

Review article



## ULTRASOUND DIAGNOSTIC OF MUSCULUS MASSETER

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### ABSTRACT:

Ultrasonography is a safe and non-invasive method of imaging organs and structures of the human body. The resulting images are detailed, easily reproducible and received in real time.

The aim of this review is to investigate and present the diagnostic capabilities of ultrasonography in the diagnosis of m. masseter in norm and pathology.

Survey material is the data from 21 literary sources, selected from 110, found by keywords from January to April 2017.

The material of the review is based on the scientific data for ultrasonic imaging of normal anatomy of m. masseter and common pathologies such as: hypertrophy, bruxism, traumas, hemangiomas, cysticercosis, etc.

In conclusion, the high diagnostic value of ultrasonography of m. masseter is confirmed in both conditions - norm and pathology. The method is considered safe, easy and effective, which can be of great benefit to the dentists, especially in the case of a difficult diagnosis.

**Keywords:** ultrasonography, ultrasound, m. masseter, diagnostic,

### INTRODUCTION

Ultrasound diagnostic (ultrasonography) is a widely used, safe and non-invasive method of imaging. According to Ratini [1], it is affordable, easy to use, inexpensive and allows visualisation of soft tissues, which is not achieved with X-ray diagnosis. Patients are not subjected to harmful ionising radiation, and the resulting images are in real-time, which allows tracking of the structure and movement of organs and parts of the body.

According to Oliveira et. al. [2], lower jaw performs numerous movements due to chewing muscles. The main of these muscles is m. masseter. That is why it is the subject of numerous scientific studies.

Knowing the ultrasound imaging of morphology and function of m. masseter is a great advantage in the dentist's clinical work. The morphofunctional characteristic of the chewing system is related to m. masseter, and in turn it can be analyzed by various methods of investigation such as ultrasonography, magnetic resonance imaging, computer tomography, electromyography, etc.

Ultrasonography is considered to be an effective, time-proven, easily reproducible method of examining the structure and thickness of m. masseter. There are objective parameters and values which allow comparison.

Some authors [3, 4, 5] write about various methodologies for conducting ultrasound diagnostics. The use of these data may be essential in the diagnosis and treatment of various pathologies of the dental system such as temporomandibular disorders, bruxism, etc. Again according to Oliveira et al. [2] normal values may be considered to be critical in the study of unhealthy groups/populations in relation about m. masseter.

Ultrasonography can be used as an additional method of researching dentistry and speech therapy, and in help of different therapeutic approaches and/or rehabilitation

### PURPOSE

The purpose of this review is to present and analyse the current trends in the ultrasonic diagnostics of the structure of chewing muscles and m. masseter in particular.

### MATERIALS AND METHODS

From January 2017 to April 2017, research was conducted in the following database PubMed and Google according to keywords: "ултразвук", "ултрасонография", "диагностика", "m. masseter", "морфология" and the corresponding terms in English - "ultrasound", "ultrasonography", "diagnostics", "masseter muscle", "morphology", and in German - „ultraschall", "sonografie", "diagnostik", "masseter muskel", "morphologie". 110 literary sources have been found. After excluding the recurring articles, 58 scientific papers remained. Articles that, after reading the title, were found to be unrelated to the purpose of this literary analysis were also excluded. The final selection is from 25 scientific papers. They were subjected to analysis, the results of which are the basis of the literary review.

### REVIEW RESULTS

Musculus masseteris one of the four chewing muscles in humans. It has a rectangular shape and is divided into surface and deep part. Its function is to close the

mouth and press the lower teeth towards the upper, and the surface of the muscle helps to move the lower jaw forward.

Geertsma [6] after several years of research on m. masseter by ultrasound diagnosis of patients from the Dutch hospital GelderseVallei, he gives images of the mean chewing muscle, which are considered to be normal. The investigations were conducted using the Aloka Hitachi ProSoundF75 and 3 HI VISION Ascendus high-end systems.

Rohila et al. [7] investigates the thickness of m. masseter in 60 healthy patients (30 male and 30 female) using ultrasound. All patients were examined by the same operator using a Toshiba ultrasonic scanner and sample (Model No Nemio SSA-550). The investigation was made along a marked line between the mouth angle and the earlobe. The ultrasound probe moves along the marked line without further pressure, with applied a water-based lubricant. It is angulated as to obtain maximum echo, which is achieved when scanning probe is perpendicular to the surface. Measurement is done bilaterally in patients lying down in both conditions: first in slightly touched teeth, in a relaxed state of the muscle, and secondly in the case of maximum clenching - in shortened muscles.

According to other authors [8, 9, 10], who explore m. Masseter, the probe is directed perpendicularly to the skin and parallel to the occlusal plane. With a view to carry out an accurate study, the occlusal plane should be designed using a specially designed facial bow that is placed on the cutting edges of the upper central incisors and the top of the tubers of the first upper molars, holding with a light bite and the operator's hand to prevent soft tissue deformation. In touched lips and relaxed muscles, the line corresponding to the occlusal plane is exported bilaterally to the skin surface. The study is conducted on sitting objects with both relaxed muscles and maximum clenching in a central occlusion. The image is repeated several times, tracking the limits of the muscle. To avoid a tracking error, values are averaged and the mean value is used for analysis.

