Health Review

Diagnosis of Temporomandibular Disorders by Magnetic Resonance: a narrative review

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Abstract: The temporomandibular joint (TMJ) is extremely important and complex for the organism, since it is responsible for joining the skull to the mandible. Therefore, any alteration due to injury or dysfunction can cause signs and symptoms that characterize temporomandibular joint dysfunction (TMD). Based on a narrative review, this study sought to analyze the effectiveness of the diagnosis of temporomandibular disorders by magnetic resonance imaging, through a literature review. It was evidenced that, among radiodiagnosis exams, magnetic resonance imaging (MRI) offers essential data and information regarding the mapping of the TMJ, especially in cases of dysfunction due to disk displacement. of the joint, also having the advantage of not exposing the patient to ionizing radiation, as in the case of computed tomography, for example. Thus, it is impossible not to link the benefits offered by MRI for the diagnosis of TMD. With high-resolution images, the MRI technique allows detailed and precise anatomical and functional observation, providing exclusive information on the studied segments, results that only the MRI device can achieve. Although it has limitations like any method, its incomparable advantages stand out, taking MRI to an unattainable level in relation to other techniques available for studying the TMJ.

Keywords: Temporomandibular joint articulation; Temporomandibular joint dysfunction; Magnetic resonance imaging.

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1. Introduction

In the mid-1970s, magnetic resonance imaging (MRI) appeared, a diagnostic imaging method considered an example of technological advancement at the time. Incorporated into hospital entities, the technology was capable of subjecting biological tissues to a magnetic field causing the hydrogen nuclei to be tracked and vibrate around an axis, emitting energy capable of generating high-definition images [1].

Different tissues are defined by different repetition time (TR) and echo time (TE) values, that is, depending on the magnetic response, the appropriate image weighting for that study or investigative diagnosis will be defined, thus guaranteeing greater sensitivity in the distinction of soft tissues, which involve blood vessels, lymphatic vessels, fatty tissue, muscles, aponeuroses, tendons, nerves and synovial tissues [2].

With regard to synovial tissues, these involve joints such as the knees, hip and temporomandibular joint (TMJ). This joint is extremely important and complex for the organism, since it is responsible for joining the skull to the mandible and any alteration, whether due to injury or some dysfunction, can cause pain and discomfort, as well as

difficulty in chewing, creptations and locks, among others, signs that characterize temporomandibular joint dysfunction (TMD) [3].

It is believed that the etiological factors that favor the development of these dysfunctions in the joint may be correlated with trauma, bruxism, stress and occlusal abnormalities. In the same way, the atypical disc displacement in the middle of the TMJ is related to an internal disturbance, characterized by medial, lateral and even posterior displacement, which can be observed through the MRI technique [4].

In view of the immense popularity of diagnostic imaging, especially due to the fact that MRI stands out as one of the main methods for diagnosing pathologies and dysfunctions that affect soft tissues, there is greater medical and technical responsibility on the part of professionals who perform and interpret the exam, making it extremely reliable in the early detection of numerous diseases and disorders, thus avoiding late treatments and enabling better response-treatment to patients.

Based on the above, the present work aims to analyze the effectiveness of the diagnosis of temporomandibular disorders by magnetic resonance imaging, through a narrative review.

2. Anatomy of the Temporomandibular Joint (TMJ)

The TMJ is considered one of the most complex joints in the human body. It represents a functional unit formed by several structures that act in a highly specialized way in the mastication process, encompassing the teeth and their structures, the mandible and its musculature, and has a direct influence on swallowing and speech [5].

Anatomically, the TMJ is classified as a synovial joint, that is, it has synovial fluid between the bones. This fact makes it easier for surfaces to move, thus ensuring greater mobility when compared to the other two types, fibrous and cartilaginous. In addition, it is subclassified as a condylar joint, however, from a functional point of view it is considered a bicondylar joint since the head of the mandible, a surface in a convex elliptical shape, relates to two surfaces in a concave shape: the mandibular fossa and the articular tubercle. The TMJ can also be classified as bilateral, because it represents two joints that are part of the same bone, an exclusive characteristic of this joint, increasing its complexity even more [6].

Regarding the articular surfaces, the head of the mandible is elliptical and has two poles, the lateral and the medial, important structures in the fixation of the articular disc, as well as the joint neck, a narrow structure that surrounds the head of the mandible. More temporally, the joint surfaces found are mandibular fossa (which extends to the petrotympanic fissure) and mandibular tubercle [6].

Because it is a synovial-type joint, the joint surfaces are covered by joint cartilage. Unlike the other joints, which are of the hyaline type, the TMJ is composed of fibrocartilaginous type cartilage, which confers more resistance and greater regenerative power, when compared to the hyaline one. Its thickness also differs from the others, since it does not present a uniform behavior. The nutrition of the tissue is carried out by means of the synovial fluid, which is found inside the joint, bathing the surfaces and nourishing the cartilage [7].

