UCSF

UC San Francisco Previously Published Works

Title

Reproducibility of visual analog scale (VAS) pain scores to mechanical pressure

Permalink

<https://escholarship.org/uc/item/77k572s8>

Journal

Cranio-The Journal of Craniomandibular Practice, 22(3)

ISSN

0886-9634

Authors

Goddard, Greg
Karibe, H
McNeill, C

Publication Date

2004-07-01

Supplemental Material

<https://escholarship.org/uc/item/77k572s8#supplemental>

Peer reviewed

Reproducibility of Visual Analog Scale (VAS) Pain Scores to Mechanical Pressure

Greg Goddard, DDS

Associate Clinical Professor
Center for Orofacial pain
Department of Oral and Maxillofacial Surgery
University of California San Francisco
San Francisco, CA

Hiroyuki Karibe, DDS, PhD

Visiting Research Fellow
Center for Orofacial pain
Department of Oral and Maxillofacial Surgery
University of California San Francisco
San Francisco, CA

Associate Professor
Department of Orthodontics & Pediatric Dentistry
Nippon Dental University Hospital
Tokyo, Japan

Charles McNeill, DDS

Professor
Center for Orofacial pain
Department of Oral and Maxillofacial Surgery
University of California San Francisco
San Francisco, CA

Correspondence to:

Dr. Greg Goddard
Center for Orofacial pain
Department of Oral and Maxillofacial Surgery
University of California San Francisco
707 Parnassus Ave. D-1050
San Francisco, CA 94143-0768
Phone: (415) 476-2522
Fax: (415) 502-6489
E-mail: goddard@itsa.ucsf.edu

Abstract

Aims: The present study tested the reproducibility of visual analog scale (VAS) pain scores to measure changes in masseter muscle pain evoked by maximally tolerable mechanical stimulation over a short time period in healthy subjects. . This study also evaluated gender differences in reproducibility of VAS scores to mechanical stimulation. **Methods:** Ten healthy female and eight healthy male individuals participated in this study. The recordings of VAS pain scores to an identical mechanical pressure on the masseter muscle were performed at 3 different sessions (T1, T2 and T3). The subjects rated their pain on a VAS to a maximally tolerable stimulus that was recorded on an algometer at the first session. The algometer pressure reading was recorded for each subject and used to duplicate the same identical mechanical stimulus at each of the three sessions. This identical pressure was repeated in the same marked spot at 6 minutes and after another 30 minutes. The subject rated the pain on a VAS to this identical stimulus at each session. **Results:** There was no significant difference to VAS pain scores of all subjects at T1, T2, and T3. There was no significant difference in reproducibility of VAS pain scores in females compared to males. Intraclass correlation coefficients were 0.811 on the right masseter and 0.844 on the left masseter. **Conclusion:** In this study VAS pain scores to mechanical stimulation were reproducible over a short time period. Gender did not affect the reproducibility. This previously unreported method of measuring pain to repeated identical mechanical stimulation appears to have potential for both clinical and research application.

Key Words: visual analog scale, pain scores, masseter muscle, pressure pain threshold, algometer

Introduction

The most common method of assessing muscle pain is by finger palpation¹⁻⁴, however, quantification and reproducibility are difficult with this method.

Pressure algometry has been used to quantify muscle pain in the jaws and limbs.⁵⁻¹³ The algometer is a pressure (force) gauge calibrated in pounds of force attached to a plunger that is pressed over a subjects muscle. A number of published studies have used the pressure pain threshold algometer reading as their measurement.⁵⁻¹³ This method utilizes the patient telling the operator when the algometer pressure first turns to pain. The pressure is recorded from the algometer gauge and the recordings are compared over time. Some studies have indicated that pressure pain recordings were reliable^{6,7}, while others have shown they are not reliable.^{8,9}

On the other hand, VAS pain scores have long been a reliable standard for assessing pain.^{14,15} We designed an original model of assessing muscle pain to use in our clinical trials. This model is to assess the VAS pain scores to a measured mechanical stimulus on the muscle at different time periods. If time course had no effect on the VAS pain score to an identical mechanical stimulus, it might be useful to use this model for assessing pain between periods.

