

## **Prevalence of temporomandibular joint sideways disc displacement in symptom-free volunteers and comparison of signal intensity ratios of masticator muscles on magnetic resonance images**

Kaan Orhan<sup>1</sup>, Ozlem Ucok<sup>1</sup>, Cagri Delilbasi<sup>2</sup>, Candan Paksoy<sup>1</sup>, Necdet Dogan<sup>1</sup>, Kemal Karakurumer<sup>1</sup>, Tuncer Ozen<sup>1</sup>

<sup>1</sup> Ankara, <sup>2</sup> Istanbul, Turkey

### **Summary**

The objectives of this study were to figure out the prevalence of sideways disc displacement of the temporomandibular joint (TMJ) in symptom-free volunteers and to compare signal. The study was based on bilateral Magnetic Resonance Images (MRI) of 112 joints in 56 symptom-free volunteers. Sideways displacements were identified as medial disc displacement (MDD) and lateral disc displacement (LDD). The signal intensity ratios (SIR) of masticator muscles for both normal joints and pure sideways displacements were measured with elliptic ROI on T1 and T2 weighted MRIs. Of the 112 TMJ images, one showed LDD and two showed MDD. The signal intensity ratios increased for pterygoid lateral and temporal muscles in sideways disc displacements. The results of this study suggest that the temporal muscle fibres are also inserting into the TMJ disc like the pterygoid muscle. Therefore, sideways disc displacements have direct effect on pterygoid lateral and temporal muscles.

**Keywords:** signal intensity; temporomandibular joint; magnetic resonance imaging; masticator muscles, disc displacement.

### **Introduction**

The understanding and interest in the diagnosis and management of patients with various temporomandibular joint (TMJ) disorders have lately increased. Much research have examined TMJ disorders for both symptomatic and asymptomatic patients with Magnetic Resonance Imaging (MRI) and made classifications of disc displacements [1]. MRI is currently the first choice of diagnostic imaging for patients with TMJ disorders. MRI can clearly demonstrate TMJ structures and signal intensities. Moreover, MRI is the most reliable procedure for imaging soft tissues (such as disk

and muscles) and TMJ disorders without using ionizing radiation [1-6].

The aim of this study was to determine the prevalence of TMJ sideways disc displacement in symptom-free volunteers and to evaluate signal intensity of the masticator muscles in a series of 112 joints in order to compare signal intensity ratios of masticator muscles in normal joints and sideways displacements.

### **Patients and methods**

In this study, MRI of the 168 joints in 84 symptom-free volunteers were evaluated. The volunteers consisted of 32 females and 24 males with a median age of 39.7 years for

females and 29.7 years for males. The age range for females was 18 to 81 years, while age range for males was 19 to 67 years. Symptom-free volunteers were selected on the basis of having no previous or present clinical signs and symptoms of TMJ disorders including pain, no previous or present treatment for TMJ disorders, no joint sound on auscultation with a stethoscope or palpable noises, having normal range of vertical (>39 mm) and horizontal (>5mm) movement, and a willingness to participate in the study. All joints were studied with a 1.5-T Magnet (Gyrosan Intera, Philips Medical Systems, Washington, USA) using a dual phased array surface coil (6 x 8 cm). All patients underwent imaging in axial, coronal and sagittal planes using fast-spin echo sequences (FSE). Imaging parameters were as follows: T1 weighted images were obtained with a repetition time (TR) of 800 ms, an echo time of (TE) of 17 ms, T2 weighted images were obtained with a TR/TE 2500/102, 192x256 matrix, 3 mm slice thickness, NEX=2, and bandwidth = 15.6 kHz. DICOM 3.0 formatted MR images were sent to the DICOM server and downloaded to a personal computer (MS Windows XP, PIV 2.0 Ghz). The images were evaluated with a special software package for interactive display and manipulation of medical images using density functions (Osiris 4.09, University Hospital of Geneva, Geneva, Switzerland). Two oral and maxillofacial radiologists without knowledge of the clinical conditions evaluated all the images separately. If the assessments were different, the final diagnosis was obtained by consultation between the two radiologists. The TMJ discs were classified according to the following criteria [3,7]:

**Normal state:** The disc was located superior to the condyle in which the posterior band of the TMJ disc was at the apex of the condylar head (12 o'clock position). In the coronal plane of imaging, the disk was centred perfectly on the condylar head.

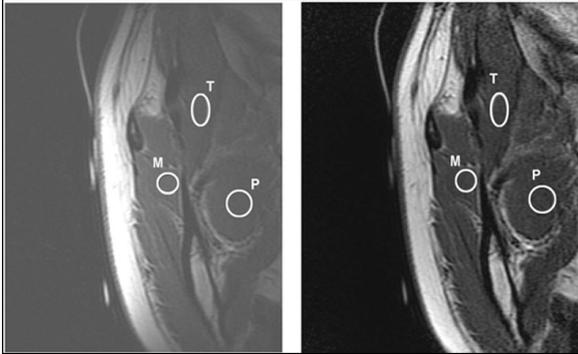
**Sideways displacements:** This state was classified as medial and lateral disc displacement without an anterior component. Sideways displacements of the disc were well-documented in the coronal plane. The disc crosses over one of the sagittal plane tangents to one of the condylar poles. Twenty-eight patients were excluded, because anterior disc displacements were noticed on the MRIs. Finally, 112 joints from 56 patients were evaluated.