In order to prevent this synovial fluid from leaking out, there is also a structure of vital importance, the joint capsule, a structure made up of fibrous connective tissue, also responsible for interconnecting the surfaces. The joint capsule is formed by two membranes, an outer one, called the fibrous membrane, and a more inner one, the synovial membrane. While the fibrous membrane confers resistance, the synovial membrane is responsible for the production of synovial fluid from blood, thus allowing constant lubrication and irrigation, minimizing friction [8].

Another important structure is the articular disc. This disc is formed by fibrocartilage, being responsible for cushioning the impact during movements. It is fixed to the poles and joint capsule, so that it allows a better fit between the surfaces and, at the same time, subdivides it into two distinct and unconnected compartments [9].

Ligaments are other structures that stand out in synovial-type joints. They are essential for the correct execution of the movements. Among these, in the TMJ, the lateral ligament is known as the true ligament, being responsible for preventing retrusion movements. The stylomandibular and spheromandibular ligaments, on the other hand, are considered accessories, since they are not truly part of the capsule and are responsible for keeping the mandible in suspension, preventing displacements [10].

TMJ biomechanics involves rotation and translation movements, which are performed in the lower and upper compartments, respectively. Therefore, it is still necessary to use two muscles to carry out these movements, such as opening the mouth (mandibular lowering), performed by the digastric and lateral pterygoid muscles. On the other hand, to perform mouth closure (mandibular lifting), the muscles most used are the temporalis, as well as the masseters and medial pterygoids. In addition, the TMJ also performs protrusion, retrusion and laterality movements [11].

3. Disfunções Temporomandibulares (DTM)

Although the etiology of TMD's is still unclear, it is known that the TMJ is constantly exposed to conditions that, together, lead to an imbalance in its function, whether due to predisposing natural or environmental factors. Such conditions, most often multifactorial, lead to a clinical condition known as TMD's [5].

According to the American Association of Dental Research, TMD can be described as "*a group of musculoskeletal and neuromuscular conditions that involve the TMJs, masticatory muscles and all associated tissues*" [12], having as predisposing factors: stress, occlusive asymmetries, bruxism, bad functional and stomatognathic system habits, which involve finger sucking, nail biting, use of pacifiers, among others, skeletal dysfunctions, traumas, systemic disorders and behavioral factors [13].

The symptomatology is quite variable among TMD patients, even constituting a challenge for professionals in the assessment of new patients. Among these signs and symptoms, one can list limitations in joint and muscle movement, facial and mandibular pain, creepiness when moving the joint, tinnitus, dizziness, headache, and malocclusion. The latter is responsible for promoting increased muscle activity and fatigue, which can lead to postural damage [14].

A late diagnosis reflects incorrect or expensive treatment, contributing to the onset and/or progression of symptoms, especially pain. For a successful treatment, a detailed anamnesis is indispensable, with clinical history, physical examination, complementary exams to control predisposing factors and, in addition to all this, an efficient approach to dentistry and other related areas is necessary, such as, for example, association to physical, pharmacological or psychological therapies [15].

In view of the growing complexity of that condition and the increase in the number of people affected, specific parameters of an international nature were developed with a view to a universal diagnostic approach. These Diagnostic Criteria for TMD are based on the assessment of the degree of psychological impairment in association with chronic pain in patients [16].

Although the signs and symptoms of TMD are expressive, they are also non-specific, making rapid and effective management difficult. Thus, it is necessary to use techniques that go beyond conventional barriers. According to the findings in the literature, the diagnosis should consist of a physical assessment, through palpation of the masticatory muscles and movements of the temporomandibular region associated with imaging tests such as panoramic radiographs, CT scans and MRI [17].

Radiographic exams stand out compared to diagnostic evaluations, especially the MRI technique, considered the gold standard for the diagnosis of disorders due to its excellence in image quality, providing a clear anatomical visualization of the TMJ from different angles [18]. Whether in any condition, an early diagnosis determines better

therapeutic responses. In the case of TMDs, a quick diagnosis, followed by a correct treatment, is essential to prevent the progression of acute symptoms to chronic ones, mainly in those marked by orofacial pain [19].

According to dental parameters, treatment revolves around interventions that vary according to the degree of dysfunction of each patient; among them we can mention occlusion adjustment or surgery, use of orthodontic appliances or occlusal splints, the latter standing out as the intervention of choice due to its advantages [20]. In some cases, a multidisciplinary team can be activated aiming at better solutions, according to the severity of the symptoms of the patients being treated [21].

