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Evaluation Study

TEMPOROMANDIBULAR JOINT DISCAL LIGAMENTS EVALUATION BY MRI

F. Cecchetti[1], M. Di Girolamo[1], L. Baggi[2] and D. Mazza[2]

[1]Department of Clinical Sciences and Translational Medicine, Tor Vergata University, Rome, Italy;
[2]Department of Social Dentistry and Gnathological Rehabilitation, National Institute for Health, Migration and Poverty (NIHMP), Rome, Italy

Correspondence to:
Dario Mazza, DDS
Department of Social Dentistry and Gnathological Rehabilitation,
National Institute for Health, Migration and Poverty (NIHMP),
Rome, Italy
e-mail: mzzdra@hotmail.com

ABSTRACT

To evaluate the discal ligaments of the temporomandibular joint (TMJ) by magnetic resonance imaging (MRI) and correlate them with disc displacement, twenty-six patients (21 females and 5 males; age range 14-54 years; mean age 34 years) had bilateral TMJ evaluated by means of MRI since they were affected by TMJ disorders. Every joint was studied at closed and opened mouth with TSE double echo T2/PD weighted parasagittal and paracoronal individualised sequences. The following parameters were evaluated: the presence of reducible disc displacement (RDD) or a not-reducible disc displacement (NRDD); signal intensity, morphology, thickness and length of the ligaments; imaging quality of lateral and medial discal ligaments in paracoronal scans, expressed in percentage and correlation between the kind of disc displacement (RDD and NRDD) and axis of best visualisation of the discal ligaments; in 69% of TMJs had RDD whereas 31% of cases had NRDD. Ligaments showed a comma-like shape, a low signal intensity on T2-weighted sequences and intermediate signal intensity on DP-weighted ones; their length ranged from 3 to 8 mm. On paracoronal scans, the lateral discal ligament was depicted in 56% of cases, while the medial ligament was clearly defined in 75%. The lateral ligament was clearly defined in 60% of TMJs with RDD and 47,1% of TMJs with NRDD, whereas the medial ligament was clearly defined in 77,1% of TMJs with RDD. and in 70,6% of TMJs with NRDD. MRI can identify soft tissues of TMJ. Coronal T2-weighted scans are useful for identifying the discal ligaments in healthy and RDD TMJs.

KEYWORDS: *temporomandibular, disk, joint, displacement, pain, imaging*

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INTRODUCTION

Temporomandibular joint (TMJ) movements are conditioned by biomechanical constraints such as dense connective tissue's discal ligaments and fibrous structures (1). In addition, collateral ligaments join the disk with the poles of the mandibular condyle guaranteeing optimal dynamic efficiency.

The most important anatomic structure of the TMJ is the articular disk interposed between the condyle and the temporal bone, preventing possible articular damage. The disk follows the movements of the condyle and guarantees optimal dynamic efficiency thanks to the presence of discal ligaments, too (2). Collateral ligaments originate from the articular disk's lateral and medial margins and insert, curving downwards, at the lateral and medial margins of the mandibular condyle.

Anatomical studies have revealed the presence of an insertion tubercle of the lateral ligament on the lateral face of the mandibular condyle; this is the only macroscopic structure of insertion of capsular or pericapsular ligaments on the condyle (3). During mouth-closing movements, the lateral ligament is the only anatomical structure that stops the disk from moving forwards and medially under traction exerted by the lateral pterygoid muscle (4). Parasagittal scans of the TMJ with T2-weighted sequences were the best to identify joint recesses, the retrodical tissue (5) and, indirectly, discal ligaments.

Few studies have examined the morphological and functional aspects of the discal ligaments, especially with MRI, although this technique is considered the gold standard in the static and dynamic (6) imaging of temporomandibular disorders (TMD) and in maxillofacial pathologies (7-8). The disc displays a linear arched shape on the coronal plane, with reduced thickness at its medial and lateral margins (9).

We aim to evaluate the discal ligaments by T2/PD-weighted sequences MRI with coronal and axial individualised planes.

MATERIALS AND METHODS

The study group consisted of 26 patients (21 females and 5 males; mean age: 34 years, range: 14-54 years) with TMD. Exclusion criteria were a history of previous trauma to the head or face and tumors or malformations of the maxillofacial region. Diagnostic, treatment, and consensus for the scientific use of data were obtained from all patients. The study was performed with respect to the Declaration of Helsinki of 2013.

1.5-T superconducting MR imaging unit (Avanto, Siemens, Erlangen, Germany) with TMJ surface coil was performed; every TMJ was studied at closed and open mouth. TSE double echo T2/PD-weighted parasagittal sequences (TR/TE 2000/105 and 2000/15 ms respectively, FoV 256x189 mm, thickness 3 mm, gap 0, 2 acquisitions) oriented perpendicular to the long axis of the condyle in the axial scout were performed. The opened-mouth sagittal images and the axial scout were used as localisers for coronal imaging with TSE double echo T2/PD weighted (TR/TE 2000/105 and 2000/15 ms respectively, FoV 256x154 mm, thickness 3.5 mm, 3 acquisitions). The section was centred on the condylar head parallel to the ideal line of collateral ligaments.

