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Does the habitual mastication side impact jaw muscle activity?

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ABSTRACT

Objective: To compare electrical activity in the anterior temporal and masseter muscles on the habitual (HMS) and non-habitual mastication side (NHMS), during mastication and in the mandibular postural position. In addition, the increase in electrical activity during mastication was assessed for the HMS and NHMS, analysing both working (WSM) and non-working side during mastication (NWSM).
Methods: A total of 28 healthy women (18–32 years) participated in the study. They were submitted to Kazazoglu's test to identify the HMS. Bioresearch 'Bio EMG' software and bipolar surface electrodes were used in the exams. The exams were conducted in the postural position and during the unilateral mastication of raisins, on both the HMS and NHMS. The working and non-working side on HMS and NHMS were assessed separately. The obtained data were then statistically analysed with SPSS 20.0, using the Paired Samples Test at a significance level of 95%.
Results: The differences in the average EMG values between HMS and NHMS were not statistically significant in the postural position (Temporal $p = 0.2$; Masseter $p = 0.4$) or during mastication (Temporal WSM $p = 0.8$; Temporal NWSM $p = 0.8$; Masseter WSM $p = 0.6$; Masseter NWSM $p = 0.2$). Differences in the increase in electrical activity between the masseter and temporal muscles occurred on the working side, on the HMS and NHMS ($p = 0.0$), but not on the non-working side: HMS ($p = 0.9$) and NHMS ($p = 0.3$). The increase in electrical activity was about 35% higher in the masseter than in the temporal muscle.
Conclusions: Mastication side preference does not significantly impact electrical activity of the anterior temporal and masseter muscles during mastication or in postural position.

1. Introduction

Understanding the role of muscles in mastication has been the aim of many researchers (Delport, de Laat, Nijs, & Hoogmartens, 1983; Diernberger, Bernhardt, Schwahn, & Kordass, 2008; Gonçalves, Campos, Gonçalves, Moraes, & Rodrigues Garcia, 2013; Nissan, Gross, Shifman, Tzadok, & Assif, 2004; Shimizu et al., 2013; Varela et al., 2003). Mastication is a vital function that stimulates the jaw muscles, and maintains both bone (Shimizu, Ishida, Hosomichi, Kaneko, Hatano, & Ono, 2013) and muscle quality (Gonçalves et al., 2013). Mastication can be exclusively unilateral or alternating bilateral, considering that most people have a habitual mastication side, even those that present a bilateral alternating mastication pattern (Delport et al., 1983; Diernberger et al., 2008; Kazazoglu, Heath, & Müller, 1994; Nissan et al., 2004; Varela et al., 2003). Preference for one side has been associated with better masticatory performance (Rovira-Lastra, Flores-Orozco, Salsench, Peraire, & Martinez-Gomis, 2014), although reports exist that unilateral mastication may be an aggravating factor for masseter hypertrophy (Skoura, Mourouzis, Saranteas, Chatzigianni, & Tesseromatis, 2001). Masticatory laterality has also been related to biting force and occlusal contacts (Julien, Buschang, Throckmorton, & Dechow, 1996; Lujan-Climent et al., 2008).

Many methods have been applied to identify the habitual mastication side, such as: the visual method, which relies on the observation of muscle contractions during mastication, in combination with electromyography (EMG) (Christensen & Radue, 1985; Mohamed, Christensen, & Harrison, 1983), electronic observation (Gomes, Custodio, Faot, Cury, & Garcia, 2011) and visual inspection (Kazazoglu et al., 1994; Mc Donnell, Hector, & Hannigan, 2004;

Abreviations: HMS, habitual mastication side; NHMS, non-habitual mastication side; WSM, working side during mastication; NWSM, non-working side during mastication; RDC, research diagnostic criteria; EMG, electromyography.

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Nissan et al., 2004; Varela et al., 2003). Varela et al. (2003) mentioned that this variety of methods may produce discrepancies in the obtained results.

EMG is one of the methods employed for the study of muscular function, and technological advancement in this field has turned EMG equipment into a useful tool applied by several authors on healthy volunteers (Sforza, Montagna, Rosati, & Menezes, 2010) and on patients with temporomandibular disorders (TMD) (Tartaglia, Lodetti, Paiva, De Felicio, & Sforza, 2011).

It is, however, important to emphasize that diagnoses should be based on a clinical assessment, supplemented with the findings of imaging studies (Okeson, 2012; Petersson, 2010).

The muscles most studied with EMG are the masseter and anterior temporal, because these can be assessed using surface electrodes (Svensson & Graven-Nielsen, 2001), separately on the right and left side of the jaw (Nissan et al., 2004; Pita, Ribeiro, Garcia, Pedrazzi, & Zuim, 2011).

Jaw muscle activity was related to bite force (Uchida et al., 2008) and mastication performance (Farias Gomes et al., 2010). In asymptomatic individuals the masseter and anterior temporal demonstrated an asymmetry between both sides during all functions, especially in the masseter during activities that involve little electrical activity, such as the postural position and centric occlusion (Ferrario, Sforza, Miani, D'Addona, & Barbini, 1993). In female patients, the electrical activity of the temporal muscle tended to be higher at every contraction level than the masseter activity, whereas in male patients masseter activity was found to be more elevated during clenching than temporal activity (Ferrario et al., 1993).

