

# Evaluation of temporomandibular joint disc displacement as a risk factor for osteoarthritis

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I. M. Dias, P. C. de F. Cordeiro, K. L. Devito, M. L. F. Tavares, I. C. G. Leite, R. de S. Tesch: Evaluation of temporomandibular joint disc displacement as a risk factor for osteoarthritis. *Int. J. Oral Maxillofac. Surg.* 2016; 45: 313–317. © 2015 International Association of Oral and Maxillofacial Surgeons. Published by Elsevier Ltd. All rights reserved.

**Abstract.** Temporomandibular joint (TMJ) disc displacement is a clinical sign often found in patients with temporomandibular disorders (TMDs) and associated with TMJ osteoarthritis. Osteoarthritis is a degenerative joint disease that may be associated with pain and functional disability. The aim of this study was to evaluate the odds ratio (OR) of joints with disc displacement presenting osteoarthritis via magnetic resonance imaging (MRI) analysis. In total, 224 TMJ images from patients with signs and symptoms of a TMD were evaluated. The OR, a measure of association, was used to calculate the likelihood of TMJ disc displacement (with or without reduction) with osteoarthritis. Joints with anterior disc displacement with reduction (ADDwR) and anterior disc displacement without reduction (ADDwoR) were 2.73- and 8.25-times, respectively, more likely to have osteoarthritis. A nine-times greater likelihood of osteophyte occurrence was observed in cases of ADDwoR, whereas a lower OR for their occurrence (OR 2.96) was observed in cases of ADDwR. The significant OR of joints with disc displacement presenting osteoarthritis, particularly in cases of ADDwoR, emphasizes the importance of accurate assessment of changes in disc position, which may be associated with other painful and functional disorders of the TMJ.

**Key words:** articular disc; degenerative bone change; magnetic resonance imaging; temporomandibular joint.

Accepted for publication 22 September 2015  
Available online 21 October 2015

Articular disc displacement is a clinical sign often observed in patients seeking treatment for the symptoms of temporomandibular disorders (TMDs). This derangement may be simply a variation in the disc position and is not necessarily

associated with the presence of symptoms or impaired function.<sup>1,2</sup> However, Stegenga,<sup>3</sup> Honda et al.,<sup>4</sup> and Dias et al.<sup>5</sup> have highlighted the relationship between internal disorders and the occurrence of osteoarthritis, primarily in cases of

anterior disc displacement without reduction (ADDwoR).

According to Levangie and Norkin,<sup>6</sup> the joints are structured to withstand repeated and high levels of force. Thus, when the articular disc is observed in its normal

physiological position between two bone surfaces, it is able to handle the load imposed on the temporomandibular joint (TMJ).<sup>7</sup> In cases where the articular disc is displaced, the load imposed on the TMJ cannot be withstood, and such cases may have an association with osteoarthritis.<sup>3,8–11</sup>

The constant mechanical loads imposed on TMJs can trigger a series of events, such as the production or release of free radicals, cytokines, catabolites, and enzymes that degrade the matrix. Under normal physiological conditions, these substances may be involved in the remodelling of joint tissues in response to functional forces. However, under pathological conditions, because either the functional demands exceed the adaptive capacity of the individual or the individual is susceptible to this adaptive response, degeneration of the articular surfaces of the TMJ may occur; this degeneration is characteristic of TMJ osteoarthritis.<sup>12</sup>

Osteoarthritis is a chronic degenerative disorder that primarily affects the articular cartilage and subchondral bone of synovial joints such as the TMJ. This disorder is usually related to increased mechanical load, stress, and joint injuries.<sup>13</sup> Moreover, osteoarthritis is an imbalance in the metabolic processes mediated by chondrocytes and is characterized by a gradual degradation of extracellular matrix components of fibrocartilage, with or without secondary inflammatory factors.<sup>14,15</sup> When the bone changes are active, this condition is often painful and is called osteoarthritis.<sup>16</sup>

The clinical signs and symptoms of osteoarthritis are usually reported as clicking noises during jaw movement, limitation of jaw movements, and pain. However, in some cases, joints undergoing degenerative changes may not exhibit clinical characteristics indicative of disease, thus emphasizing the importance of diagnosing TMJ osteoarthritis through imaging.<sup>17</sup> The primary signs of TMJ

osteoarthritis found by imaging include the following: subchondral bone sclerosis, erosion, flattening, irregularities or deformities on the surface of the mandibular condyle, osteophytes, and joint space narrowing.<sup>8,18</sup>