Therefore, the purpose of this study was to test the reproducibility of the subject rating their pain from a measured mechanical stimulus on a visual analog scale (VAS; 0-100mm) over a short time period.

Materials and Method

Subjects

Eighteen healthy subjects (10 females and 8 males) were recruited into the study. The mean age and standard deviation for the 10 females was 35.8 ± 7.6 years, and was 28.5 ± 5.2

years for the 8 males. They all signed a consent form approved by the University of California at San Francisco Committee on Human Research. Inclusion criteria was a healthy adult 18 years of age or older. Exclusion criteria were masseter muscle pain to palpation at the time of the experiment, a VAS rating of more than zero at the beginning of the experiment, a history of pain on chewing in the past week, any prescription pain medications including tricyclic antidepressants and over the counter aspirin, tylenol and NSAID's, in the last 24 hours, and current treatment for TMD that was ongoing at the time of the experiment.

Apparatus

The hand-held pressure algometer measures the pressure being applied to a certain area. A Wagner algometer (model FDK 10, Wagner Instruments, Greenwich, CT) was used. It is calibrated by the factory to meet the specified accuracy of $\pm 1\%$ of full scale. The tip size was 7mm. by 7mm. square. Measurements were recorded in pounds of pressure and pressure was applied at a constant rate of 1 pound per second.

Recording Procedures

The time course of the experiment was shown in Fig 1. The following process was performed by the same investigator. All subjects were seated in a dental chair in the upright position in a room with one researcher.

1. The right and left masseter muscles were marked extraorally in the approximate center of the muscle with a 5 millimeter diameter sticker.
2. A baseline VAS (0-100mm) pain score of the subject's masseter muscle at rest was recorded by the subject (BL1). The VAS was a 100 mm. line anchored by the words "no pain" and "the most pain I can imagine".

3. An algometer was pressed perpendicularly to the muscle on the marked spot at the constant rate of 1 pound per second on the subject's right side. The subject was instructed to keep their teeth apart. The subject was instructed to raise their hand when the pain became the "most they could stand". The algometer pressure reading was recorded and this same pressure was used for that subject at the next two pressure recordings. Subject then rated their pain to the mechanical stimulation from the algometer pressure on a VAS (T1). This procedure was repeated on the subject's left side. This VAS rating was used as baseline.
4. The algometer pressure reading was recorded at that point so that the same pressure could be duplicated at 6 minutes after (T2) and again at another 30 minutes after (T3).

At 6 minutes after T1, a second baseline VAS pain score at rest was recorded before the second mechanical stimulation (BL2). Then the algometer was pressed at a rate of 1 pound per second on the right side marked spot until the previously recorded pressure was reached. The subject was again asked to rate their pain on a VAS (T2). This was repeated for the other side.⁶

At 30 minutes after T2, a third baseline VAS pain score was recorded before the third mechanical stimulation (BL3). Then the algometer was again pressed at a rate of 1 pound per second on the right side marked spot until the previously recorded pressure was reached. The subject was again asked to rate their pain on a VAS (T3). This was repeated for the other side.

Statistical Analysis

The significance of the change in VAS pain scores to mechanical stimulation during the three consecutive recordings was performed with repeated measures ANOVA. Pearson's correlation coefficient and the intraclass correlation coefficient of reliability were calculated to

quantify the reproducibility of the measurements. The data were analyzed with a commercial statistical software package (Stat View ver. 4.5 Abacus Concepts and SPSS 10.0 for Windows). A significance level below 0.05 was considered significant.

Results

There was no significant difference to VAS pain scores of all subjects on both masseter muscles among three sessions (repeated measures ANOVA, $p=0.733$ on the right masseter muscle, $p=0.314$ on the left masseter muscle). (Fig 2)

Pearson's correlation coefficients of the VAS pain scores to algometer pressure between sessions ranged from 0.791 to 0.876 on the right masseter muscle (Table 1) and from 0.862 to 0.933 on the left masseter muscle (Table 2). Intraclass correlation coefficients (r) of the VAS pain scores to algometer pressure among sessions were 0.811 on the right masseter muscle and 0.844 on the left masseter muscle.

