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Review article

APPLICATION OF MRI IN THE DIAGNOSTICS OF M. MASSETER

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ABSTRACT

Magnetic resonance imaging (MRI) is a non-invasive diagnostic method which can provide detailed images of organs and structures of the human body.

The purpose of this review is to explore and introduce the diagnostic capabilities of MRI in imaging m. masseter in conditions of norm and pathology.

The material of the review is information of 20 literary sources selected from 530, found by keywordsfromJanuary to April 2017.

The information about MRI imaging of the normal anatomy of m. masseter and the most common findings in muscle - muscle hypertrophy, inflammatory changes, vascular malformations, intramuscular hemangioma, cysticercosis and changes after radiotherapy was analyzed.

In conclusion, the diagnostic capabilities of MRI of masseter muscle – both in the conditions of norm and pathology were confirmed. The method is considered to be reliable, objective, non-invasive and accurate.

Keywords: MRI, diagnostics, m.masseter,

BACKGROUND

Magnetic resonance imaging (MRI) is a method for imaging a variety of conditions and disorders [1], which by the means of magnetic field and frequency remote impulse digitally provide detailed images of organs and structures of the human body. Soft tissue and bone are depicted in details. MRT can be used as a very accurate method with high diagnostic value. Advantages of MRI are clear and detailed images, which according to Lam [2] are extremely useful in monitoring of various pathologies.

M.masseter is one of four main muscles of the masticatory mechanism. Its function is to close the mouth and press the lower dentition towards the upper. The surface area of the muscle assists the movement of the lower jaw forward. [3] In patients with functional pathology of the masticatory mechanism m.masseter often reacts with inflammation, hypertrophy and other conditions (like Cysticercosis) which can also be manifested by a characteristic change in the muscle that is the subject of imaging.

According to Razek [4], the research of m.masseter by MRI provides an accurate and precise image on the morphology and function of the muscle. Clinical benefit of the research is analyzed in regard to early diagnosis of various diseases, their follow-up and evaluation of the healing process.

Knowing the characteristics of MRI imaging of masseter muscle is an advantage for the clinical activity of the dentist. Including such test in the diagnostic protocol associated with bruxism craniomandibular dysfunctions, allows refinement of the diagnosis and is an object of scientific interest.

The aim of the review is to explore and submit the diagnostic capabilities of MRI in imaging the masseter muscle in conditions of norm and pathology.

MATERIALS AND METHODS

From January 2017 to April 2017 research was conducted in the following databases PubMed, SpringerLink and Google according to keywords in Bulgarian (“MPT”, “диагностика”, “морфология”, “m. masseter”); English (“magnetic resonans imaging”, “diagnostics”, “morphology”, “masseter muscle”,); German (“Magnetresonanztomographie”, “Diagnostik”, “Morphologie”, “Masseter Muskel”). There were found a total of 530 literary sources. The repeating articles and those that are not related to the aims of this study are excluded. Total selection comprises 20 research papers. They were subjected to critical analysis, the results of which are set out in this literature review.

REVIEW RESULTS:

NORMAL ANATOMY OF THE MASSETER MUSCLE SHOWN BY MRI

Normally the masseter muscle has three layers. His borders are as follows: the surface is limited by m.platysma and gl.parotidea, at a depth of m.temporalis and mandibula, ventral located from m.buccinator and dorsally located from

gl. Parotidea. M.masseter is covered by cervical fascia and surrounded and covered by fat.

According to Seltzer [5], MRT image of masseter muscle is easily recognisable as a large oval structure with a density of soft tissue. The three layers of the muscle can be clearly defined, but it is usually observed as a whole. The boundaries of the muscle can be easily detected - the lower jaw is a medial border with low intense density, gl. parotidea is a rear-lateral border with high intense density.