According to Kiliaridis and Kalebo [11], ultrasound is established a method of studying the thickness of m. masseter. He performed a bilateral study of 40 middle-aged subjects - 20 of them female and 20 male, with healthy dentition, both in the relaxed state of the muscles and at maximum clenching. There were established values in relaxed state of the muscle at  $9.7 (\pm 1.5)$  mm thick and in shortened muscles  $15.1 (\pm 1.9)$  mm thick. For women, the values are  $8.7 (\pm 1.6)$  mm and  $13.0 (\pm 1.8)$ . They also found a relationship between facial morphology and the thickness of m. masseter. The study was performed with an ultrasonic system SSA-250A; Toshiba, Tokyo, Japan. This system has a real-time B-mode scanner with an annular transducer. The characteristics of the system are a piezoelectric material, polymer film P (VDF-TrFe), 7.5 MHz frequency, 36 mm hole diameter, 60 mm radius of curvature, 12 elements and 45-90 mm effective focal length.

Following a literary review by Oliveira et al. [2], which aims is to detect evidence of measurement values. masseter in healthy young adults using ultrasonography, he found that since 1991 until 2006 there are numerous studies in the field of ultrasonography of m. masseter and setting a norm. It was found that there are different research methodologies, different study samples - including a different number of patients, the difference in female / male participation, and study of patients of different ages. The overall in all studies is that the observed patients are healthy and without symptoms of any craniomandibular disorders. The studies are made under two main circumstances: in a relaxed and shortened state of m. masseter.

There is a difficulty in interpreting the results and generalising them, due to differences in methodology and samples of the studies.

It is assumed that there is a variety of models for conducting the ultrasound imaging, which leads to the inability to standardise the measurements of the chewing muscles. The measurement of the thickness of m. masseter by ultrasound is considered an applicable, non-invasive, accurate, objective and reproducible method of research.

There have been found values for men and women considered to be as normal limit for adult muscle thickness and also a statistical correlation between values measured in resting and in contraction. This information can be widely used in clinical practice.

There is a statistically significant difference in conditions of the muscle in rest and contraction in both genders, and also a difference in resting muscle in the different genders.

Based on the studies, the following facts can be summarised: to conduct an ultrasound study of m. masseter there is need of pre-localization, by palpation and marking; It is recommended to make a comparative analysis of a minimum of three images and average value is taken to be read; The measurements are recorded in millimeters, which guarantees greater precision; Special attention to dosing the pressure with the probe as it may have an impact on measurement; The position of the patient may be seated or lying depending on the purpose of the study;

#### **Ultrasound diagnostic of different pathology of musculus masseter**

##### Bruxism:

Musculus masseter is a muscle that closes the mouth and also participates in parafunctions such as bruxism. It can be divided into one that appears in a waking or sleeping state. Patients suffering from bruxism are more likely to experience pain and movement limitations than those who do not suffer from it. According to Areej [10], there is a difference in muscle thickness measured in the ultrasound imaging of bruxists and non-bruxists.

For the purpose of this study, 2 groups of 20 patients were divided according to whether or not they suf-

fer from bruxism, and the thickness of m.masseter is measured by ultrasonography.

The results show that in the case of bruxism, the basic thickness of the relaxed and shortened muscle is 11.7 ( $\pm 1.4$ ) and 16.4 ( $\pm 1.3$ ), respectively for non-bruxists, the results are 11.2 ( $\pm 0.4$ ) and 13 ( $\pm 0.3$ ). There is a remarkably high difference between shortened muscles in bruxists and non-bruxists. Thickness at rest is smaller than that of shortened muscles for both groups. There was also dependence between the thickness of the muscle and its function in a state of bruxism.

The thickness of the muscle in cases of bruxism is greater in comparison with unaffected objects and is thought to be the result of increased muscle function.

#### Hypertrophy of Musculus masseter:

Morse and Brown [11] conducted a study of volunteers with symptoms of hypertrophy and those without symptoms. The objects are located laterally and the relationship between the jaws in physiological rest. A 5MHz linear transducer (Acuson, Stevenage, UK), with stand-off device (Kitecko, 3M, Loughborough, UK), is positioned at the level and parallel to the occlusal plane on the surface of the masseter. Measurement is also applied with maximum teeth clenching.

The normal thickness of the masseter muscle, in patients without symptoms of muscle hypertrophy is considered to be:

Resting condition: 8.5 – 13.5 mm

Shortened condition: 10.5 - 16.5 mm

There is significant increasing of these values when the muscles is hypertrophied.

#### Temporomandibular disorders:

Liao and Lo [12] conducted a study of 42 patients with a real-time 5-12MHz linear scanner on the HDI 5000 system (Philips, Bothell, WA, USA). The transducer is positioned against the patient's face through the zygomatic arch and the temporomandibular (TM) joint is at an angle of 60° according to the Frankfurt Horizontal plane. It is established that the maximum size of the capsule width of TM joint is measured between the two joint surfaces with a mouth closed.

