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Validity and reliability of the Egyptian algometer in patients with bruxism

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Abstract

Introduction. Pressure pain threshold has been quantified by using a gold standard algometer in patients with bruxism. However, the expense associated with quantifying pressure pain threshold to detect trigger points with a gold standard algometer precludes its use in the clinic. This study aimed to measure the reliability and validity of the more accessible Egyptian algometer for pressure pain threshold evaluation in patients with bruxism.
Methods. A descriptive repeated-measures study was performed among 100 participants with bruxism. Pressure pain threshold values were collected from the left temporalis, right temporalis, left masseter, and right masseter muscles with the participants sitting. Pressure pain thresholds were assessed over 2 sessions separated by a 1-week interval.
Results. Intraclass correlation coefficient (ICC) determined the intra-rater reliability and Pearson correlation analysis determined the validity of the Egyptian algometer. ICC equalled 0.878, 0.785, 0.896, and 0.903 for the right masseter, left masseter, right temporalis, and left temporalis muscles, respectively. The standard error of measurement ranged from 0.24 to 0.5, the minimal detectable difference ranged from 0.66 to 1.41, ICC ranged from 0.785 to 0.903. Pearson correlation values were 0.673, 0.670, 0.408, and 0.705 for the right masseter, left masseter, right temporalis, and left temporalis muscles, respectively.
Conclusions. High ICCs indicated a strong agreement between the measurement systems, suggesting that the Egyptian algometer is a reliable and valid device for quantification of pressure pain threshold in patients with bruxism.
Key words: algometer, validity, reliability, bruxism

Introduction

Bruxism is defined as a stereotyped movement disorder involving grinding or clenching the teeth during sleep, which may be a reason for permanent temporomandibular disorder due to prolonged mechanical stimulation of the masticatory system. The disorder is characterized by the presence of active myofascial trigger points (MTrPs) [1], which are hypersensitive spots located in tight muscles. The masseter and temporalis are the muscles most commonly presenting with active MTrPs in patients with temporomandibular disorder [2]. Quantification of pain associated with active MTrPs is a fundamental component of physical examination and treatment in patients with temporomanidibular disorder. Difficulty quantifying pain clinically in these individuals may underlie the pain persistence [2].

Algometers have been widely used to quantify soft tissue pain associated with active MTrPs by measuring the pressure pain threshold (PPT) and to evaluate the effectiveness of treatment interventions implemented to reduce pain. PPT is the point where a subject perceives pain upon the application of a force stimulus or pressure [3]. PPT values have been used in evaluating a variety of musculoskeletal disorders, which include fibromyalgia, arthritis, spinal conditions, and myofascial pain syndrome [4–7].

The algometer has been shown to be a reliable tool for quantifying PPT [8–10]. However, the expense associated with assessing pain with gold standard algometers precludes their use in the clinic. The Egyptian algometers are more available on the market than the gold standard algometers owing to importing issues, which makes them more affordable and practical for quantification of pain in clinics. Therefore, this study aimed at determining the validity and reliability of the Egyptian algometer in the measurement of PPT in patients with bruxism.

Subjects and methods

Participants

The study involved 100 patients with bruxism aged 18–40 years. The participants were recruited from among the workers and students of the Faculty of Physical Therapy, Cairo University, Egypt. Bruxism was diagnosed on the basis of the American Academy of Sleep Medicine criteria, and patients were included in the study if they had experienced muscle fatigue or tenderness on wakening, awake clenching, and grinding at night within the previous 6 months. Individuals were excluded from the study if they reported any of the following: using medications that influenced motor behaviour or sleep; direct trauma or past surgery in the orofacial region; currently undergoing physical therapy for a temporomandibular disorder; systemic and/or degenerative diseases; more than 2 missing teeth except third molars.

Instrumentation

The Egyptian algometer used in this study was a commercially available hand-held electronic pressure algometer (made in Egypt). Its electronic display provides a pressure reading in kilograms, and can also present the pressure in pounds, jins, and ounces. The algometer has a 1-cm^2 rubber tip attached to a probe which is inserted into the gauge that records the pressure. It has a power supply of two 1.5 V AAA

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batteries. The maximum capacity of the Egyptian algometer is 45 kg and its operating temperature is 10–40°C. The gold standard algometer used in this study was Wagner FPK2F0® (Wagner Instruments, USA). Prior to each data collection, the algometer was calibrated in accordance with the manufacturer's instructions. The examiner was familiar with the algometer, having practised its usage for several weeks.

Procedure

The participants underwent 2 testing sessions, 1 week apart. Upon arrival, the study procedures were explained and the informed consent was obtained. All measurements were taken with the patient sitting. The left and right temporalis, and left and right masseter muscles were selected for assessment. The 4 most painful trigger points on each muscle were identified by an experienced physical therapist for PPT evaluation with the Egyptian algometer. To quantify PPT, the rubber tip of the Egyptian algometer was placed on the marked MTrP and was held vertically to the muscle belly. The examiner increased the pressure on the tested point and the participant was then asked to indicate when the sensation of pressure changed to pain or discomfort. Once the patients started to perceive pain, the pressure was released and the reading was recorded. All testing was performed between the hours of 8:00 a.m. and 4:30 p.m. This procedure was repeated 1 week after the initial test. The same testing procedures were conducted to assess the PPT of the selected MTrPs in the tested muscles by using the gold standard algometer.

