Pesquisa Brasileira em Odontopediatria e Clínica Integrada 2019, 19:e5030
DOI: http://doi.org/10.4034/PBOCI.2019.191.105
ISSN 1519-0501

ORIGINAL ARTICLE

Differences in Pain Threshold Values of Masseter and Temporalis Muscles Before and After Mastication

Aditya Pratama Sarwono[1], Laura Susanti Himawan[2], Ira Tanti[3]

[1]Prosthodontic Residency Program, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia. 0000-0001-7669-393X
[2]Department of Prosthodontics, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia. 0000-0002-6331-5160
[3]Department of Prosthodontics, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia. 0000-0002-0119-3153

Author to whom correspondence should be addressed: Ira Tanti, Department of Prosthodontics, Faculty of Dentistry, Universitas Indonesia, Jalan Salemba Raya No. 4 Jakarta Pusat, Jakarta 10430, Indonesia. Phone: +62 8161164801. E-mail: iratanti@ymail.com.

Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 14 January 2019 / Accepted: 28 May 2019 / Published: 18 June 2019

Abstract

Objective: To analyze the differences in the pain thresholds of the masseter and temporalis muscles before and after chewing at the 5th and 10th minutes. **Material and Methods:** In this cross-sectional study, the pain thresholds of the muscles in both sides of 43 non-TMD subjects were measured using a digital algometer before and after chewing the bubble gum Xylitol for 5 and 10 min. The values of the muscles before and after mastication at the 5th and 10th were analyzed using Repeated ANOVA. A difference in the values between the left and right sides of the muscles were analyzed using independent t-test, and among the age groups using one-way ANOVA. **Results:** Average pain threshold values were 1.76 and 1.93 KgF/cm^2 for the masseter and temporalis muscles. ANOVA tests indicated significant differences in the values of the muscles before and after mastication at the 5th and 10th min ($p=0.000$ vs. $p<0.001$). The differences in the values between the left and right sides of the muscles ($p>0.05$) and among the age groups ($p>0.05$) showed no significant difference. However, the values between temporalis and masseter and the values between men and women for each session revealed a significant difference ($p<0.05$). **Conclusion:** The masseter and temporalis pain threshold values were reduced 10 min after chewing. The values in both sides of the masseter and temporalis muscles and in different age groups were the same. The temporal muscle and men showed a higher pain threshold than the masseter muscle and women, respectively.

Keywords: Temporomandibular Joint Disorders; Pain Threshold; Masseter Muscle.

Introduction

Almost all activities in the lives of humans require body movements. Even for eating, humans need to move their jaws for masticating and swallowing before the food enters the gastrointestinal system. However, excessive mastication activity could be harmful for the muscles in the body. In this case, the muscles that are used for mastication are at an increased risk of temporomandibular disorders (TMDs), which limit the movement in mastication, decrease the productivity, and lower the person's nutritional intake. Because mastication is an important activity for survival, individuals always find ways to prevent pain or injuries that could disturb their eating activity [1]. However, most Indonesians still lack awareness of the importance of preventing pain or injury in the mastication muscles. Moreover, people are unaware that excessive mastication can be harmful to the muscles. Thus, several patients who visit their doctors already have TMD and require a complicated, risky, time-consuming, and expensive treatment.

The presence of muscle pain or increased pain due to muscle palpation on physical examination can indicate the source of pain and facilitate diagnosis. The level of pressure from the fingers can affect the results of palpation examination, and the patient's response toward palpation may differ from time to time. Muscle palpation has been proven to provide reliable results. Masseter and temporalis muscles can be palpated bilaterally to identify differences in size, stiffness, and pain threshold. In this study, an algometer, which is a device that determines the amount of pressure administered when palpating muscles, was used. This instrument increases the reliability of examining pain sensitivity, which in this case is the pain threshold [1].