An increase in the width of the TM capsule is seen in patients suffering from temporomandibular disorders. Measurement of muscle thickness is considered to be the distance between the external fascia of the muscle and the lateral surface of the lower jaw branch at rest and maximum occlusion.

According to another author [13] in an ultrasound study of m. masseter, in patients with temporomandibular disorders, the occurrence of intramuscular echogenic strips which are in relation with the inner fascia and these strips are thickened and/or reduced in number.

Major craniomandibular dysfunctions cover a wide range of pathological conditions associated with orofacial pain and impaired function of the lower jaw, m. masseter and temporomandibular joints [14, 15, 16]. Prolonged, low

levels of static contractions or high levels of periodical isometric contraction can lead to muscular disorders that can be diagnosed with ultrasonography.

#### Facial paralysis:

In people with peripheral facial paralysis, one-sided chewing is seen from the unaffected side, mainly due to the difficult action of m. buccinator [17, 18]. Sassi et al. [19] conducted a study which aims is to establish the motor control and morphology of m. masseter in individuals with unilateral peripheral facial paralysis using ultrasonography.

Participants in the study were 16, from both genders, on age over 18 years. The study group consists of 8 individuals who have idiopathic unilateral facial paralysis for more than 6 months. The control group consists of 8 healthy individuals. All individuals are subject to an assessment of m. masseter by ultrasonography in a resting state, biting of cotton rollers and maximum teeth clenching.

The reported results did not show a statistically significant difference within and between the groups in terms of facial asymmetry and the activity of m. masseter.

Finally, the motor control and morphology of m. Masseter in individuals with unilateral peripheral facial paralysis is similar to those of healthy individuals.

#### Inflammatory changes:

According to Gallagher and Marley [20], in ultrasound study of 32 patients with inflammatory changes in the area of m. masseter it was found that sore chewing muscles often show a decrease in echo intensity and complete or partial lack of hyperechoic bands. Average thickness of m. masseteron in the intact side is 8.6 mm while on the affected side is 12.9 mm. The dark section of the ultrasound image usually reflects a large sub masseteric abscess cavity.

According to Geertsma [6], observing of the osteomyelitis of the lower jaw with ultrasound reveals thickening of m. masseter.

#### Cysticercosis:

According to Gokarn et al. [21] Cysticercosis is a tissue infection caused by a young form (cysticercosis) of pork tapeworm (Taeniasolium), that can affect the muscles, including m. masseter.

Muscle cysticercosis has non-specific clinical manifestations, and the diagnosis may be difficult. An ultrasound evaluation demonstrates a classic cyst with scolex inside.

Some authors [22] after an extensive study of affected patients, give images of the healing process in the area of m. masseter

#### Trauma:

Myositis ossificans traumatica (MOT) is known as a disease with a characteristic bone formation in the muscle or in fascia due to acute trauma or periodic injury. MOT of

m. masseter is a rare disease causing difficulty in opening the mouth. Study through imaging shows the presence of calcifications in the muscle [23].

According to Andersen et. al. [24] as a result of trauma, a hematoma can also be formed, which can be detected by ultrasound.

#### Hemangioma:

According to Jain et al. [25] in an ultrasound study of an 8-year-old girl suffering from hemangioma on m. masseter it was observed massive, lobular, hypoecho lesion and also asymmetry in both muscles.

#### **CONCLUSION**

In conclusion, it can summarise the wide possibility of applying the ultrasound diagnostics in the examination of the jaw muscles, and especially m. masseter and its pathologies. Despite the lack of standardisation for measurement, ultrasonography is considered to be a reliable, objective and accurate method of research. A normal range of thickness of the m.masseter is found in men and women, respectively, at rested and strained muscles.

Typical ultrasound images and regularities have been identified in the presence of various pathologies:

- The thickness of masseter muscle in the bruxists is

significantly higher than in the non-bruxists.

- In hypertrophy of m. masseter, there is increasing of the values considered as a norm, both in resting and in shortened muscles.

- In the presence of temporomandibular disorders, there is evidence of a thickened and / or decreased number of intramuscular echogenic strips.

- There is no evidence of differences in the morphology of m.masseter in patients with facial paralysis and healthy ones.

- There is reduced echo and full or partial lack of hyperecho strips in cases of inflammation of m. masseter.

- In cysticercosis, there is a classic cyst with scolex inside.

- There is typical calcification and/or hematoma in the case of trauma.

- Hypoecho lesion in ultrasound evaluation of hemangioma.

Ultrasonography is considered reliable, non-invasive, objective and easily reproducible, with no evidence of adverse effects on patients, method of diagnostic. It is extremely important for the work of clinicians in research of chewing muscles, discovering of the diseases, their follow-up and subsequent treatment.

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*Please cite this article as:* Dimova-Gabrovska M, Dimitrova D. Ultrasound diagnostic of musculus masseter. *J of IMAB.* 2017 Apr-Jun;23(2):1611-1615. DOI: <https://doi.org/10.5272/jimab.2017232.1611>

Received: 27/04/2017; Published online: 26/06/2017



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