The following parameters were evaluated: number of TMJs showing a reducible disc displacement (RDD) or a not-reducible disc displacement (NRDD); signal intensity, morphology, thickness and length of the discal ligaments; imaging quality of lateral and medial discal ligaments in paracoronal scans, expressed in percentage and a correlation between disc displacement (RDD and NRDD) and the axis of best visualisation of discal ligaments.

In order to define the quality of images, these parameters were assessed by scoring images on a scale from 0 to 3, in which 0 corresponded to poor visualisation of the discal ligament, 1 to sufficient definition, and 2 and 3, respectively, to good and excellent definition.

RESULTS

As regards disc displacement, 35 (69%) TMJs have RDD, while 17 (31%) have NRDD (Table I). Both internal and external collateral ligaments showed a homogeneous low signal intensity on T2-weighted sequences and intermediate signal intensity on PD-weighted ones, similar to the disc. They presented a curve, comma-like shape with a thickness of 5 mm in the superior part and 1 mm at the insertion point; the length was from 3 to 8 mm (Fig. 1 and Fig. 2).

On paracoronal scans, the morphology of lateral discal ligament was depicted (score 2-3) in 56% of cases, sufficient in

36%, while in 8%, it was not visible (Fig. 3A). In regards to medial ligament, it was clearly defined (score 2-3) in 75% of cases, sufficient in 19%, and it was not well depicted in 6% of cases (Fig. 3B). In the case of RDD, the lateral ligament was clearly defined (score 2-3) in 21/35 (60%) cases while the medial ligament in 27/35 patients (77.1%). In TMJs with NRDD, the lateral ligament was clearly defined (score 2-3) in 47.1% (8/17) of cases and the medial ligament in 70.6% (12/17).

In the TMJs with RDD, the visualisation of the ligaments was better in the coronal plane (58% of cases) than in the axial one (15%) and similar in 27% of cases, while in the TMJs with NRDD, the visualisation of the ligaments was better in the axial plane (29% of cases) than in coronal plane (14%) and similar in 57% of cases.

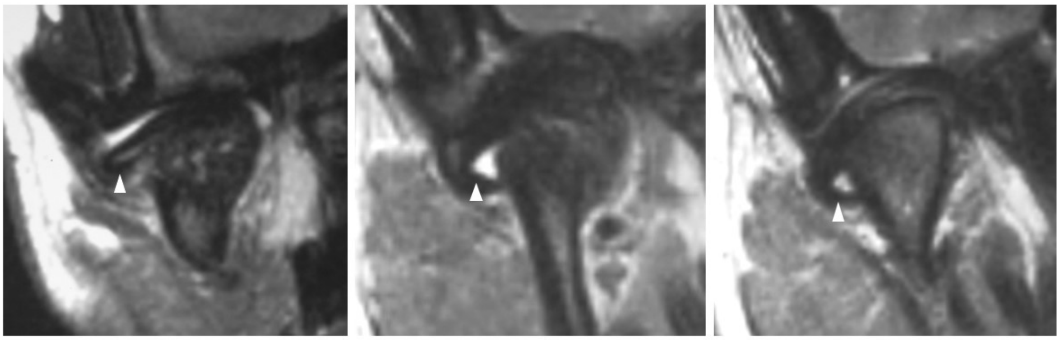

Fig. 1. *TSE T2 W MRI individualized coronal scans. The white arrowhead shows the lateral discal ligament.*

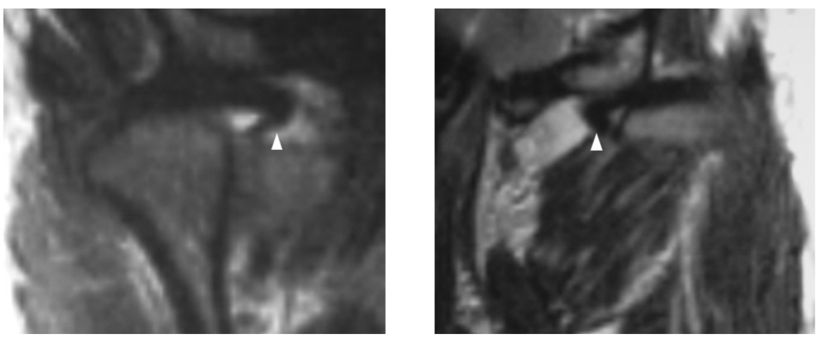

Fig. 2. *TSE T2 W MRI individualized coronal scans. The white arrow head show the medial discal ligament.*