Computed tomography (CT) is considered an accurate technique for identifying hard tissue changes, whereas magnetic resonance imaging (MRI) is defined as the gold standard for determining the position of the articular disc; MRI allows the visualization of hard tissues in the region, with the great advantage of not exposing the patient to ionizing radiation.<sup>9,19</sup>

Although many studies having evaluated the association between disc displacement and osteoarthritis, few have directly evaluated or demonstrated the risk of joints with articular disc displacement presenting a degenerative change.<sup>20</sup> Therefore, with the above findings in mind, the objective of this study was to evaluate the odds ratio (OR) of joints with disc displacement presenting osteoarthritis by MRI analysis.

### Materials and methods

To conduct this cross-sectional retrospective study, 224 static TMJ images were evaluated. Patients selected for imaging were of both sexes (91 female patients, 21 male patients) and were between 18 and 70 years old. All patients had been diagnosed with signs and symptoms of a TMD, including arthralgia, joint sounds, and limited or locking mouth opening, and were recommended for MRI. Sagittal sections of the right and left sides were obtained in both a closed-mouth and a completely open-mouth position using T1-weighting.

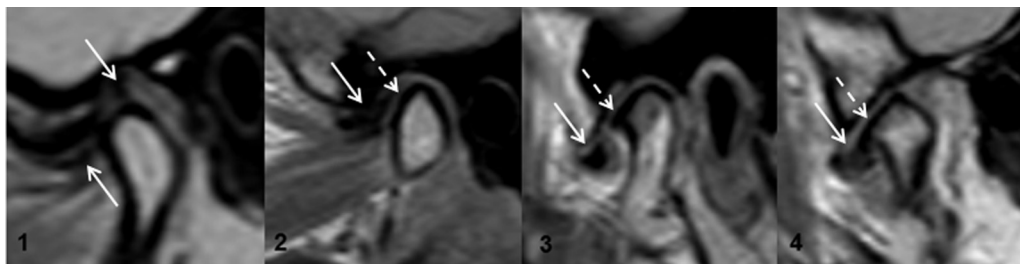
Evaluation of the images was initiated only after approval for the study was obtained from the necessary research ethics committee. The MRIs were evaluated by a single examiner, an expert in TMD/orofacial pain and experienced in radiology, who was duly trained and calibrated for this procedure. The calibration

process for image analysis was conducted in two steps: (1) studying the positioning of the articular disc and condylar degenerative changes according to the criteria proposed by Ahmad et al.,<sup>21</sup> and (2) performing two evaluations of 20% of the total images, with an interval of 1 month between the evaluations.

To evaluate the reliability and reproducibility of the methods used, a coefficient of intra-observer agreement was defined using the kappa test, with a significance level of 5%. The evaluator was considered calibrated when this coefficient was 0.60 or higher (substantial agreement, Landis and Koch<sup>22</sup>). After calibration, the MRI sagittal sections were evaluated regarding articular disc position and condylar bone changes according to the criteria of Ahmad et al.<sup>21</sup>

For the articular disc evaluation, its position was classified as follows: (1) normal, when in the closed-mouth position, the posterior band of the articular disc is at the 11:30–12:30 position superior to the condyle, with the intermediate zone in contact with the condylar head; (2) anterior disc displacement (ADD), when in the closed-mouth position, the posterior band is located in a position below 11:30, with the intermediate zone having no contact with the condylar head. During mouth opening movement, this displacement can be classified into ADD with reduction (ADDwR) when the dislocated disc moves back to its normal position, and ADDwoR when the dislocated disc does not return to its normal position (Fig. 1).

In assessing condylar bone changes, the TMJs were classified as follows: (1) no changes; (2) flattening of the condyle: a remodelling process described as the loss of the rounded contour of the condyle; (3) osteophyte occurrence: marginal hypertrophy, with sclerotic edges and spiculated angular bone formation; (4) erosion: a loss of cortical margin continuity; and (5) subchondral bone sclerosis: increased cortical thickness in the load-bearing areas relative



*Fig. 1.* Magnetic resonance images showing (1) TMJ with the articular disc in the normal position and the mandibular condyle without bone changes; (2) TMJ with ADD and flattening in the condyle region; (3) TMJ with ADD and osteophyte in the anterior condyle region; and (4) TMJ with ADD and associated degenerative bone changes (flattening and osteophyte in the anterior condyle region). Complete arrows indicate the articular discs and dashed arrows indicate the condylar bone changes.

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