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Review Article

Magnetic resonance and sonographic imagings of masticatory muscle myalgia in temporomandibular disorder patients

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Splint therapy;
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Summary This article reviews recently published studies investigating the MRI and sonographic diagnosis of masticatory muscle myalgia in temporomandibular disorder patients. The MRI and sonographic features of muscle after treatment are also discussed. Literature published within the last 15 years was obtained from the PubMed database using the following Mesh terms: magnetic resonance imaging (MRI) or sonography, masticatory muscle pain, and treatment. MRI and sonography enable accurate visualization and evaluation of the masticatory muscles, thereby increasing our understanding of pathology and cause of pain associated with these muscles. Although therapeutic efficacy is often evaluated based on clinical findings, MR and sonographic imaging studies may also be valuable.

Contents

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1. Introduction

Masticatory muscles were evaluated using electromyography (EMG) [1—3], near-infrared spectroscopy (NIRS) [4], and so on, for purpose of evaluation of muscle activities and blood oxygen kinetics. Al-Saleh et al. performed systematic review of two studies (74 patients) that were collected using Mesh terms of TMD, jaw pain and EMG, and stated that the sensitivity of EMG in diagnosing TMD was low (0.25—0.40) [1].

In the recent years, studies using MRI and sonography in patients with masticatory muscle myalgia have frequently been reported, and the newly developed technologies have been introduced [5—38]. Muscles after treatment in those patients also have been evaluated using MRI and sonography [5—15].

This article reviews recently published studies focusing on the MRI and sonographic diagnosis of masticatory muscle myalgia in temporomandibular disorder (TMD) patients, and shows the intramuscular state, blood flow, and muscle hardness. The MRI and sonographic evaluations in relation to the efficacy of various treatments are also discussed.

2. Methods

Literatures published within the last 15 years were searched from the PubMed database using the following Mesh terms: (1) (MRI or sonography) and masticatory muscle pain; (2) (MRI or sonography) and masticatory muscle pain and treatment. Original papers and review articles published in English and Japanese were adopted. Selection criteria were MRI and sonographic features in diagnosis of masticatory muscle myalgia and in evaluation of muscle after therapy. Studies of neoplastic lesions and case report were excluded.

3. Results

3.1. MRI and sonographic diagnosis of masticatory muscle myalgia in TMD patients

The number of literature that met the mesh terms of (1) and the above-mentioned criteria was 34 [5—38].

Most MRI studies in TMD patients evaluated intra-articular changes, such as disk displacement [5—7,16—18], and MRI studies evaluating the masticatory muscles were a few. Zanoteli et al. evaluated changes in the signal intensities of the masticatory muscles in 15 patients with myotonic dystrophy on T1- and T2-weighted images, and diagnosed the presence of a high signal intensity area (fatty replacement) as abnormal [19]. Gregor et al. [20] and Okada et al. [21] investigated masseter muscle metabolism using ^{31}P-magnet resonance spectroscopy. The former revealed a difference in masseter muscle metabolism between 11 dolichofacial and 11 brachyfacial subjects, and the latter showed an increase in masseter muscle metabolism secondary to heat pack use in 12 healthy subjects.

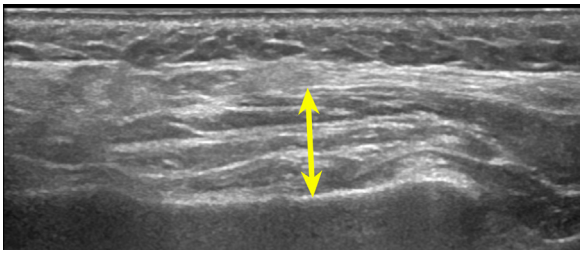

Figure 1 Method for measuring the thickness of the masseter muscle.

The most common index for evaluation of masticatory muscles in the sonography studies was muscle thickness (Fig. 1) [8—12,22—29]. Ariji et al. showed that the masseter muscle thickness in 25 TMD patients was greater than that of 30 healthy volunteers [22]. Strini et al. showed that the masseter muscle thickness on sonography and the masseter muscle activity on electromyography were positively correlated with occlusal force in 19 TMD patients [23]. Other reports examined the relationship between masseter muscle thickness and facial morphology [24,25].

A next focusing index was the appearance of the intramuscular echogenic bands, which correspond to the internal fascia (Fig. 2) [39]. Masseter muscle appearance was classified into three types based on the internal echogenic bands, and it was revealed that the masseter muscles in 25 TMD patients frequently displayed thickened bands or reduction in the number of bands [22].

In recent years, sonoelastography has been used to evaluate the skeletal muscles [40—43]. The principal of sonoelastography can be divided into two types: strain and shear wave elastography [44]. Strain elastography is based on the distortion due to vibration caused by manual pressure. Hardness on strain elastography is displayed as a relative value compared to the reference (Fig. 3). Shear wave elastography is based on the propagation velocity of the shear wave generated by acoustic radiation force. Hardness on shear wave elastography is displayed as the shear wave speed or Young's modulus (Fig. 4).

Studies regarding the masseter muscle hardness on strain elastography recently have been reported [30,31]. Hardness on strain elastography is expressed as elasticity index (EI). The EI was originally developed for sonography machine and software, and defined as the strain values of each area compared with the average strain value (EI = 1) of the whole area of interest. The EIs of the softer and harder areas than the average EI were assigned as 0—1 and 1—6, respectively. EI ratio of the masseter muscle was evaluated compared with

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