The pain threshold value can be used as a reference to measure the pain thresholds of various muscles, including the craniofacial ones such as the masseter and temporal muscles [1,2]. These muscles display variations in the pain level, and increased sensitivity is known to play an important role in the pathogenesis of the disorders and painful conditions related to the craniofacial area, such as TMD and headaches [3,4]. The pain threshold value is found to be lower in subjects with disrupted muscles than in healthy subjects [1,2]. However, even under normal conditions and in healthy populations, there is a possibility of different muscle sensitivities toward mechanical stimulation, which can be measured using an alogemeter.

The objective of this study was to analyze the values of pain thresholds in the masseter and temporal muscles before and after 5 and 10 min of mastication activity.

Material and Methods

Study Design and Sample

This research was a cross-sectional design. A total of 43 subjects aged 17-45 years, consisting of 20 men and 23 women were willing to participate in the study and fulfilled the inclusion criteria. The subjects had to undergo the intraoral and extraoral examination procedures as well as the interview about their identity and medical history. The study was performed in Dental Hospital of Universitas Indonesia.

The subjects were included based on the following criteria: healthy, no TMD (based on ID-TMD measurement), age 17–45 years, mouth opening (ROM) >40 mm, presence of a complete set of teeth, and lateral jaw movement >6 mm [5]. The exclusion criteria was the unwillingness to sign the consent form.

Data Collection

The study measured the pain thresholds of masseter and temporal muscles with an algometer before and after a mastication intervention using the bubble gum Xylitol for 5 and 10 min. The algometer tip was positioned in the masseter and temporal muscles until the individual described the pain. The value shown by the algometer was considered as pain threshold. Data collection were performed by a single experienced examiner.

Ethical Aspects

The research has been approved by Bioethics Committee Faculty of Dentistry University of Indonesia (Number: 8/Ethical Approval/FKGUI/II/2017) on February 13th 2017.

Data Analysis

The values of the muscles before and after mastication at the 5th and 10 th were analyzed using Repeated ANOVA. A difference in the values between the left and right sides of the muscles were analyzed using independent t-test, and among the age groups using one-way ANOVA. However, the values between temporalis and masseter and the values between men and women for each session were analyzed using independent t-test. All the tests were conducted with SPSS version 22 20 (IBM Corp., Armonk, NY, USA), with a 5 % significance level.

Results

The respondents' distribution based on the sociodemographic status is shown in Table 1. The number of women participants was higher and respondents aged 26-35 years (young adults) were the majority.

Table 1. Distribution of subjects by sex and age.

Variables	N	%
Sex		
Male	20	46.5
Female	23	53.5
Age		
Late Teen (17–25 Years)	18	41.9
Young Adult (26–35 Years)	20	46.5
Late Adult (36–45 Years)	5	11.6

Data collected from the pain threshold examination using an algometer were later tested for their normality. The results of repeated ANOVA from the normally distributed data are presented in Table 2.

Based on multivariate testing, it can be concluded that at least 2 measurements were different; thus, a post-hoc pairwise comparison test was performed to know which sessions were different by comparing the previous measurement of before mastication with after 5 min, before mastication with after 10 min, and after 5 min of mastication with after 10 min. All data have a statistically significant difference in the pain thresholds of the temporal and masseter muscles that were measured before mastication and after 5 min, before mastication and after 10 min, and after 5 min, and 10 min of mastication.

Table 2. Mean and standard deviation before and after mastication according to time.

Muscle	Time	Mean (SD) KgF	p-value*
Left Temporalis	Before Mastication	1.93 (0.16)	<0.001
	After Mastication at 5 Minutes	1.88 (0.15)	
	After Mastication at 10 Minutes	1.82 (0.15)	
Left Masseter	Before Mastication	1.80 (0.15)	<0.001
	After Mastication at 5 Minutes	1.78 (0.15)	
	After Mastication at 10 Minutes	1.70 (0.15)	
Right Temporalis	Before Mastication	1.92 (0.15)	<0.001
	After Mastication at 5 Minutes	1.87 (0.15)	
	After Mastication at 10 Minutes	1.80 (0.15)	
Right Masseter	Before Mastication	1.79 (0.16)	<0.001
	After Mastication at 5 Minutes	1.73 (0.15)	
	After Mastication at 10 Minutes	1.67 (0.15)	

*Repeated ANOVA test; Post-hoc analysis.