4. Magnetic resonance imaging as a diagnostic tool for TMD

RM images are characterized as a mapping of hydrogen protons present in organic tissues. These are obtained through energy measurements that are captured, processed and translated by a computer in the form of a digital image. Two main mechanisms participate in this process, T1 and T2, which are the result of the interaction of the characteristics of the tissue under study with the technical parameters established by the operator at the time of image acquisition [22].

With several synonyms, bilateral TMJ MRI is one of the exam modalities among the investigations offered by MRI. As the name suggests, through this exam images are obtained at different angles on both sides of the joint. Thus, enabling a detailed study of the temporal and mandibular bones, as well as the muscles, tendons and, especially, the joint disc, structures that are components of the joint [23].

Through the examination, it is possible to identify alterations such as disc displacement, degenerative processes such as arthritis, in addition to wear and tear and fractures in the joint. Moreover, it also allows the evaluation of cancerous processes, infections, cases of osteonecrosis, in addition to hyperplasia of the coronoid process, the latter being one of the factors responsible for the difficulty in opening the mouth, a classic sign of TMJ disorders [17].

In view of the need for an anatomical evaluation of the TMJ, during the MRI examination, the operator will require the patient to open and close the mouth, with the duration established by the operator for better detailing and more accurate information. . It is through these movements that the position of the joint disc will be observed, that is, if it is in a position anterior or posterior to the condyle, and if the dysfunction is characterized by reduction [24].

Among the criteria for its realization, it is extremely forbidden for the patient or companion to enter with metallic accessories, be they earrings, bracelets, necklaces or even piercings due to the powerful magnetic field present in the room, even when the device is turned off. It is also indicated the use of clothes without the presence of metallic objects, in addition to presenting yourself with dry hair, free of gels, and without makeup [25].

Still in this sense, it is contraindicated for patients who have a pacemaker, with exceptions, intra-auricular implants, external orthopedic fixators, subcutaneous sensors, clips for aneurysms, among others. Pregnant women with a gestation period of less than three months should also not undergo the test. On the other hand, intrauterine device (IUD), fixed orthodontic appliances, heart prostheses, bladder clips, orthopedic implants and intravascular stents are allowed [26].

To perform the TMJ MRI examination, a skull coil is used, and the protocol used includes joint registration in the closed-mouth and open-mouth position in T1, T2 and Proton Density (PD) weightings in the sagittal and coronal planes (Figures 1 to 8). The T1 weighting provides excellent anatomical detailing and PD presents satisfactory spatial resolution of the joint disc, in addition to being excellent in showing disc displacements. T2 images register joint effusion, bone edema and fat saturation (FAT, SAT or IR) better demonstrate the presence of fluid. Videos called Movies/Cines can be acquired through acquisition of images in different phases of mouth opening and demonstrate TMD's well [27].

