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ORIGINAL ARTICLE

Imaging of masseter muscle spasms by ultrasonography: a preliminary study

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Abstract

Objectives The aim of this study was to determine the effectiveness of ultrasonography (USG) in locating spasm points in the masseter muscle.

Methods Fifteen patients with TMJ dysfunction and five healthy controls were included in the study. First clinical examination of TMJ and palpation of masticatory muscles were done. Then, the masseter muscles were examined by USG. A total of 40 masseter muscles were examined within the study.

Results Spasm points were observed as limited isoechogenic areas within normal heterogeneous muscle tissue. Within the 30 masseter muscles of patients with TMJ dysfunction, a total of 14 spasm points were detected clinically and 18 spasm points were detected ultrasonographically. No clinic or sonographic spasm point was detected in the masseter muscles of healthy controls.

Conclusion USG demonstrated in detail the internal structure of the masseter muscle in all patients and provided precise localization of the spasm points on the muscle. This is a preliminary study, showing that changes in muscle internal structure can be visualized with USG.

Keywords Ultrasonography · Masseter muscle · Spasm points

Introduction

The masticatory muscles are one of the major muscle groups in the head which are a group of muscles associated with movements of the temporomandibular joint (TMJ). There are four masticatory muscles that are the masseter, temporalis, medial pterygoid, and lateral pterygoid. The masseter muscle is an important muscle of the masticatory system. It allows closing the mouth by pulling the mandible upward, and it is actively employed in functions such as chewing and speaking. Therefore, it is affected by TMD (temporomandibular joint disorders), myofascial pain, and parafunctional habits, such as bruxism [1].

TMD is often caused by muscular problems. It is important to distinguish muscle-based problems from intra-articular problems. Therefore, clinical examination should be well done and the masticatory muscles should be evaluated also. Active spasm points in the masticatory muscles can cause pain when they are palpated, and they can produce typical regional reflected pain patterns also.

Myofascial pain is the most common cause of chronic orofacial pain. The previous studies have shown that 85% of myofascial pain is related to the masseter muscle [2]. Bruxism or other parafunctional habits are conditions that can cause damage to masticatory muscles as well as masseter muscle. These conditions may cause dropsical modification in the masseter muscle due to muscle over-activity, and this may cause a change in the image of the masseter's internal echogenicity [3].

Ultrasonography (USG) is used in dentistry generally for several purposes such as; salivary gland diseases, cervical lymphadenopathy, various soft tissue mass, masticatory and neck muscles, as well as novel usage areas such as maxillofacial fractures, periapical lesions, temporomandibular joint, tongue tumors, dental tissues' decay, cracks and fractures, mucosal lesions, periodontal tissues, implant dentistry, and orthodontia [4]. It can provide clearer images in the masseter

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muscle than Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) [5]. Muscle tissue shows heterogenic low echogenicity in USG with occasional hyperechoic fascia layers.

The purpose of this study was to determine the effectiveness of USG in detecting and locating spasm points in the masseter muscle.

Materials and methods

The present study was carried out in the Oral and Maxillofacial Radiology Department and was approved by the ethical committee of faculty (Decision No. 59). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The study was conducted on 20 patients of whom 15 patients with TMJ dysfunction and five healthy controls without TMJ dysfunction with their informed consent. None of the patients included in the study had any disease affecting the musculoskeletal system. Primarily, the clinical examination was done after the anamnesis. Mandibular movements and the entity of deviation, deflection, and also clicking were evaluated during the clinical examination. Patients who were thought to have intracapsular problems in clinical examination were not included in the study. The masseter muscles were palpated and spasm points and their reflected pain were detected. After clinical examination, routine conventional TMJ radiographies were also gained from the patients with TMJ dysfunction. However, these are not included here because they are not matter of the study.

Then, 40 masseter muscles of 20 (15 patients with TMJ dysfunction and 5 patients without TMJ dysfunction) patients were examined by USG. USG was applied using an Aplio-300 device (Toshiba Corporation, Tokyo, Japan) and a 12 MHz linear array transducer by the two observers with at least 3 years of experience with maxillofacial USG and the master with at least 6 years of experience with maxillofacial USG. They were calibrated each other about the clinical examinations and USG evaluations before the study. They used clinical examination and USG trials for practice together and discussed the method each other. Subsequently, only the one of the researchers conducted the USG examinations of patients used in the study and the other researcher established the clinical examinations. USG examinations established blind of the clinical findings.