Data regarding the difference between the pain thresholds of the masseter and temporal muscles on the same side in each session are displayed in Table 3.

Table 3. Difference of pain threshold between masseter and temporal muscles at the same side in each session.

Time	Muscle	Mean (SD) KgF	p-value	95% CI
Before Mastication	Left Temporalis	1.93 (0.16)	0.001	0.12 (0.05–0.19)
	Left Masseter	1.80 (0.15)		
	Right Temporalis	1.92 (0.15)	0.000	0.14 (0.07–0.20)
	Right Masseter	1.79 (0.16)		
After Mastication at 5 minutes	Left Temporalis	1.88 (0.15)	0.000	0.15 (0.09–0.22)
	Left Masseter	1.73 (0.15)		
	Right Temporalis	1.87 (0.15)	0.000	0.14 (0.75–0.20)
	Right Masseter	1.73 (0.15)		
After Mastication at 10 minutes	Left Temporalis	1.82 (0.15)	0.001	0.11(0.05–0.18)
	Left Masseter	1.70 (0.15)		
	Right Temporalis	1.80 (0.15)	0.000	0.13 (0.06–0.19)
	Right Masseter	1.67 (0.15)		

Independent T-Test.

There were significant differences between the pain thresholds of the temporal and masseter muscles on each side before mastication, after 5 min of mastication, and after 10 min ($p<0.05$) (Table

4). There were significant differences in the pain thresholds between the left and right temporal muscles, as well as in the left and right masseter muscles before mastication, after 5 min, and after 10 min ($p<0.05$).

Data regarding the difference between the pain thresholds of men and women for each muscle are presented in Table 5. There was a statistically significant difference between the pain thresholds of men and women in all the muscles before mastication, after 5 min, and after 10 min ($p<0.05$).

Table 4. Difference of pain threshold between the right side and left side of each muscle in each session.

Time	Muscle	Mean (SD) KgF	p-value	95% CI
Before Mastication	Left Temporalis	1.92 (0.20)	0.603	-0.02 (-0.12–0.07)
	Right Temporalis	1.94 (0.25)		
	Left Masseter	1.75 (0.21)	0.946	-0.03 (-0.12–0.11)
	Right Masseter	1.76 (0.31)		
After Mastication at 5 minutes	Left Temporalis	1.86 (0.19)	0.514	-0.03 (-0.12–0.06)
	Right Temporalis	1.89 (0.24)		
	Left Masseter	1.75 (0.27)	0.568	0.03 (-0.08–0.15)
	Right Masseter	1.72 (0.30)		
After Mastication at 10 minutes	Left Temporalis	1.43 (0.27)	0.265	-0.06 (-0.18–0.05)
	Right Temporalis	1.50 (0.29)		
	Left Masseter	1.27 (0.27)	0.662	0.03 (-0.11–0.17)
	Right Masseter	1.24 (0.24)		

Independent T-Test.

Table 5. Difference in pain threshold between male and female subjects.

