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Diagnostic value of ultrasonography in the evaluation of the temporomandibular joint anterior disc displacement

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SUMMARY. **The aim of the study was to evaluate the extent of agreement between the findings of ultrasonography (US) and magnetic resonance imaging (MRI) in the assessment of anterior disc displacement (ADD), with or without reduction, and to assess the sensitivity, specificity and the accuracy of the US examination in establishing diagnosis. Fifty-two temporomandibular joints (TMJ) in 52 patients with chronic TMJ pain were examined by US and MRI with respect to ADD, with, and without reduction of the TMJ. The level of agreement between US and MRI findings was evaluated. The sensitivity, specificity, and the accuracy of US were found to be respectively 91%, 16% and 82% in the assessment of ADD; 70%, 38% and 57% in ADD with reduction; 50%, 89% and 76% in ADD without reduction. The findings of both methods were in agreement with each other. US method is fairly sensitive especially in detecting ADD, and it is very reliable in determining the absence of ADD without reduction. However, it was not found to be as quite effective in demonstrating ADD whether it was with or without reduction. © 2009 European Association for Cranio-Maxillo-Facial Surgery**

Keywords: **internal derangement, anterior disc displacement, ultrasonography, magnetic resonance imaging, sensitivity, specificity**

INTRODUCTION

Internal derangement (ID) is one of the most widely observed forms of temporomandibular disorders (TMD), which generally expresses the abnormal position of the articular disc with respect to the mandibular condyle and articular eminence (*Truelove* et al., 1992; *Katzberg* et al., 1996; *Guler* et al., 2003). Characteristic findings of ID include pain, crepitation, click, and disorders of mandibular functions (*Emshoff* et al., 2003). The disc has two main types of abnormal position when the mouth is opened; one is anterior disc displacement (ADD) with reduction and the other is ADD without reduction. The incidence of ADD with reduction is 40–80% in symptomatic joints while that of ADD without reduction is 30% (*Payne* and *Nakielny*, 1996).

Magnetic resonance imaging (MRI) is currently regarded as the gold standard in temporomandibular joints (TMJ) imaging. MRI is perfectly capable of providing information on the disc position and its morphology through soft-tissue resolution without exposing the patient to radiation. Despite all these advantages, it suffers from such drawbacks as being expensive, necessity of advanced equipment, longer time needed to use it for TMJ images, and being contraindicated in the presence of ferromagnetic implants and claustrophobia (*Tasaki* and *Westesson*, 1993; *Pieshilinger* et al., 1995; *Latheirn*, 1995; *Tvrdy*, 2007). Accuracy of MRI in establishing disc position and form has been found to be 95% (*Tasaki* and *Westesson*, 1993; *Sener* et al., 2002).

Ultrasonography (US) is a specific non-invasive technique enabling dynamic imaging of the TMJ, and is capable of demonstrating not only soft-tissue alterations but also bone anomalies (*Melchiorre* et al., 2003). US can show the articular capsule, the disc and the bone boundary of the laterosuperior aspect of the condyle (*Manfredini* et al., 2003). A recent study reported that US has higher sensitivity for the evaluation of individual condylar translation and is a sensitive tool for assessing joint function (*Landes* and *Sader*, 2007). Gateno et al. (1993) estimated the sensitivity and specificity of US in locating condyle position as 95% (*Gateno et al.*, 1993). However, Emshoff et al. (1997) estimated the sensitivity and specificity of static US (7.5 Mhz) to be respectively 41% and 70% in locating disc displacement, and that of dynamic US to be respectively 31% and 95%. They also stated that both US modalities were insufficient to provide the correct diagnosis for the

presence or absence of disc displacement, while only dynamic US was reliable in demonstrating the absence of disc displacement (*Emshoff* et al., 1997). However, sensitivity and specificity of US have been found to be higher in studies where more powerful probes (12 Mhz) providing better tissue differentiation were used (*Jank* et al., 2001; *Tognini* et al., 2005). US (12 Mhz) has shown a sensitivity of 78%, a specificity of 78% and an accuracy of 78% in detecting abnormal disc position, in the closed-mouth position, while at maximum mouth opening, the values were respectively 61, 88, 77%, showing decreased sensitivity and increased specificity (*Jank* et al., 2001).

The objective of this study was to investigate whether the findings obtained by US were in agreement with MRI findings in demonstrating ADD, with or without reduction, and effusion, and additionally, taking MRI findings as the base line, to assess the sensitivity, specificity and accuracy of US in establishing ADD, with or without reduction, and effusion.

