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ORIGINAL ARTICLE

Women with more severe degrees of temporomandibular disorder exhibit an increase in temperature over the temporomandibular joint

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KEYWORDS

Temporomandibular joint disorders;
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Abstract *Aim:* The purpose of the present study was to correlate the degree of temporomandibular disorder (TMD) severity and skin temperatures over the temporomandibular joint (TMJ) and masseter and anterior temporalis muscles.

Materials and methods: This blind cross-sectional study involved 60 women aged 18–40 years. The volunteers were allocated to groups based on Fonseca anamnestic index (FAI) score: no TMD, mild TMD, moderate TMD, and severe TMD ($n = 15$ each). All volunteers underwent infrared thermography for the determination of skin temperatures over the TMJ, masseter and anterior temporalis muscles. The Shapiro–Wilk test was used to determine the normality of the data. The Kruskal–Wallis test, followed by Dunn's test, was used for comparisons among groups according to TMD severity. Spearman's correlation coefficients were calculated to determine the strength of associations among variables.

Results: Weak, positive, significant associations were found between FAI score and skin temperatures over the left TMJ ($rs = 0.195$, $p = 0.009$) and right TMJ ($rs = 0.238$, $p = 0.001$). Temperatures over the right and left TMJ were significantly higher in groups with more severe TMD ($p < 0.05$).

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Conclusion: FAI score was associated with skin temperature over the TMJ, as determined by infrared thermography, in this sample. Women with more severe TMD demonstrated a bilateral increase in skin temperature.

1. Introduction

Temporomandibular disorder (TMD) is characterized by myofascial and/or joint pain, joint noises, lack of motor coordination, and a limited range of mandibular motion (Manfredini et al., 2011; Peck et al., 2008). Conceptually, TMD is a complex pathological condition that can affect different structures of the stomatognathic system, such as the temporomandibular joint (TMJ) and masticatory muscles (Leeuw, 2008).

Due to the particular characteristics of TMD, such as its multifactorial etiology and the different structures involved in the pathological process, the evaluation of affected patients plays a determinant role in the clinical management of signs and symptoms and is directly related to the effectiveness of the rehabilitation process (Manfredini et al., 2011; McNeill, 1997; Oral et al., 2009). Several measures have been employed for the diagnosis and evaluation of TMD, such as the Research Diagnostic Criteria for Temporomandibular Disorders, radiography, magnetic nuclear resonance imaging, computed tomography, and electromyography (Look et al., 2010; Rodrigues-Bigaton et al., 2008). The Fonseca anamnestic index (FAI) is a simple measure based on the Helkimo index that has been employed to identify the degree of TMD severity in the Brazilian population (Chaves et al., 2008; Fonseca et al., 1994).

Individuals with TMD exhibit circulatory and/or autonomic alterations. Thus, infrared thermography has been employed for the evaluation of this condition (Barão et al., 2011; Haddad et al., 2012). This non-invasive assessment method allows the measurement of skin temperature based on infrared radiation emitted by bodies with temperatures above absolute zero (Brioschi et al., 2003). Recent studies have found that skin temperature over the TMJ is increased in individuals with joint pain (Rodrigues-Bigaton et al., 2013), whereas skin temperature over the masticatory muscles is reduced in those with myofascial pain (Barão et al., 2011; Rodrigues-Bigaton et al., 2014). Moreover, individuals with TMD exhibit greater asymmetry in skin temperature than do those without this condition (Gratt and Anbar, 1998; Gratt and Sickles, 1993; Gratt et al., 1994a; McBeth and Gratt, 1996).

Although several studies have investigated the use of infrared thermography for the evaluation of individuals with TMD (Barão et al., 2011; Costa et al., 2013; Haddad et al., 2012; Rodrigues-Bigaton et al., 2013, 2014), the behavior of skin temperature as a function of TMD severity has not been determined. Thus, the aim of the present study was to correlate the degree of TMD severity with skin temperatures over the TMJ and masticatory muscles. The hypothesis was that significant associations would be found among the variables investigated.

2. Materials and methods

2.1. Ethical considerations

The Human Research Ethics Committee of the Methodist University of Piracicaba, São Paulo, Brazil, approved the study procedure (protocol No. 15/11). Volunteers agreed to participate by signing a statement of informed consent.

2.2. Study design

A blind cross-sectional study was performed. One physiotherapist administered the FAI, another captured and analyzed the infrared images, and a third was in charge of data processing and analysis.

2.3. Sample size calculation

The sample size was calculated using Ene software (version 3.0; Autonomic University of Barcelona, Barcelona, Spain). Based on data reported by Pogrel et al. (1989), absolute skin temperature over the TMJ was considered to be the outcome. The calculation was based on the detection of a difference of 0.97 °C among groups, a standard deviation of 0.83 °C, a statistical power of 80%, and an alpha value of 0.05. A minimum of 13 volunteers per group were needed. To compensate for possible losses, 15 volunteers were selected for each group.

2.4. Sample

Seventy female volunteers aged 18–40 years were recruited from the university community in the cities of Piracicaba and Americana (SP, Brazil). The exclusion criteria were body mass index (BMI) $> 25\ kg/m^2$, use of total or partial dentures, history of trauma to the face or TMJ, systemic disease (arthritis, arthrosis, or neuromuscular disorder), and current physical therapy, dental treatment, and/or medication use (analgesic, anti-inflammatory, or muscle relaxant).

Only women were selected for the study due to the high prevalence rate of TMD in female individuals (Oliveira et al., 2006). According to Bagis et al. (2012), the greater frequency of symptoms in female individuals is due to anatomic, biological, and hormonal factors.

2.5. Fonseca anamnestic index

The FAI was used to determine the severity of signs and symptoms of TMD. This instrument, one of few assessment tools developed in Portuguese for this purpose, is composed of 10 questions. Responses of ''yes'' are given 10 points, responses of ''sometimes'' are given 5 points, and responses of ''no'' are given 0 points. The sum of points allows the classification