Muscle	Sex	Mean (SD) KgF	p-value	95% CI
Left Temporalis Before Mastication	Male	1.99 (0.14)	0.013	0.11 (0.02–0.2)
	Female	1.87 (0.14)		
Left Masseter Before Mastication	Male	1.88 (0.13)	0.003	0.13 (0.04–0.22)
	Female	1.74 (0.14)		
Right Temporalis Before Mastication	Male	1.98 (0.14)	0.011	0.11 (0.02–0.2)
	Female	1.86 (0.14)		
Right Masseter Before Mastication	Male	1.87 (0.11)	0.000	0.16 (0.8–0.24)
	Female	1.71 (0.14)		
Left Temporalis at 5 Minutes	Male	1.94 (0.14)	0.013	0.11 (0.02–0.2)
	Female	1.83 (0.14)		
Left Masseter at 5 Minutes	Male	1.84 (0.12)	0.007	0.11 (0.03–0.2)
	Female	1.72 (0.14)		
Right Temporalis at 5 Minutes	Male	1.93 (0.14)	0.013	0.11 (0.02–0.2)
	Female	1.81 (0.14)		
Right Masseter at 5 Minutes	Male	1.81 (0.11)	0.000	0.16 (0.07–0.24)
	Female	1.65 (0.14)		
Left Temporalis at 10 Minutes	Male	1.88 (0.14)	0.018	0.1 (0.1–0.19)
	Female	1.77 (0.14)		
Left Masseter at 10 Minutes	Male	1.77 (0.12)	0.004	0.12 (0.04–0.21)
	Female	1.65 (0.15)		
Right Temporalis at 10 Minutes	Male	1.86 (0.13)	0.006	0.12 (0.03–0.21)
	Female	1.73 (0.14)		
Right Masseter at 10 Minutes	Male	1.75 (0.11)	0.001	0.15 (0.07–0.23)
	Female	1.59 (0.14)		

There was no difference in pain threshold between the 3 age groups in each session (p>0.05) (Table 6).

Table 6. Difference in pain threshold among age groups.

Muscle	Age	N	Mean (SD) KgF	p-value
Temporalis Left Before Mastication	Late Teen	18	1.97 (0.16)	0.249
	Young Adult	20	1.90 (0.14)	
	Late Adult	5	1.86 (0.13)	
Masseter Left Before Mastication	Late Teen	18	1.85 (0.14)	0.174
	Young Adult	20	1.78 (0.15)	
	Late Adult	5	1.72 (0.14)	
Temporalis Right Before Mastication	Late Teen	18	1.96 (0.15)	0.236
	Young Adult	20	1.89 (0.15)	
	Late Adult	5	1.86 (0.14)	
Masseter Right Before Mastication	Late Teen	18	1.82 (0.15)	0.153
	Young Adult	20	1.78 (0.15)	
	Late Adult	5	1.67 (0.16)	
Temporalis Left at 5 Minutes	Late Teen	18	1.92 (0.15)	0.223
	Young Adult	20	1.85 (0.15)	
	Late Adult	5	1.81 (0.13)	
Masseter Left at 5 Minutes	Late Teen	18	1.82 (0.13)	0.186
	Young Adult	20	1.76 (0.14)	
	Late Adult	5	1.69 (0.14)	
Temporalis Right at 5 Minutes	Late Teen	18	1.92 (0.16)	0.200
	Young Adult	20	1.84 (0.14)	
	Late Adult	5	1.80 (0.13)	
Masseter Right at 5 Minutes	Late Teen	18	1.76 (0.14)	0.171
	Young Adult	20	1.73 (0.15)	
	Late Adult	5	1.61 (0.15)	
Temporalis Left at 10 Minutes	Late Teen	18	1.86 (0.15)	0.253
	Young Adult	20	1.80 (0.14)	
	Late Adult	5	1.76 (0.14)	
Masseter Left at 10 Minutes	Late Teen	18	1.75 (0.14)	0.173
	Young Adult	20	1.69 (0.15)	
	Late Adult	5	1.62 (0.14)	
Temporalis Right at 10 Minutes	Late Teen	18	1.84 (0.14)	0.223
	Young Adult	20	1.76 (0.16)	
	Late Adult	5	1.75 (0.14)	
Masseter Right at 10 Minutes	Late Teen	18	1.69 (0.14)	0.156
	Young Adult	20	1.67 (0.15)	
	Late Adult	5	1.55 (0.15)	

One-way ANOVA test.

Discussion

This study was performed on 43 subjects, who were bachelor's degree students and resident doctors in the Faculty of Dentistry, Universitas Indonesia, thereby allowing all data collection to be performed in the same location.