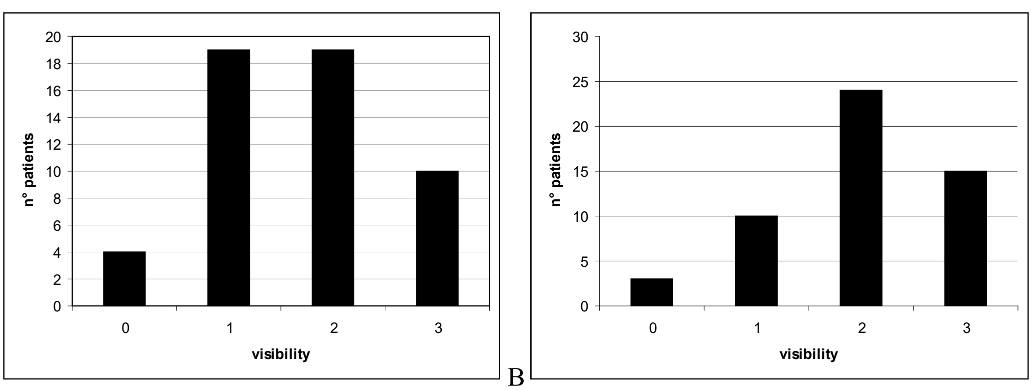

Fig. 3. ***A)*** *Lateral ligament visibility score distribution.* ***B)*** *Medial ligament visibility score distribution.*

Table I. *Visibility score (VS) versus reducible disc displacement (RDD) or a not-reducible disc displacement (NRDD) at open mouth.*

Patients 1-26	Lateral ligament VS	Medial ligament VS	RDD/NRDD at open mouth	Patients 27-52	Lateral ligament VS	Medial ligament VS	RDD/NRDD at open mouth
1	2	2	RD	*27*	2	1	RD
2	2	1	RD	*28*	2	2	NRD
3	3	3	RD	*29*	1	3	RD
4	3	3	RD	*30*	2	2	RD
5	3	3	RD	*31*	1	3	RD
6	1	2	NRD	*32*	0	3	RD
7	2	1	RD	*33*	2	3	NRD
8	3	2	NRD	*34*	2	3	RD
9	2	2	RD	*35*	2	2	RD
10	2	3	RD	*36*	2	2	RD
11	1	2	RD	*37*	3	3	RD
12	1	2	RD	*38*	3	3	RD
13	2	2	RD	*39*	0	0	NRD
14	1	2	RD	*40*	0	0	NRD
15	1	1	RD	*41*	2	3	RD
16	0	1	NRD	*42*	3	3	RD
17	1	2	NRD	*43*	1	1	NRD
18	2	2	RD	*44*	1	2	NRD
19	3	3	RD	*45*	1	0	RD
20	1	2	RD	*46*	1	1	RD
21	3	3	NRD	*47*	2	1	NRD
22	2	2	RD	*48*	2	2	NRD
23	1	1	RD	*49*	1	2	RD
24	1	2	NRD	*50*	1	2	NRD
25	1	2	RD	*51*	2	2	NRD
26	1	1	RD	*52*	3	2	NRD

DISCUSSION

Discal ligaments are well identified on paracoronal images. However, the medial ligament is more easily depicted than the lateral one: in fact, the disc undergoes antero-medial traction from the superior belly of the lateral pterygoid muscle (4), thus distending the medial part of the joint capsule, the inferior joint compartment and, therefore, the medial ligament.

With the antero-medial displacement of the disc, the lateral ligament is likewise subjected to medial traction. Thus it adheres to the cortical portion of the head of the condyle, which is isointense, making identification of lateral ligament more difficult.

Using a scan plane parallel to the ligament axis makes it possible to show the entire discal ligaments from their origin on the disc to their insertion on the condyle. In this way, it is easier to identify and distinguish the ligaments from the surrounding isointense structures (cortical bone of the condyle, disc and capsule wall) thanks to the synovial liquid, hyperintenses in the T2 weighted sequences while the ligaments structures are hypointenses.

Noteworthy, when the disc dislocation cannot be reduced, the disc is placed anteriorly instead of above the condyle when the mouth is open, so individualised "paracoronal" scans will be inclined anteriorly. In this way, scans will be parallel to ligaments. Our results agree with those of recent literature (10-13).

CONCLUSIONS

MRI can easily identify soft TMJ tissues. Disc and the retro-discal tissues are clearly visualised in parasagittal scans, while the condyle-discal ligaments are better visible in individualised scans parallel to the ligaments' axis.

Authors' contributions

DM acquisition of clinical and imaging data and interpretation of data; FC drafted the manuscript; MDG revised the manuscript; LB gave final approval of the version to be published.

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