There was no significant difference in change of VAS pain scores of females over three sessions compared to males. (Table 3, Fig. 3 and Fig. 4) (ANOVA, $p=0.617$ on the right masseter, $p=0.815$ on the left masseter).

Maximally tolerable mechanical pressure on masseter muscles in each subject was showed in Table 4. There was no significant difference in maximally tolerable mechanical pressure on masseter muscles of females compared to males. (t-test, $t=-0.651$, $p=0.520$)

Discussion

There are many variables in measuring muscle pain with an algometer. Subjects were all seated upright in a dental chair in a separate room with only the operator in the room. The problem of using the same location on the muscle was addressed by marking the spot with a sticker, so that the same location could be repeatedly used. We also used the same operator and the same calibrated algometer for all subjects. The operator used the same rate of pressure (one pound of pressure per second) at each measurement on each subject. The duration of pressure varied for each subject, from 2.2 seconds to 9.6 seconds. The pressure required to elicit the maximally tolerable pain response from the subject was recorded and this enabled the operator to repeat the same pressure for that individual subject at subsequent times. Each individual subject had their own specific maximally tolerable magnitude of pressure that was recorded and repeated by using the algometer.

We chose to test VAS pain scores to mechanical pressure at 6 minutes and 30 minutes, because we designed this model to use in two of our clinical trials. Trial one was on the effect of a 6 minute chewing test on muscle pain and trial two was on the effect of 30 minutes of acupuncture treatment on muscle pain.

Some studies have shown that algometer pressure pain threshold measurements are not reproducible in consecutive measurements.^{8,9} Residual pain from the previous algometer pressure has been thought to affect the reading. To address this, we took baseline VAS pain scores at rest and repeated these baseline scores before each algometer measurement. All initial

baseline scores were 0 mm. However, at the end of the first resting period (BL2), one subject had a score of 2 mm. At the end of the second resting period (BL3), five subjects had scores above 0 mm (2 mm, 3 mm, 3 mm, 12 mm and 15 mm). This was not considered clinically relevant for the scores of 2 mm, 3 mm and 3 mm, since a VAS score of less than 10 mm on a 100 mm is minimal pain. For the scores of 12 mm and 15 mm, which were also considered minimal, this did not seem to effect the next VAS pain score to algometer pressure as they both went down compared to the first algometer VAS score. These slightly elevated (BL3) VAS scores could be due to residual pain from the previous algometer pressure or due to pain variation over time.

Subject variation to algometer pressure over repeated measures was controlled by only recording the first algometer pressure measurement. We repeated this same pressure at each time interval. The subject then only had to mark their VAS pain response to their maximally tolerable pressure. VAS has been shown to be a reliable and valid measurement for pain.^{14,15}

This study shows that the VAS pain scores to maximally tolerable mechanical stimulation using an algometer to reproduce the identical amount of pressure for that subject are very reproducible. The absolute mean VAS scores between the three sessions did not vary more than 5mm on a 100mm scale. Intraclass correlation coefficient of reliability (r) was 0.811 on right masseter and 0.884 on left masseter, which shows an excellent degree of reliability. In general, r-values of 0.75 and above represent excellent reliability.¹⁶⁻¹⁸

Our study did not show any gender difference in reproducibility and this is consistent with other algometer studies of the masticatory muscles.^{5,19,20} A previous study indicates that women report more severe pain, more frequent pain, and pain of longer duration than do men.²¹ At the level of masticatory muscles, myofascial pain has been reported to worsen during the menstrual and premenstrual periods²². In our study, all the participants were healthy subjects and

intervals of mechanical stimulation were short time periods (i.e. 6 minutes and 30 minutes). We suppose that is why gender did not affect the reproducibility in this experiment.

This method also needs to be tested on other muscles as well as over the long term. However, this method of measuring pressure-pain response appears to have potential for both clinical and research application.

Conclusion

In this study VAS pain scores to maximally tolerable mechanical stimulation were reproducible over a short time period. Gender did not affect the reproducibility. This previously unreported method of measuring pain to repeated identical mechanical stimulation appears to have potential for both clinical and research application.