All the subjects were expected to have a decreased pain threshold score in the temporal and masseter muscles after 10 min of mastication activity, and a valid score was obtained before it went back to normal. The main hypothesis was that there would be a significant difference in the pain

thresholds of the muscles before and after mastication activities. This is aligned with the previous studies in which a significant change in the pain threshold was observed when comparing the scores before and after mastication activity. This study further supports the earlier reports that stated a significant difference in pain threshold after the mastication activity [6,7].

Examination of both the temporal and masseter muscles on each side revealed a similar pattern in the pain threshold, with decreased pain threshold from before and after mastication. In previous studies, it was reported that the masseter muscle is more sensitive and that this anatomical area is the most appropriate one to be used as a pain predictor when compared with others, including the temporal muscle. This is because the masseter muscle has more receptors and blood vessels than the temporal muscle. We attempted to find the difference in the pain threshold between the masseter and temporal muscles on each side and found significant differences for each session. Furthermore, we calculated the mean pain threshold value for the masseter muscle (1.76 KgF/cm^2) and the temporal muscle (19.93 KgF/cm^2) in non-TMD subjects. Thus, it can be concluded that there was a significant difference in the pain thresholds of the two muscles. A different measuring device protocol of DC/TMD, created in 2014, stated that the ideal pressure on the temporal and masseter muscles were both 1 KgF/cm [4,5].

Regarding the difference in pain threshold between the left and right sides of the temporal and masseter muscles, we found no significant difference between the two sides of both the muscles before and after mastication. This may be because we did not include potential subjects with teeth loss and those with the habit of masticating on one side owing to tooth loss on the other side. These factors may affect our study results for pain threshold, because previous studies stated that there is a low pain threshold on the masticating side, especially with a long duration of mastication [8].

The next hypothesis is that there is a significant difference in the pain threshold between men and women, with men usually showing a higher threshold in the temporal and masseter muscles after masticating [9,10]. Several investigations have reported that gender is a determining factor in pain sensation and, although the underlying mechanism has been extensively studied, the exact physiological and psychological reasons remain unclear and need to be further explored. In this study, we found a significant difference when measuring the pain threshold before and after mastication, in all areas of the muscles used for mastication after comparing men and women had a significant difference.

The last hypothesis is that there is a significant difference in pain threshold between the 3 age groups of late teenagers, young adults, and late adults. However, this study did not determine any significant difference between the age groups before and after 5 and 10 min of mastication. This may be due to the results being affected by the limited number of samples. In research performed previously, no correlation was noted between age and pain threshold for all healthy subjects [11,12].

The limitation of the current study was only examining the temporalis and masseter muscles, and not including other masticatory muscles such as digastricus, mylohyoid, geniohyoid,

stylohyoid, lateral pterygoid and medial pterygoid. The subjects were less varied because only healthy subjects that are included, without TMD subjects.

The implication of this study is by knowing the value standards of pain threshold before and after chewing, we can do the early detection of temporomandibular disorder (TMD) as soon as you found the symptoms like pain so they are more easily diagnosed and treated since TMD can lead to more serious conditions. The pain threshold over the masseter muscle, demonstrating that patients with more severe signs and symptoms of TMD have a lower pain threshold [13-15].

Conclusion

Our results indicated a significant decrease in the pain thresholds of the masseter and temporal muscles before and after masticating for 5 and 10 min. The pain threshold scores of the left and right muscles in each age group were the same, while the scores of the temporal muscle was higher than that of the masseter muscle. Moreover, there was a significant difference in the pain threshold between the genders with men have higher thresholds than women. The average can be used as a standard value for pain threshold.

Authors' Contributions: APS designed the study, performed the experiment and wrote the manuscript. LSH and IT designed the study and reviewed the manuscript.

Financial Support: This work was supported by grant from Universitas Indonesia (Hibah PITTA).

Conflict of Interest: The authors declare no conflicts of interest.