During the USG examinations, the masseter muscle was scanned on the transversal plane in rest position without clenching by keeping the probe parallel to the occlusal plane. The whole body of masseter muscle was examined from zygomatic arch to angulus of mandible by sliding the probe over the muscle. Normal master muscle showed heterogenic

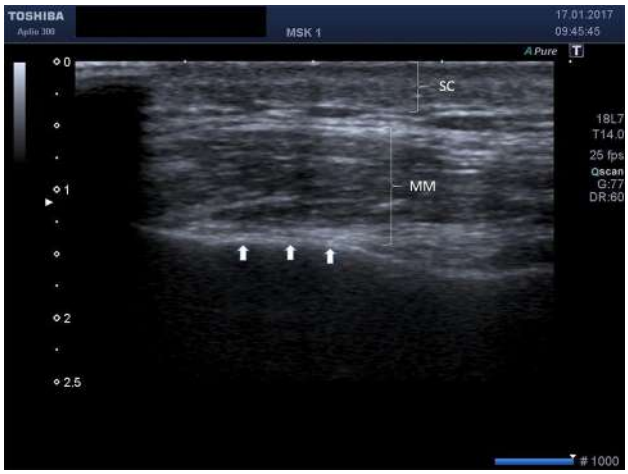

Fig. 1 Normal masseter muscle in USG (Arrows indicate mandibular bone, *SC* skin and subcutaneous tissue, *MM* masseter muscle)

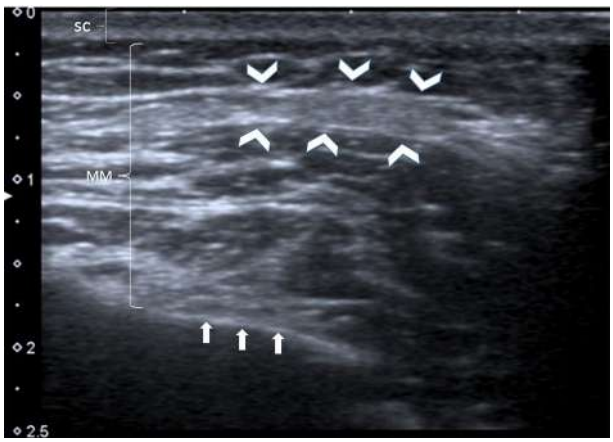

Fig. 2 An active spasm point (clinically painful) in the masseter muscle (arrows indicate mandibular bone, arrow heads indicate spasm area, *SC* skin and subcutaneous tissue, *MM* masseter muscle)

hypoechogenity with hyperechogenic fascia layers by the USG (Fig. 1). Spasm points were observed clearly as limited isoechogenic areas within normal heterogeneous muscle tissue (Fig. 2).

The findings obtained were transferred to SPSS® software (SPSS v. 20.0 for Windows, SPSS Inc., Chicago, IL). The descriptive analyses and frequencies were determined.

Results

The mean age of the 15 patients (3 males, 12 females) with TMJ dysfunction was 26.13 ± 8.31 years (min: 20, max: 46) and the mean age of the healthy controls (2 male, 3 females) was 23.4 ± 5.64 years (min: 18, max: 32).

Table 1 The clinic and USG findings of masseter muscles of patients with TMJ dysfunction

Clinic	USG		
	Spasm +	Spasm −	Total
Spasm +	14	0	14
Spasm −	4	12	16
Total	18	12	30

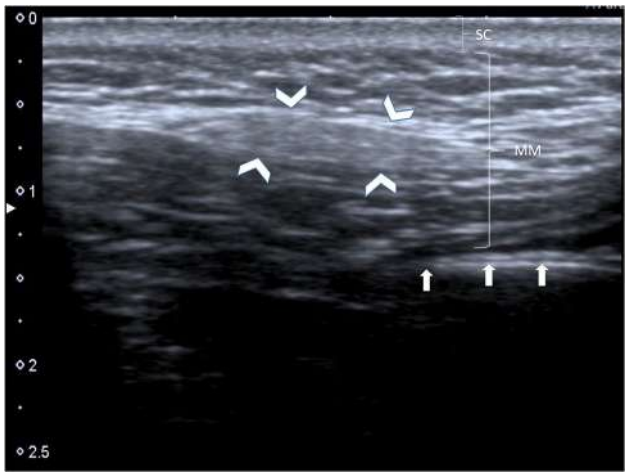

Fig. 3 A spasm point in the masseter muscle which did not cause pain (passive point) clinically (arrows indicate mandibular bone, arrow heads indicate spasm area, *SC* skin and subcutaneous tissue, *MM* masseter muscle)

The clinical and USG findings are summarized in Table 1. The clinical findings were as follows; painful spasm points in the masseter muscles were detected by palpation in 11 of the 15 patients with TMJ dysfunction. Three of them were bilateral. Namely, a total of 14 spasm points were detected 30 masseter muscles clinically.

