

# Avaliação eletromiográfica e ultrassonográfica do músculo masseter em indivíduos normais: estudo piloto\*\*\*\*\*

## Electromyographic and ultrasonographic assessment of the masseter muscle in normal individuals: a pilot study

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### Abstract

**Background:** recent studies have used ultrasonography with the purpose of measuring muscle cuts. Aim: to characterize the motor control and the morphology of the masseter muscle in normal individuals, verifying the compatibility between surface electromyography and ultrasonography. Method: five adult individuals, with no alterations of the stomatognathic system. The adopted assessment procedures for all participants were: 1. Surface Electromyography; 2. Ultrasonography. Results: a high correlation was observed only when comparing both hemifaces in the ultrasonographic assessment (rest 0.95; biting 0.86). Conclusion: the results indicate that there is no correlation between the tested methods, suggesting that both methods are complementary and not mutually excludent.

**Key Words:** Masseter Muscle; Electromyography; Ultrasonics.

### Resumo

Tema: estudos recentes utilizaram a ultrassonografia com o objetivo de medir cortes musculares. Objetivo: caracterizar o controle motor e a morfologia do músculo masseter em indivíduos normais, verificando a compatibilidade entre a eletromiografia de superfície e a ultrassonografia. Método: cinco indivíduos adultos, sem alterações no sistema estomatognático. Os procedimentos adotados para a avaliação dos participantes foram: 1. Eletromiografia de Superfície; 2. Ultrassonografia. Resultados: houve alta correlação apenas para a comparação entre hemifaces direita e esquerda no exame de ultrassonografia (repouso 0,95; máxima intercuspidação dentária 0,86). Conclusão: os resultados indicam não haver correlação entre os métodos testados, sugerindo que os exames são complementares e não excludentes.

**Palavras-Chave:** Músculo Masseter; Eletromiografia; Ultra-som.

## Introduction

Recent studies have used ultrasonography to measure cross-sectional distances of muscles of the head and neck and have correlated these data with other pathologies like temporomandibular disorders (TMD), muscle palpation pain, facial morphology, bite force and occlusal factors 1-4.

The purpose of the present study was to characterize muscle control and the morphology of the masseter muscle in normal individuals, and also to verify the compatibility between surface electromyographic and ultrasonographic data.

## Method

### Participants

Participants of this research were five individuals with ages between 20 and 30 years (mean age 24.6 years), with no alterations of the stomatognathic system and scapular region, with complete permanent dentition (absence/extraction of the third molar was accepted), with Angle's Class I facial pattern and absence of severe malocclusion and braces, and with no history of previous speech-language intervention (CP 024/09).

### Materials and Procedures

Participants were evaluated at the Speech-Language Service of the Central Institute of Hospital das Clínicas and at the Radiology Service of the Radiology Institute of the same hospital. These services are responsible for the electromyographic and ultrasonographic assessments respectively.

The methodology and procedures adopted for both assessments are described below:

#### 1. Objective instrumental assessment - Surface Electromyography (SEMG).

A surface electromyography equipment - Miotool 400 - was used for the objective instrumental assessment, following the parameters recommended by THE INTERNATIONAL SOCIETY OF ELECTROPHYSIOLOGICAL KINESIOLOGY (ISEK) (nd).

The electric activity of the masseter muscles was assessed during:

- . rest (3 data collections with 30 seconds each);
- . Teeth clenching using cotton roles between the teeth - AL (3 data collections of 5 seconds of isometric contraction, with an interval of 5 seconds between each muscle activity);
- . teeth clenching with maximal teeth intercuspidation

- MIC (3 data collections of 5 seconds of isometric contraction, with an interval of 5 seconds between each muscle activity) 5,6 .

Electromyographic tracing was obtained using a raw signal and then analyzed using a rectified signal (RMS).

#### 2. Objective instrumental assessment - Ultrasonography (USG).

Assessment of the thickness of the masseter muscle was done using the methodology proposed by Satiroglu et al. 4. Each participant was examined by the same radiologist using a Philips iu22 equipment.