References

1. Helkimo M. Epidemiological surveys of dysfunction of the masticatory system. In: Zarb GA, Carlsson GE (eds). Temporomandibular Joint function and Dysfunction. St Louis: CV Mosby, 1979; 175-192.
2. Krough-Poulsen W. Klinisk undersogelse. In: Krough-Poulsen W, Carlsen O (eds). Bidfunktion, Bettfysiologi, Patofunktion. Copenhagen: Munksgaard, 1974; 423-463.

3. Duinkerke ASH, Luteijn F, Bouman TK, DeJong HP. Reproducibility of a palpation test for the stomatognathic system. *Community Dent Oral Epidemiol* 1986 ;14:80-86.
4. Carlsen GE, Helkimo M, Agerberg G. Observer differences in clinical function examination of the masticatory system.(English summary) *Tandlakartidningen* 1974; 66:565-572.
5. Jensen K, Orbaek Andersen H, Olesen J, Lindblom U. Pressure-pain threshold in human temporal region. Evaluation of a new pressure algometer. *Pain* 1986 ;25:313-323.
6. Fischer AA. Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. *Pain* 1987 ;30:115-126.
7. Reeves JL, Jaeger B, Graff-Radford SB. Reliability of pressure algometer as a measure of myofascial trigger point sensitivity. *Pain* 1986 ;24:313-321.
8. Fredrikssen L, Alstergren P, Kopp S. Absolute and relative facial pressure-pain thresholds in healthy individuals. *J Orofac Pain* 2000; 14: 98-104.
9. Isselee H, DeLaat A, Bogaerts K, Lysens R. Short-term reproducibility of pressure pain thresholds in masticatory muscles measured with a new algometer. *J Orofac Pain* 1998; 12:203-209.
10. Graven-Nielsen T, Babenko V, Svensson P, Arendt-Nielsen L. Experimentally induced muscle pain induces hypoalgesia in heterotopic deep tissues, but not in homotopic deep tissues. *Brain Res* 1998; 787: 203-210.
11. McMillan AS, Nolan A, Kelly PJ. The efficacy of dry needling and Procaine in the treatment of myofascial pain in the jaw muscles. *J Orofac Pain* 1997; 11: 307-314.
12. Norholt SE, Aagaard E, Svensson P, Sindet-Petersen S. Evaluation of trismus, bite force, and pressure algometry after third molar surgery: A placebo-controlled study of ibuprofen. *J Oral Maxillofac Surg* 1998; 54: 420-427.

13. Reid KI, Gracely RH, Dubner RA. The influence of time, facial side, and location on pain-pressure thresholds in chronic myogenous temporomandibular disorder. *J Orofac Pain* 1994; 8: 258-265.
14. Revill SI, Robinson M, Rosen M, Hogg MIJ. The reliability of a linear analogue for evaluating pain. *Anesthesia* 1976; 31: 1191-1198.
15. Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain* 1983; 17: 45-56.
16. Zonnenberg AJJ, Van Maanen CJ, Elvers JWH, Oostendorp RAB. Intra/interrater reliability of measurements on body posture photographs. *J Craniomandib Pract* 1996; 14: 326-331.
17. Becser N, Sand T, Zwart JA. Reliability of cephalic thermal thresholds in healthy subjects. *Cephalalgia* 1998; 18: 574-582.
18. Gallo LM, Svoboda A, Palla S. Reproducibility of temporomandibular joint clicking. *J Orofac Pain* 2000; 14: 293-302.
19. Ohrbach R, Gale EN. Pressure pain thresholds, clinical assessment, and differential diagnosis: Reliability and validity in patients with myogenic pain. *Pain* 1989; 39: 157-169.
20. Isselee H, De Laat A, Lesaffre E, Lysens R. Short-term reproducibility of pressure pain thresholds in masseter and temporalis muscles of symptom-free subjects. *Eur J Oral Sci* 1997; 105: 583-587.
21. Unruh AM. Gender variations in clinical pain experience. *Pain* 1996; 65: 123-167.
22. Dao TTT, Knight K, Ton-That V. Modulation of myofascial pain patterns by oral contraceptives: a preliminary report. *J Dent Res* 1997; 76:148.)