Spasm points were observed clearly as isoechogenic areas within normal heterogeneous muscle tissue. The USG findings were as follows: spasm points were detected in all 15 patients with TMJ dysfunction by USG. Three of them were bilateral. Namely, a total of 18 spasm points were accurately localized by USG in patients with TMJ dysfunction. The location of the spasm points was also verified when the patients felt pain, while the probe moved around this region on the masseter muscle. The spasm points in four patients detected by USG were inactive clinically, they were painless on palpation. Although there was no clinical pain in these four patients, the spasm area was observed by USG (Fig. 3). There were no differences of appearance of active and inactive spasm point by USG.

No clinic or sonographic spasm point was detected in the masseter muscles of healthy controls. The masseter muscle of control group patients was showed normally low echogenicity with heterogeneous fascia layers.

Discussion

Approximately 40–60% of the general population is affected by TMJ dysfunction. TMD can be divided into two groups basically as intra-articular disorders or internal derangements and extra-articular disorders originating from the musculoskeletal system. In addition to clinical examination, radiological examinations are, of course, important in the diagnosis of TMD. Bone structures of TMJ can be clearly examined by the conventional radiography and tomography if necessary. MRI is considered to be the gold standard in the examination of soft tissues of TMJ, especially for determining the position of the disk in internal derangements. Acute inflammatory conditions and effusion of the TMJ and surrounding tissues can also be examined clearly by MRI. Although muscular problems have an important role in TMJ dysfunction, no imaging modalities are routinely used to examine masticatory muscles in clinics.

Recently, USG has become increasingly popular in the field of dental radiology [4]. The echogenicity of superficial anatomic structures depends on an acoustic impedance difference between different structures according to USG principle. As this difference increases, the echogenicity increases. Healthy muscles show heterogenic hypoechogenity on USG images with hyperechoic thin transversal lines. These lines are probably images of internal fascia or tendons, and are sometimes called septa [6, 7]. Some studies have shown that the number of echogenic lines decreased in inflammatory muscles; these studies have asserted that echogenic lines are an important indicator of masseter muscle inflammation [8, 9].

There are many USG studies in the literature that measure masseter muscle thickness [10–12]. And a present study was evaluated the masticatory muscle hardness and its association with TMD by elastography with USG [13]. Another study evaluated the internal structures of muscular changes in bruxers and patients with myofascial pain/myositis and oral submucous fibrosis by USG compared with healthy individuals. They reported significant echogenic changes in the internal structure of the masseter muscle in patients' group [14]. The present study differs from these, because it is aimed to assess the internal structure and the spasm points of the masseter muscle by USG.

Tater and Pandey [15] mentioned that the use of electromyography and ultrasound improves the accuracy of the botulinum toxin injection procedure in movement disorders. Park et al. [16] used USG to measure the masseter muscle thickness and subcutaneous thickness. In a recent systematic review by Reis Durão et al. [17], it was mentioned that

the articles in the literature were categorized as thickness, cross section, volume, and the length of the masseter muscle measured by USG. There is no other study in the literature showing masseter muscle spasms by USG. Therefore, the present study is an issue in this respect.

The aim of the present study was to emphasize the effectiveness of USG in the imaging of spasm points, because there is no other study in the literature based on this issue. This study may also be a guide for future studies about therapeutic intramuscular local anesthetic injections to spasm points guided by USG. The location of the spasm points can be detected exactly by USG, and in this way, the success of the intramuscular therapeutic local anesthesia injections on the masseter muscle will increase.

This study was done on a limited population by only examining the masseter muscle. USG clearly showed the internal structure of the muscle and ensured the localization of spasm points in the masseter muscle.

Compliance with ethical standards

Conflict of interest There are no funders and no disclosure. Kader Azlag Pekince, Fatma Caglayan, and Adem Pekince declare that they have no conflict of interest.

Human rights statement All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions.

Informed consent Informed consent was obtained from the patients for being included in the study.

Animal rights statement This article does not contain any studies with animal subjects performed by the any of the authors.

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