Although at present few studies take mastication side preference into account (Rahal & Goffi-Gomez, 2009), it may well be an important factor, because the recruitment patterns of some mastication muscles can vary for the production of the same jaw movement, and isotonic exercise may reduce this variability (Wirianski et al., 2014). It is possible that mastication plays a role in these patterns. In a study with healthy subjects, some authors affirm that the mastication muscles are highly adaptable and present decreases in electrical activity after long-term coordination exercises (Hellmann et al., 2011). According to Hellmann et al. (2011), there appears to exist an optimising recruitment strategy that may subsequently have reduced the initially redundant activation patterns by switching off redundant motor units. This affirmation is in accordance with the 'task group' hypothesis formulated by Loeb (1985). Our hypothesis was that the jaw muscles on the HMS demonstrate lower levels of electrical activity during mastication and in postural position than muscles on the NHMS.

The objective of this study was to assess whether mastication side preference influences electrical activity in the anterior temporal and masseter muscles in the postural position and during mastication.

2. Materials and method

2.1. Selection of individuals

All participants gave informed consent and the experiments were carried out in accordance with the principles of the Helsinki Declaration. Following approval by the Ethics Committee, 322 participants of this cross-sectional study were recruited among students of the Dentistry School of Araçatuba. The selection of participants was performed through anamnesis and a physical exam performed by an experienced professional.

The study was conducted with a sample of 28 female subjects (mean age 21.6 years, SD 3.7 years) from a group of 133 volunteers. Participants with the following characteristics were excluded: natural dentition of less than 24 teeth; TMD symptoms in accordance with Research Diagnostic Criteria (RDC) (Dworkin & LeResche, 1992), currently undergoing medical treatment; neurological and metabolic systemic diseases; migraine; chronic pain; psychiatric disorders; and absence of a habitual mastication side.

2.2. Verification of habitual (HMS) and non-habitual (NHMS) mastication side

In order to verify the habitual mastication side, volunteers were submitted to a visual assessment using the method developed by Kazazoglu et al. (1994). Each individual chewed on a $30 \times 13 \times 4$ mm, 8.9 g chewing gum tablet (Trident Menthol, Cadbury Adams Ltd.). This test was performed without informing the participants beforehand, thus ensuring that knowledge of the experiment would not interfere with the choice for a particular mastication side. All volunteers were instructed to chew normally and were observed by an examiner for two consecutive minutes. During this period, they were interrupted 4 times to check on which side the gum was. This test was conducted twice in each individual so that an average could be obtained, allowing for the habitual mastication side to be classified as unilaterally left or right.

2.3. Electromyographic exam

The anterior temporal and masseter muscles were examined on both sides during the unilateral mastication of raisins and in the postural position. Prior to the exam, the participants were instructed to wash the part of their faces that corresponds with both muscles using water and soap. Then, the skin was rubbed with alcohol swabs (70%) in order to reduce skin oiliness and impedance, thus improving signal conductivity.

Next, bipolar surface electrodes (Kendall Medtrace 100–ECG Conductive Adhesive Electrodes, Tyco Healthcare Group LP, Mansfield, Canada) were placed at intervals of 18 mm along the full extent of the masseter and anterior temporal muscles on both sides (Fig. 1).

The electrodes were wired to an amplifier, which transmitted the obtained muscle activity data to a computer equipped with the programme Bio EMG (Biopack—System Bio-Research, Inc., Milwaukee, Wisconsin, USA), band-pass filtered with a low frequency

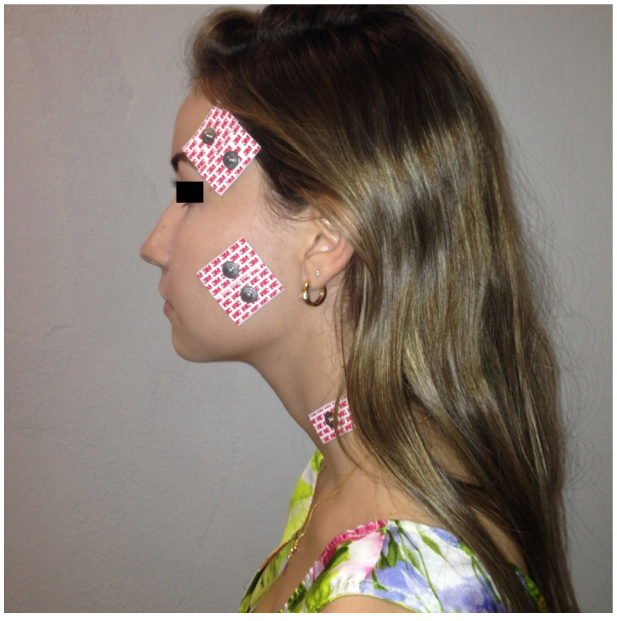

Fig. 1. Anterior temporal, masseter and reference electrodes position.