Masticator muscles' signal intensities were measured with elliptic ROI on T1 and T2-weighted coronal MRIs (*Figure 1*). The muscles that were investigated for signal intensities are as follows: temporal muscle, lateral pterygoid muscle, and masseter muscle. We did not investigate the medial pterygoid muscle, because this muscle is located far from the surface coil. Unlike body or head coils, the response of surface coils is basically irregular and falls off especially beyond a distance of approximately one radius of surface coil [8]. Pterygoid medial muscle is located far than one radius of surface coil; therefore, we excluded this masticator muscle from the study. Data were analysed with SPSS/PC+ (11.0 Version; SPSS Inc, Chicago, IL). Independent Samples t-test was used for statistical analysis and results were considered significant for  $p < 0.05$ .

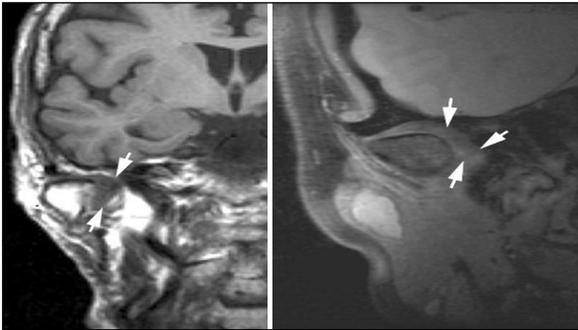
## Results

Analysis of the MRIs of the 112 joints showed one lateral disc displacement and two medial disc displacements (*Figure 2-3*). The rest of the joints were classified as normal. The signal intensity ratios of pterygoid lateral and temporal muscles increased in sideways displacements and there was a statistical difference for both muscles ( $p = 0.025$ ,  $p = 0.017$  respectively). Signal intensity ratios of masseter muscle were approximately the same for both normal discs and sideways displacements ( $P = 0.144$ ).

**Figure 1.** The measurement of masticator muscles' signal intensities with elliptic ROI on T1 and T2 weighted images



**Figure 3.** MR images of medial disk displacements



**Figure 2.** MR image of lateral disc displacement



## Discussion

The relationship between temporomandibular joint disk and masticator muscles is a controversial subject. Some studies report the insertion and relation of masticator muscles; particularly lateral pterygoid muscle, with the TMJ. Bertlsson and Strom reviewed publications from past 100 years concerning the relationship between the lateral pterygoid muscle and the disk [9]. They reported that the majority of the articles (60%) found that the lateral pterygoid muscle inserted into the disk, the capsule and the condyle. 30% of the investigations found that only a few muscle fibres inserted into the disk; the remainder inserted into the condyle. Only 10% of investigations held the view that the lateral pterygoid muscle inserted exclusively into the condyle. It is commonly accepted that the lower head of

the pterygoid muscle inserts into the pterygoid fovea of the condyle and the upper head inserts into the anteromedial portion of the disk [10-15].

The insertion of masseter and temporal muscles is also a controversial subject. Some investigators observed no insertion of these muscles into the disk [16-18], while others observed the opposite. Le Toux [19] described discotemporal muscle bundle having a supplementary function for guiding the articular disk anteriorly. Two other studies reported a muscle bundle, which originates from the medial surface of the middle part of temporalis muscle and inserts into disk [20,21]. Akita et al. [22] reported the discotemporal muscles for all specimens, which originate from the middle and posterior part of the temporalis muscle and inserts into the disk. They suggested the discotemporal bundle and lateral pterygoid muscle

are in cooperation during closing. Velasco et al. [10] reported that temporalis muscle fibres attaching to the disk arose from the posterior third of the muscle. Once these fibres extended beyond the root of the zygomatic process of the temporal bone, they curved downward, thus reaching the disk.

In this study we found a significant increase in SIR for pterygoid and temporal muscles in sideways disc displacements. This may cause inflammation of the muscles, edema or morphological changes. A possible explanation of this significance can be due to positional relationship of the muscles with TMJ disk. In our opinion temporal muscle fibres are also inserting into the TMJ disc like the lateral pterygoid muscle. It can be concluded that when the disc is depressed medially or laterally structural changes occur in the masticator muscles particularly lateral pterygoid and temporal muscles. These results are comparable with previous-

ly published studies.

Raustia et al. [23] reported that the patients with long duration of internal derangements of TMJ showed morphological changes in their masticator muscles. Liu et al. [24] concluded in their study that the morphology of lateral pterygoid muscle may not be related to a specific disc displacement. Our findings can be argued with this study, but only disc displacement with and without reduction were reported in the mentioned study, but no data on sideways disc displacement were present. Thus, there can be a difference between anterior disc displacements and sideways disc displacements.

We believe that further studies are needed to examine the effect of disc displacement on the masticator muscles and to examine insertion of the muscles into TMJ disk from the radiological point of view.

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Correspondence to: Dr. Cagri Delilbasi, Yeditepe University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery. Bagdat Caddesi No: 238, 34728 Goztepe-Istanbul, Turkey. E-mail: delilbasi@hotmail.com