References

[1] Poluha RL, Pereira MC, Silva RD. Comparison of pressure pain threshold between muscles on the contracted and relaxed state in patients with myofacial pain: A cross-sectional study. Stomatologija 2019; 21(1):18-21.

[2] Bezov D, Ashina S, Jensen R, Bendtsen L. Pain perception studies in tension-type headache. Headache 2011; 51(2):262-71. https://doi.org/10.1111/j.1526-4610.2010.01768.x

[3] Cairns BE. Pathophysiology of TMD pain - Basic mechanisms and their implications for pharmacotherapy. J Oral Rehabil 2010; 37(6):391-410. https://doi.org/10.1111/j.1365-2842.2010.02074.x

[4] Frank L, McLaughlin P, Vaughan B. The repeatability of pressure algometry in asymptomatic individuals over consecutive days. Int J Osteopath Med 2013; 16(3):143-52. https://doi.org/10.1016/j.ijosm.2012.10.004

[5] 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. J Oral Facial Pain Headache 2014; 28(1):6-27. https://doi.org/10.11607/jop.1151

[6] Koutris M, Lobbezoo F, Naeije M, Wang K, Svensson P, Arendt-Nielsen L, et al. Effects of intense chewing exercises on the masticatory sensory-motor system. J Dent Res 2009; 88(7):658-62. https://doi.org/10.1177/0022034509338573

[7] Glas J, Rohlin A, Häggman-Henrikson B, Österlund C. Effect of excessive chewing on pain thresholds. Independent Thesis Advanced Level (Degree of Master), 2014. Available at: https://pdfs.semanticscholar.org/54cd/80321ff1f42ffc150544899efb47cb3aab08.pdf. [Accessed on Dec 5, 2018].

[8] Ohrbach R. Diagnostic criteria for temporomandibular disorders clinical protocol and assessment instruments. International RDC/TMD Consortium Network; 2014. Available at: https://ubwp.buffalo.edu/rdc-tmdinternational. [Accessed on Dec 8, 2018].

[9] Okayasu I, Oi K, De Laat A. The effect of tooth clenching on the sensory and pain perception in the oro-facial region of symptom-free men and women. J Oral Rehabil 2009; 36(7):476-82. https://doi.org/10.1111/j.1365-2842.2009.01961.x

[10] Maurer AJ, Lissounov A, Knezevic I, Candido KD, Knezevic NN. Pain and sex hormones: A review of current understanding. Pain Manag 2016; 6(3):285-96. https://doi.org/10.2217/pmt-2015-0002

[11] Barbosa JS. Pressure pain threshold and pain perception in temporomandibular disorder patients: Is there any correlation? Rev Dor 2015; 16(1):22-6. https://doi.org/10.5935/1806-0013.20150005

[12] Graue AM, Jokstad A, Assmus J, Skeie MS. Prevalence among adolescents in Bergen, Western Norway, of temporomandibular disorders according to the DC/TMD criteria and examination protocol. Acta Odontol Scand 2016; 74(6):449-55. https://doi.org/10.1080/00016357.2016

[13] Herpich CM, Gomes CAFP, Dibai-Filho AV, Politti F, Souza CDS, Biasotto-Gonzalez DA. Correlation between severity of temporomandibular disorder, pain intensity, and pressure painthreshold. J Manipulative Physiol Ther 2018; 41(1):47-51. https://doi.org/10.1016/j.jmpt.2017.08.001

[14] La Touche R, Paris-Alemany A, Hidalgo-Pérez A, López-de-Uralde-Villanueva I, Angulo-Diaz-Parreño S, MuñozGarcía D. Evidence for central sensitization in patients with temporomandibular disorders: a systematic review and meta-analysis of observational studies. Pain Pract 2018; 18(3):388-409. https://doi.org/10.1111/papr.12604

[15] Vinholi GH. Change of pain threshold in patients with muscle disorder subjected to conservative treatment. Int Res H Public Health 2019; 3:26.