During imaging, the transducer was held perpendicular to the surface of the skin and special care was taken to avoid excessive pressure. The measurement site was at the thickest part of the masseter, close to the level of the occlusal plane, approximately in the middle of the mediolateral distance of the ramus 2,3,7. The imaging and measurements were performed bilaterally with participants in supine position under three different conditions: at rest (habitual position - 3 times - Figure 1); during maximal clenching using 10mm cotton roles between the dental arches in the first and second molars region (3 times - Figure 2; AL); and during maximal clenching without the cotton roles (3 times - Figure 3; MIC).

## Resultados

For the statistical analysis the Pearson's Correlation Test was used in order to verify compatibility between the applied techniques (Table 1) and between the hemifaces (Table 2 USG; Table 3 SEMG).

Results indicate that there was a high positive correlation only for the comparison between the right and left sides of the face during the USG assessment.

FIGURE 1. Ultrasonographic image of the rest condition (right masseter).



FIGURE 2. Ultrasonographic image during AL (right masseter).



FIGURE 3. Ultrasonographic image during MIC (right masseter).



## Discussion

Surface electromyography (SEMG) has been extensively used in researches related to the assessment of the masticatory function. It is considered a valid method for the assessment of the masticatory muscles and can be correlated to masticatory efficiency<sup>8</sup>. However, due to within subject differences it is hard to determine significant quantitative differences between subjects using this method. Specific literature indicates that SEMG can be influenced by the thickness of the skin fat layer, by the positioning of the electrodes and by the individual's motivation in undergoing the exam<sup>5</sup>. Besides that, the results of the present study indicate that there is no symmetry between muscle activities during the tested conditions.

Ultrasonography of the masseter muscle demonstrated to be a simple, quick, non-invasive and reproducible technique for the accurate assessment of muscle thickness provided the radiologist strictly follows the described protocol, i.e. avoiding excessive pressure of the transducer on the skin surface.

Previous studies<sup>3</sup> discuss the difficulty in determining whether changes observed in muscle thickness is either because of an actual change of the parameter under study or measurement error. In the present study, transducer position was strictly standardized<sup>2,3,4,7</sup>. In addition, variables such as body posture, interocclusal relationship and resting time did not differ among the participants. The results of our study suggest that the meaningful interpretation of repeated masseter muscle thickness requires accurate repositioning of the transducer.

Other studies also indicate large variation in masseter muscle thickness among individuals, during

TABLE 1. Pearson's Correlation Coefficient Values - USG x SEMG.

	USG/SEMGs					
	Rest	MIC L	AL L	Rest R	MIC R	AL R
Rest L	-0.10569993					
MIC L		0.512993124				
AL L			0.78922939			
Rest R				0.577823082		
MIC R					0.207729686	
AL R						0.05996

both relaxation and contraction. These inter-individual differences may be due to a variable number of muscle fiber, variation in fiber size, or both<sup>9</sup>. Further studies are necessary in order to investigate differences between ages, gender, facial pattern and body mass index (BMI).

While USG has been viewed as a useful tool for studying masseter muscle thickness, our findings suggest that it may also be used to investigate specific regions of the masseter. Of course, the relative spatial sensitivity of masseter muscle thickness is not determined solely by the anatomical characteristics of the tissues being scanned (bone, muscle, fascia, skin), but is influenced by the adopted imaging techniques<sup>4</sup>. For example, optimization of a pulse sequence or post-processing of images may increase ultrasonography imaging sensitivity to a difficult-to-image masseter cross-section.

## Conclusion

The results of this study do not indicate any correlation between the tested methods, suggesting that these provide complementary but not excluding data. It is important to highlight that this is a pilot study and that the group of participants will be increased, not only with normal individuals but also with those with craniofacial alterations, in order to confirm the findings .

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TABLE 2. Pearson's Correlation Coefficient Values - USG.

	USG		
	Rest L	MIC L	AL L
Rest R	0.948742179		
MIC R		0.85684586	
AL R			0.61201558

TABLE 3. Pearson's Correlation Coefficient - SEMG.

	SEMG		
	Rest L	MIC L	AL L
Rest R	0.586551807		
MIC R		0.5001288	
AL R			0.65578723