MATERIAL AND METHODS

Fifty-two TMJs of 52 patients presenting with unilateral chronic TMJ pain were evaluated. The patients were assessed according to RDC/TMD (Research Diagnostic Criteria for Temporomandibular Disorders) clinical criteria, which provide standard criteria for TMD diagnosis (*Dworkin* and *LeResche*, 1992). According to RDC/TMD classification, patients are divided into 3 groups as follows; group-I muscle disorders, group-II: disc displacement, and group-III: arthralgia, osteoarthritis and osteoarthrosis. Patients falling into group-II and group-IIIa (arthralgia) according to RDC/TMD classification were included in the study. In all patients', informed consent had been obtained.

After the diagnosis, the TMJ's of all patients were consecutively examined with respect to the presence of ADD, with or without reduction and effusion inside the joint within a maximum of one week, first with MRI (1.5 T Siemens® Magnetom Vision) and then with US (High Definition Imaging (HDI) 1500) methods. Patients were not allowed to receive any treatment between the two examinations. MRI evaluation was performed by a radiologist experienced TMJ examinations. All ultrasonograms were obtained and interpreted prospectively by an experienced physician who has a certificate in soft-tissue US, who had no previous knowledge of the results of the MRI and clinical assessment results.

MRI examination was performed in a sagittal oblique plane using a head coil, in the forms of images with proton density and gradient echo T2 weighted, keeping the mouth in maximum opened and closed positions. The section thickness of the images was 3 mm. Fig. 1 shows the anatomical view of the TMJ in the sagittal plane. When defining disc positions, the normal disc position for the closed-mouth position was taken as the disc posterior band being located superior to the condyle (at 12:00 o'clock position), and for maximum opening, as the disc being located between condyle and articular eminence. ADD without reduction was defined as the

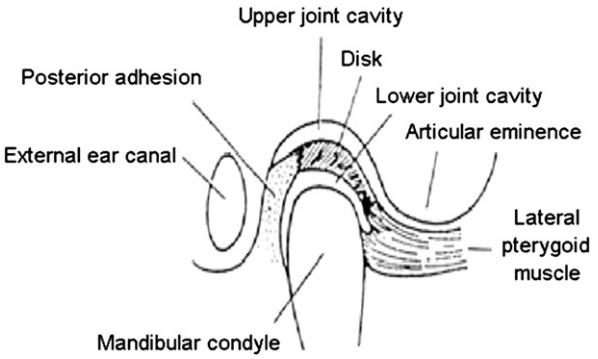

Fig. 1 – Anatomical view of TMJ in the sagittal plane.

location of the disc at the anterior aspect of the condyle while the mouth was in both closed and maximum opening positions, and ADD with reduction was defined as the placement of the disc to the anterior condyle while the mouth was closed but returning to the normal position when the mouth was opened. Higher signal intensities giving brighter views in the lower and upper joint cavities in T2 weighted images were considered as an effusion (*Tasaki* and *Westesson*, 1993; *Sener* et al., 2002).

US examination was performed with 7.5-Mhz linear probe, holding it in horizontal and longitudinal position over the zygomatic arch and on the TMJ. Static examination was performed while the mouth was in the closed and fully open position, followed by the dynamic examination which was performed with the joint opening. Disc position was accepted as normal when the intermediate zone of the disc was located between anterior-upper face of the condyle and posterior-lower face of the articular eminence while the mouth was closed (Fig. 2), and the disc was considered to be displaced when the intermediate zone of the disc was located anterior to this position (Fig. 3). The disc position was considered normal if the intermediate zone of the disc was located between the condyle and articular eminence when the mouth was opened. If the disc displaced at the closed-mouth position and returned to its normal position at the opened-mouth position, it was regarded as disc displacement with reduction. Otherwise, if it continue in its displaced position, it was accepted as disc displacement without reduction (*Emshoff* et al., 2002). Hypo-echoeic appearances in the articular cavity was interpreted as effusion (*Manfredini* et al., 2003).

Mc Nemar test was employed in the statistical analysis of the data to investigate whether US findings were different from MRI findings, and sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), and accuracy rates of US were calculated.

RESULTS

Average age of the patients was 28.30 ± 10.76. Forty-seven (90.4%) of the patients were female and 5 (9.6%) were male. Education level of the patients was as follows: 4 (7.7%) primary school, 19 (36.5%) high school and 29 (55.8%) university graduate. Examined