Statistical analysis

Statistical analysis was carried out by using the SPSS software, version 23 (SPSS Inc., Chicago, IL, USA). The level of significance was set at $p < 0.05$ for all statistical tests. The intraclass correlation coefficient (ICC) was calculated to assess the intra-rater reliability. The criteria ranges for ICC reliability were as follows: < 0.50, poor; 0.50–0.75, moderate; > 0.75, good [11]. Standard error of measurement (SEM) (pooled standard deviation of all scores multiplied by the square root of 1 – ICC) and 95% confidence intervals were computed to estimate the amount of error associated with the measurement. Moreover, the minimal detectable difference (MDD) was analysed (SEM * 1.96 * $\sqrt{2}$) in order to determine the minimum threshold of measurement to ensure that differences between measurements were real and outside the error range [12]. A Pearson correlation analysis was performed to evaluate the relationship between the Egyptian algometer results and the gold standard algometer measures.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Cairo University Supreme Council of Postgraduate Studies and Research.

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

The mean values ± standard deviations of PPT in the tested muscles are presented in Table 1. ICC determined the intra-rater reliability of the Egyptian algometer. The values were 0.878, 0.785, 0.896, and 0.903 for the right masseter, left masseter, right temporalis, and left temporalis muscles, respectively. SEM values ranged from 0.24 to 0.5, MDD ranged from 0.66 to 1.41, and ICC ranged from 0.785 to 0.903.

Table 1. Intra-rater reliability for the Egyptian algometer results

Muscle	Mean	*SD*	SEM	MDD	ICC (95% CI)
Right masseter	1.87	0.7	0.24	0.66	0.878 (0.819–0.918)
Left masseter	2.05	0.74	0.5	1.41	0.785 (0.68–0.856)
Right temporalis	2.59	0.97	0.31	0.85	0.896 (0.845–0.93)
Left temporalis	2.46	1.08	0.33	0.91	0.903 (0.856–0.935)

SEM – standard error of measurement, MDD – minimal detectable difference, ICC – intraclass correlation coefficient

To quantify the level of agreement between the Egyptian algometer and the gold standard algometer, construct validity was determined by using Pearson correlation analysis. For clinical measurements, the correlation between the measurement systems should be strong positive ($p < 0.05$) to ensure reasonable validity. The Pearson correlation values were 0.673, 0.670, 0.408, and 0.705 for the right masseter, left masseter, right temporalis, and left temporalis muscles, respectively (Table 2).

Table 2. Correlation coefficients between the Egyptian algometer and the gold standard algometer results

Muscle	Pearson correlation (*r*)	*p*
Right masseter	0.673	0.0001*
Left masseter	0.670	0.0001*
Right temporalis	0.408	0.0001*
Left temporalis	0.705	0.0001*

* Significant at the alpha level of < 0.05

Discussion

This study aimed to examine the validity and reliability of the Egyptian algometer for assessing PPT in patients with bruxism. Strong ICCs (0.785–0.903) were obtained during the application of the Egyptian algometer in the selected MTrPs of the tested muscles. Therefore, the Egyptian algometer may be used as an alternative to the gold standard algometer for PPT assessment of MTrPs in patients with bruxism. In their studies investigating the reliability of a pressure algometer between different examiners in schizophrenics and healthy subjects, Merskey et al. [10] and Mersky and Spear [13] reported that PPT correlated well between varying examiners, occasions, and sites. Similar results were reported in the temporomandibular musculature by Reeves et al. [14]. In other studies [1, 2, 5, 7, 15, 16], the intra-reliability and inter-reliability of pressure algometers were accepted. Similarly, Chung et al. [2] demonstrated that the reliability of PPT measurements performed with an electronic algometer in head and neck muscles was accepted.

At this time, the knowledge of the proper application rate has not been studied. Previously, the PPT value changed at different application rates [17, 18], whereas a constant pressure application rate is necessary to detect a good reliability with an algometer [7, 18, 19]. Even though the application rate needs to be fast enough to avoid prolonged pressure on the

tissues and the fatigue of the examiner, it should be slow enough to allow the examiner to apply pressure for sufficient time before the PPT is reached to avoid PPT overestimation [2]. The Egyptian algometer is more available on the market and is characterized by good reliability and validity, which makes it profitable and cost-efficient in the clinical use.

Limitations

Only patients with strict inclusion criteria indicating bruxism were included in the study. It is not known if similar results would apply in those who present with different musculoskeletal conditions.

Conclusions

The results of the present study provide evidence to support the use of the Egyptian algometer as a valid, reliable, and easy alternative to the gold standard algometer for measuring PPT in temporomandibular musculature. The current findings of validity and reliability are limited to bruxism patients.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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