The image of the structure and form of masseter muscle may vary depending on the pulse sequence which is used. Usually, the image of a higher intensity is obtained with T1- sequences than the T2- sequences. Seltzer [5] describes m. masseter as a low-intensive structure in the axial image in the T2 sequence (TR = 2000ms; TE = 160ms). It is represented as surrounded by high-intense fat tissue. The mandible is seen as a vertical linear gap. In the coronary image in the T2- sequence (TR = 1500ms; TE = 80ms) m.masseter is represented as a structure with an average intense density, which is surrounded by fat tissue with high-intense density and the lower jaw is positioned medially (represented by low intense of the density).

Razek [4] examines the structure of m.masseter in patients without evidence of existing pathological changes and diseases associated with muscle. In the MRI study are administered T2 and T1-sequences (Fast spin-echo (SE) sequence; axial short inversion time recovery (STIR) sequence; Fat-saturated). Contrast material based on gadolinium was applied.

Of interest are the results of Lewis [6]. The author found a correlation between the thickness of m.masseter, measured by MRI and the vertical facial morphology. MRI image by Lewis [6] showing the thickness of masseter muscle in a short face, long face and normal vertical facial morphology.The author found a significant difference in the thickness of m.masseter in different types of facial profile. Biggest thickness was observed in persons with a reduced vertical size and significantly smaller in subjects with increased vertical facial size.

COMMON FINDINGS IN THE DIAGNOSTIC OF M.MASSETER WITH MRI

M. masseter may be affected by some neoplastic, infectious, inflammatory and degenerative diseases. Early detection and clear documentation are important to conduct timely and appropriate treatment. Since the clinical trial of m.masseter may be inaccurate and incomplete, there is a need of additional imaging. According to William [1], MRI provides extremely detailed images, as well as additional information that is not found in other imaging methods such as X-ray and ultrasound.

HYPERTROPHY OF THE MASSETER MUSCLE

The hypertrophy of m.masseter is a unilateral or bilateral enlargement of the muscle with unknown aetiology.

In a clinical examination of 31-year old patient Sannomiya [7] established a unilateral enlargement around the left masseter muscle, which increases by clenching of the teeth. There was no evidence of facial trauma, dental anomalies or temporomandibular disorders. MRI scans (1.0 TeslascannerMagnetonSiemens) shows a typical image of hypertrophy of the muscle.

Kamble [8] also investigate patients with evidence of hypertrophy of the masseter muscle, using 1.5 Tesla GE Scanner. One of the cases is a 20-years-old female patient with complaints of bilateral swelling in the masticatory muscles.MRT image reveals bilateral hypertrophied masseter muscles.

The another clinical case is of a 17-years-old patient who complains of swelling in the right masseter muscle for two years. Diagnosis of unilateral hypertrophy of the muscle has been proved by MRI image. Axial and coronal T2-weighted image reveals hypertrophied right masseter muscle.

INFLAMMATORY CHANGES IN M. MASSETER

The submasseteric abscessus localised, often chronic infection of the masseter muscle and the lower jaw. Jones K. et al. [9] made a research of a group of patients with chronic complaints and symptoms of sub masseteric abscess. The diagnosis is confirmed by the typical images found by MRI. One of the cases is 17-years-old patient with spontaneouss welling in the masseter muscle. After extraction of the lower right molar, swelling persists with no evidence of fever or trismus. MRI(T1-weighted images (500/20 [TR/TE]number of signals averaged [NSA], 2256 × 224; section thickness, 5 mm) reveals a collection of exudate in the right masseter muscle. It is visibable that the right masseter muscle is enlarged and there is a fluid collection with lower intense of density, which is considered purulent exudate. The author describes an area with strong, intense density between this collection and m.masseter, which probably represent oedema and myositis.

MRI diagnosis of another patient who reported 18 months of persistent swelling in the right masseter muscle, associated with the presence of fever, display an image with high intense density suspected of the abscess. The T2-weighted imaging by Jones [9] shows a definite fluid collection as a region of high signal intensity within the right masseter muscle comparable with oedema and myositis.

VASCULAR MALFORMATIONS OF M. MASSETER

According to Jayaraman et al. [10], intramuscular vascular abnormalities are rare lesions. Musculus masseter is often affected. These lesions may present at birth but usually appear right in adolescence. There are impaired motor functions and nerve damages.

