls.**

| | TMD Patients (n=31) | Controls (n=31) |
|---|---|---|
| | Mean (± SD) | Mean (± SD) |
| Right LPM | 245 grams (±98)<br>*62 KPa (±24)* | 191 grams (±79)<br>*49 KPa (±20)* |
| Left LPM | 256 grams (±85)<br>*63 KPa (±21)* | 200 grams (±84)<br>*51KPa (±21)* |
| Maxillary labial frenum | 150 grams (±63)<br>*36 KPa (±16)* | 102 grams (±46)<br>*26 KPa (±11)* |

SD = Standard Deviation, KPa = Kilopascal

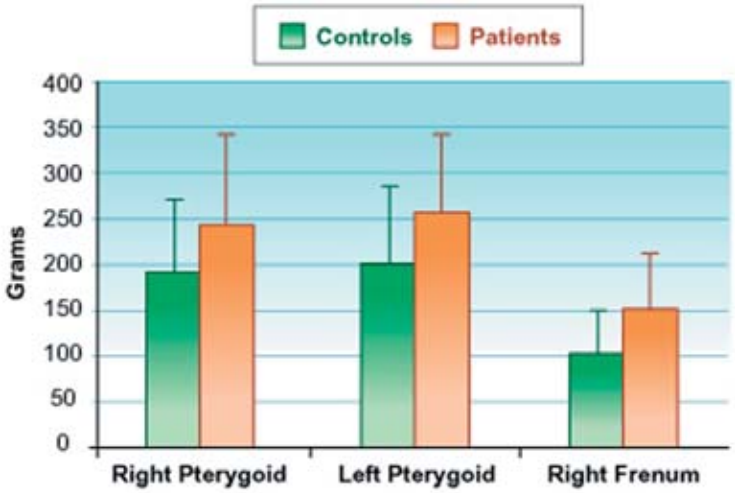



**Figure 2.** PPT (grams) for the LPM (right and left) and area on the right of the maxillary labial frenum in TMD patients and controls.

ANOVA was performed for the PPT measurements of the LPM between the controls and patients, right and left sides. There was a significant difference between the 4 measurements, $F_{df=3} = 4.1$, p=0.008. Post Hoc test was then conducted. The results showed that only the difference between the PPT readings of the right LPM of the controls and the PPT readings of the left LPM of the patients was significant, p=0.029 (Table 1, Fig. 2). No significant differences were observed between the other measurements (p>0.05). When comparing the PPT of the frena of the patients and controls, independent Student's t-test showed that controls had lower PPT than patients ( $t_{df=60} = 3.4$, p=0.001). Table 1, Figure 2.

## Discussion

The data in this study showed some differences in the PPT of the LPM between TMD patients and asymptomatic controls, but only the measurements between the PPT readings of the right LPM of the controls and the PPT readings of the left LPM of the patients was significant, with patients affected by myofascial pain reporting higher PPTs. According to Thomas and Okeson[27], digital palpation is not an effective method to evaluate the symptomatology of the lateral pterygoid muscle, but their examiners used the first digit of their forefingers to palpate LPM sites and obtain pain reports from the subjects, whereas in our study access to the LPM was achieved by the use of semi-spherical queue-tips in the attempt to improve proximity to the muscle, and PPT was quantified using an algometer. Their results seem in contrast with what is reported by Kaplan[23], that TMD patients have less pain on palpation of the LPM after treatment.

Different outcomes can be attributed to the fact that palpation of this muscle is inadequately reliable because of its location, and the exam can give a certain number of false positives[27],

probably for the pain caused by other muscles (medial pterygoid and temporalis), the temporalis tendon, and tension on the mucosa overlying the muscles.[16, 27] Use of one cadaver dissections and lateral head radiograph showed that it is not possible to palpate the LPM directly by conventional clinical techniques without applying pressure through the overlying superficial head of the medial pterygoid muscle.[15] The superficial fascicle of the medial pterygoid muscle was found in direct proximity to the LPM in 86 out of 106 dissected specimens, and 7.8 ± 3.2 mm remained between the LPM and buccinator fascia indented by the tip of the finger.[17] In half the 20 remaining specimens with an absent superficial fascicle, the finger was able to reach the LPM. Since it was a finger tip that was used in the latter study, one may assume that a queue-tip would go deeper; furthermore cadaver rigidity is non existent in humans. Even in the case that we were able to directly access the pterygoid muscle, the detected increased PPT in the patient group (both in the area of insertion of the LPM and the area adjacent to the maxillary frenum) needs some exploration. One explanation might fit the definition of hypoalgesia: diminished pain in response to a normally painful stimulus.[2] Hypoalgesia was reported for the first time by Graven-Nielsen et al.[28] They were able to prove that this phenomenon was experimentally induced by muscle pain only in heterotopic pain sites.[28] It was suggested that the decrease in deep sensitivity at the heterotopic sites (referred pain area), but not at homotopic sites, probably reflected the occurrence of diffuse noxious inhibitory control (DNIC). The inhibitory mechanism during muscle pain was shown to be effective for the deep tissue sensitivity in healthy subjects. It was concluded, that a pathologically disturbed inhibitory mechanism may result in widespread deep hypoalgesia in muscle pain patients. Such conclusion might also be true in the present study, whether it is the lower head of the LPM or the site of deep intraoral mucosa that was palpated. In both cases DNIC might be involved.