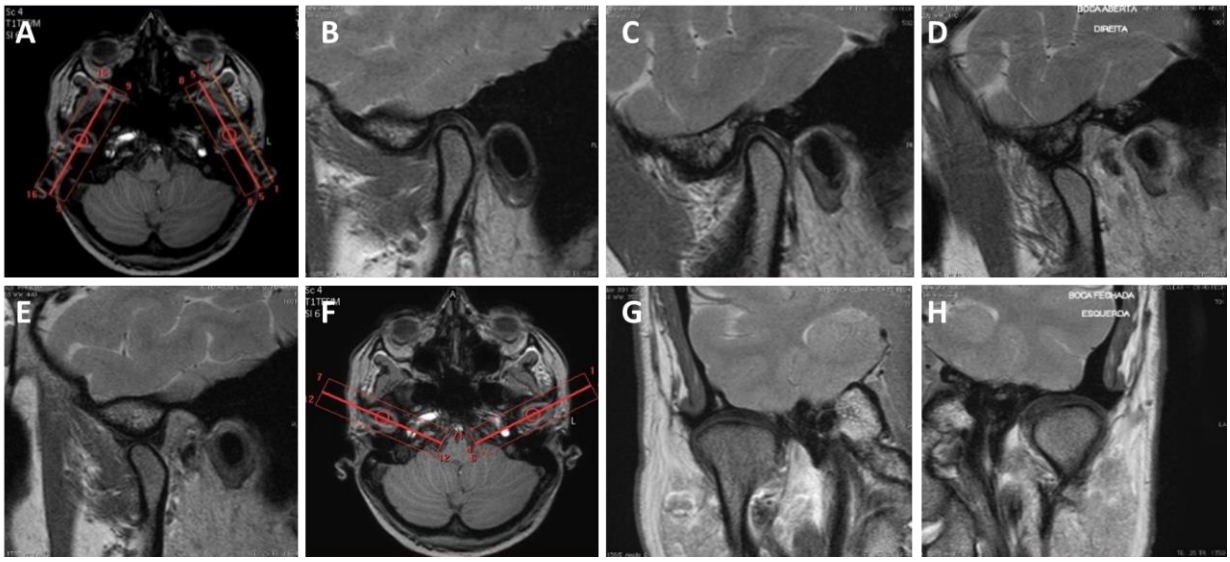

Figure 1: (A). Programação Corte Sagital. (B). Sagital DP Boca Fechada D. (C). Sagital DP Boca Fechada E. (D). Sagital DP Boca Aberta D. (E). Sagital DP Boca Aberta E. (F). Programação Corte Coronal. (G). Coronal DP Boca Fechada D. (H). Coronal DP Boca Fechada E. Fonte: PACS Clínica Omnimagem.

4. Discussion

TMDs directly influence the balance of the stomatognathic system and its imbalance, in turn, can interfere with chewing, swallowing, sucking and speech articulation. Furthermore, the disorder itself is responsible for signs and symptoms that may affect any age, ranging from mild symptoms such as jaw crepts and tinnitus, to more severe symptoms such as difficulty moving the mouth and severe pain [28]. Thus, a precise and objective approach is necessary for proper patient management [29].

As observed in the present study, among the imaging exams, MRI provides an essential diagnosis in terms of mapping the TMJ, especially in cases of dysfunction due to disk displacement, since it offers sectioned images of the entire joint set, with the aim of advantage of not exposing the patient to ionizing radiation, as in the case of computed tomography, for example [30].

With very high-quality images and in a non-invasive way, the MRI exam provides an overview of the bone contour, in addition to details on abnormalities of the condyle medulla associated with degenerative processes. It also allows visualization of soft tissues and the articular disc. The TMJ disc is a flexible and elastic cartilage responsible for cushioning between the two bones [31].

In cases of TMD due to disc alteration, it is possible to notice disc anatomical changes due to tissue degeneration. Characterized as number one among TMD's, disc displacements are described as abnormal alignments between the articular disc and the condyle, which can be displaced in the antro-medial and anterior directions. In cases of anterior displacement, anatomical modification is commonly found, a fact observed in studies by Wang et al. [32] and Martins et al. [33] in which differences in thickness between normal and abnormal discs were verified.

Although it has a higher cost than other radiographic techniques, MRI stands out compared to other techniques due to its more precise and unique information, with details of intra- and extra-articular alterations. Furthermore, with regard to symptomatic patients, the test has shown greater specificity by providing a better correlation between findings and symptoms [34]. Costa et al., in 2008, analyzed 42 patients with TMD who had a clinical picture of headache and joint pain using magnetic resonance imaging, showing that headaches are directly related to joint effusions in patients with TMJ alterations.

At MRI, images can be obtained in T1, T2 or DP weights, these sequences being divergent in contrast, with different proton relaxation times. These image acquisitions are used for a better visualization of the structures, being able to distinguish the tissues according to their composition. For example, in a weighting where white structures are observed, in another weighting it will be displayed in gray. T1-type images provide anatomical details, while T2-type images analyze fluids, in addition to providing pathological details [4].

According to the literature, T1 images express better structural detailing, and are therefore considered the method of choice for investigation compared to T2 images, since the latter fits as a method of investigation of joint edema or effusion [35]. As described, Garcia et al. [17] also reaffirm the value of MRI in the diagnosis of TMDs due to its high-resolution images, with a special focus on T1 and DP images.

However, even with these advantages, it is necessary to consider some limitations of MRI. Although it is considered the method of choice for assessing the articular disc, the technique presents difficulties in assessing perforations and adhesion disorders, as well as limitations in the analysis of the lateral and medial regions. However, it should be noted that the technique is expensive and requires highly specialized equipment. Due to the use of a magnet, patients with an incompatible pacemaker or carriers of ferromagnetic metallic implants are ineligible. MRI can still cause a feeling of claustrophobia in some patients [36].

5. Conclusion

Based on what has been exposed, a correct, fast and accurate diagnosis is essential for planning the most appropriate treatment. Therefore, in cases of TMD (especially in cases of disk displacement) it is known that the visualization of the TMJ is essential for the diagnostic process, allowing the evaluation of the structures, mainly under suspicion of anatomophysiological alteration. Thus, it is impossible not to link the benefits offered by MRI for the diagnosis of TMD.

With high-resolution images, the MRI technique allows detailed and precise anatomical and functional observation, providing exclusive information on the studied segments, results that only the MRI device is capable of achieving. Although it has limitations like any method, its incomparable advantages stand out, taking MRI to an unattainable level in relation to other techniques available for studying the TMJ.

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