The research of such abnormalities with MRT is very important for accurate diagnosis because of their rare occurrence and non-specific clinical picture. There is a represent of a patient at the age of 28, with a proven consequently histopathological diagnosis of vascular malformation. MRI images show a heterogeneous mass in the right m.masseter with multiple hypointense zones in the middle, suggesting venous vascular malformations.

INTRAMUSCULAR HEMANGIOMA

Intramuscular hemangiomas are rare tumours of the head and neck. According to the literature [11], m.masseter is most commonly affected in this area. Hemangioma of m.masseter can be misdiagnosed as parotid neoplasms or maseter hypertrophy. In such cases, application of MRI has a high diagnostic value. Images show the pathological morphology: benign vascular mass containing non-vascular elements such as fat, fibrous tissue, smooth muscle, bone, and blood clots [12].

According to Buetow et al. [13], hyperintense of hemangioma observed in the T2-weighted images is associated with increased free water in stagnant blood in the larger vessels of the lesion. Low-signal linear reflections were observed which represent adipose tissue in the tumour.

Other authors [14] studying hemangioma of m. masseter describe hyperintense image clearly distinguished from the muscle in T2-sequence. In T1-sequence is presented haemorrhage as a hyperintense mass in the tumour.

Kim H, et al. [15] also present MRI study of intramuscular hemangioma of the left masseter muscle, showing 3.3 cm soft tissue mass without evidence of bony invasion.

Kanaya et al. [16] investigate the case of a 14-years-old child suffering from intramuscular hemangioma of the right masseter muscle, presented as a clear hyperintense area with numerous rounded hypointense areas around it.

Other scientific reports [17] also demonstrated the case of intramuscular hemangioma of m.masseter by MRT with hypointense and hyperintense lesionofm.masseter.

CYSTICERCOSIS

According to Kumar et al. [18] cysticercosisis a tissue infection caused by young form (cysticercus) of porktapeworm (Taeniasolium), which may affect muscles, including m. masseter.

Muscle cysticercosis has non-specific signs and diagnosis can be difficult. MRI scan demonstrate classical cyst with scolexinside. The T2-weighted image by Kumar et al. [18], shows hypointense well-limited lesion in the right masseter muscle and edema around hypointense lesion and presence of calcification within the lesion.

CHANGES IN M. MASSETER AFTER RADIOTHERAPY, SHOWN IN MRI IMAGES

Radiotherapy can result in serious consequences for temporomandibular joint and masticatory muscles [19, 20, 21, 22]. Changes in the tissues like atrophy, hypertrophy, inflammation, necrosis and fibrosis may occur as a result of ionising radiation [23, 24, 25]. Caused change scan be establish and document byMRI. The images are unspecific - most commonly observed findings has characteristics of inflammation with odontogenic character, atrophy and fibrous tissue [19].

CONCLUSION

This review confirms the broad spectrum of diagnostic capabilities of MRI of m. masseter – in both conditions of norm and pathology. Themethodisconsideredtobereliable, objective, noninvasive and accurate.The literary sources point out the possibility of specifying the information of the study objects, which regarding to diagnosing of m. masseter has an undeniable advantage of clinical and scientific importance. There are images that are considered normal and typical findings in different pathologies.

Based on the analysis it can be concluded that:

• normal m.masseters is observed as a homogenous oval structure with a density of the intensity such as soft tissue;

• if there is hypertrophy/atrophy, the masseter muscle changes its size and shape;

• inflammatory changes are usually observed as a low-intense zone, representing the inflammatory exudate;

• Benign tumours (vascular malformations, hemangiomas, etc.) are observed as hyperintense zones.

• Cysticercosis of the masseter muscle can be observed as well limited hypointense lesion, with presence of calcification;

MRI of m. masseter is an imaging method recommended for early diagnosis of various diseases of the muscle, tracking the changes in dynamics and objectifying the results of the treatment. The provided information is relevant to scientific researches and studies on morphology and function of the muscle.

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