However, most of the measurements of PPT of the LPM were similar and the difference was not statistically significant. Only the PPT values of the right LPM of the controls and the PPT value of the left LPM of the patients were significantly different, and this outcome might be due to the small number of subjects included in the study that makes the results less reliable. In fact increasing the number of both patients and controls, PPT values might distribute more evenly between the groups canceling any significant difference between the PPT values of patients and controls.

Another confounding factor might be due to our inclusion criteria for the selection of the patients. Pain in one or more muscles of the face and neck gives us a diagnosis of myofascial pain, but does not automatically imply suffering from the LPM, that was not evaluated. The inferior head of this muscle, that is probably the one that was evaluated, is involved in the lateral and protrusive movements of the mandible as well as during mouth opening and is not active during mouth closing movements.[29] This means that disruptive habits like clenching might affect elevating muscles such as masseter, medial pterygoid and temporalis muscles without affecting the LPM. The patients we chose had some sore muscles of the face and neck, but the problem does not necessarily involve the LPM, as we discovered from the results of the study. Nonetheless the patients who showed tenderness on palpation of the LPM may have improvement in their symptoms after appropriate treatment for TMD according to what is reported by Kaplan.[23]

We must specify that although they assess the same variable: muscle tenderness, PPT and muscle palpation are not the same entity although strongly related. In fact to obtain PPT we palpated the LPM by the use of the described algometer, and we measured the value indicated by the scale at the time initial pain sensation was perceived; but we could have different results palpating the area of the muscle and asking the patient his or her sensation of pain. This is why comparison between studies that assessed LPM tenderness by digital palpation and measuring PPTs in different ways may be indicative, but not necessarily reliable.

## Conclusion

Based on the results of this study, PPT on palpation of the LPM by the use of the described algometer, is not reduced in patients suffering from myofascial pain. Our opinion is that clinicians should not rely on single and isolated signs or symptoms for diagnosing TMD, but the whole clinical picture needs to be evaluated during a thorough examination.

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## About the Authors


**Youssef S. Abou-Atme, DDS, MS**

Dr. Abou-Atme received his DDS from Université Saint Joseph (Lebanon) in 1994. After finishing a residency in Craniomandibular Disorders from Université de Nantes (France) in 1996, he joined the Craniofacial Pain Center at Tufts University where he completed a Fellowship in TMD and Orofacial Pain (1998) and a Master Degree in Oral Biology. He worked as a clinical and research associate at the Craniofacial Pain Center during the academic year 1998-99. Dr. Abou-Atme's practice in Lebanon is limited to TMD and Orofacial Pain. He is also an active pain researcher at Université Saint Joseph.

e-mail: youssefaa@yahoo.com

**Marcello Melis, DMD, Rpharm**

Dr. Melis received his degree in Pharmacy from the University of Cagliari (Italy) in 1990, and his DMD from the Dental School of the same University in 1998. He was a resident in the Craniofacial Pain Center at Tufts University, Boston (U.S.A.) from 1998 to 2000. Currently he practices in Cagliari in the field of Temporomandibular Disorders and Orofacial Pain, and is Adjunct Clinical Instructor in the Craniofacial Pain Center at Tufts University. He has been involved in several international research activities focusing on temporomandibular disorders and orofacial pain, occlusion and muscle function.

e-mail: marcellomelis01@libero.it

**Khalid H. Zawawi, BDS, DSc**

Dr. Zawawi Graduated from de'Montmorency College of Dentistry (Pakistan) in 1992. In 2001, he completed the certification program in TMD and Orofacial Pain at Tufts University School of Dental Medicine, Boston (USA). He received the Doctorate of Science degree in Oral Biology from Boston University School of Dental Medicine in 2004. Dr. Zawawi worked as a clinical instructor in Oral Surgery at King Abdulaziz University, Faculty of Dentistry in Jeddah (Saudi Arabia) and served as a research associate at the Craniofacial Pain Center at Tufts University (USA). Currently he is a resident in the Department of Orthodontics at Boston University in Boston, Massachusetts.

e-mail: zawawi@bu.edu



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