RESEARCH

Clinical and MRI investigation of temporomandibular joint in major depressed patients

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Objective: The aim of the present study was to describe the clinical and MRI findings of the temporomandibular joint (TMJ) in patients with major depressive disorders (MDDs) of the non-psychotic type.

Methods: 40 patients (80 TMJs) who were diagnosed as having MDDs were selected for this study. The clinical examination of the TMJs was conducted according to the research diagnostic criteria and temporomandibular disorders (TMDs). The MRIs were obtained bilaterally in each patient with axial, parasagittal and paracoronal sections within a real-time dynamic sequence. Two trained oral radiologists assessed all images. For statistical analyses, Fisher's exact test and χ^2 test were applied ($\alpha = 0.05$).

Results: Migraine was reported in 52.5% of subjects. Considering disc position, statistically significant differences between opening patterns with and without alteration ($p = 0.00$) and between present and absent joint noises ($p = 0.00$) were found. Regarding muscular pain, patients with and without abnormalities in disc function and patients with and without abnormalities in disc position were not statistically significant ($p = 0.42$ and $p = 0.40$, respectively). Significant differences between mandibular pathway with and without abnormalities ($p = 0.00$) and between present and absent joint noises ($p = 0.00$) were observed.

Conclusion: Based on the preliminary results observed by clinical and MRI examination of the TMJ, no direct relationship could be determined between MDDs and TMDs.

Dentomaxillofacial Radiology (2012) **41**, 316–322. doi: 10.1259/dmfr/27328352

Keywords: major depression disorder; temporomandibular disorders; magnetic resonance imaging; orofacial pain

Introduction

The complexity of the temporomandibular joint (TMJ) and its structure increases the susceptibility to pathological changes. Temporomandibular disorders (TMDs) are a multifactorial syndrome involving the TMJ and/or the masticatory muscles (MMs),^{1,2} and the most common symptoms are joint noises, articular disc displacement, abnormal movements of the mandible and pain. It has been suggested that chronic pain conditions and depressive disorders share common pathophysiological characteristics³ and could cause major stress to the patient, thus precipitating a chronic pain condition.

A high degree of comorbidity was found between chronic facial pain, depression and anxiety.^{4–6} There is evidence that some TMD patients experience more anxiety than healthy control groups.⁷ According to some studies, depression and anxiety play an important role in the aetiopathogenesis of TMDs,^{7,8} while others found a weak association.⁹

Among the different types of depression, major depressive disorder (MDD) of the non-psychotic type is a category characterized by a severely depressed mood and is prevalent in 17.1% of the general population.¹⁰

There are multiple reports of subjects with MDDs and symptoms in their TMJs and MMs, such as limited jaw opening, joint noises and orofacial pain,^{3,11} but there is a lack of information about the relationship

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between TMDs and MDDs, although several studies have asserted the importance of the psychological factors in the aetiology of TMD.

Imaging of the TMJ is a helpful tool in the diagnosis of TMD in addition to its clinical findings. MRI allows analysis of disc position in both sagittal and coronal planes as well as dynamic assessment of condylar translation and disc movement during opening and closing, disc morphology and requires no ionizing radiation.^{12,13}

The aim of this study was to verify any correlation between the pathological clinical parameters of the TMJ and MRI diagnoses in MDD patients.

Materials and methods

This study was approved by the School of Dentistry, UNICAMP ethical committee, and informed consent was given by all patients. We evaluated 40 patients (26 females and 14 males; mean age 40.2 years), all of whom were diagnosed with an MDD of the non-psychotic type by a trained psychiatrist according to Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (Text Revision) criteria.¹⁴ The patients had received only an initial treatment of MDD and still showed the symptoms of this disease.

Clinical examination

Patients were asked about TMD symptoms and were evaluated by a qualified dentist according to the research diagnostic criteria for TMD (RDC/TMD axis I)¹⁵ in order to assess the presence of TMD symptoms. The RDC/TMD examinations allowed the diagnoses of the following: muscle disorders, disc displacement, arthralgia, osteoarthritis and osteoarthrosis. Joint sounds, *i.e.* click and crepitus, were recorded separately for each joint. The mouth opening and jaw excursions were measured (mm) and the presence of pain during these movements was recorded. During the procedure, the patients were asked whether or not they felt any pain. Symptoms such as headaches, bruxism and jaw protrusion were classified as always present, occasionally present, not present and uncertain.

Magnetic resonance imaging

Patients were examined using a 1.5 T scanner (Signa; GE Medical Systems, Milwaukee, WI) with 8.5 cm diameter surface coils.

MRI protocol was:

1. Axial images in maximum intercuspation position using spin echo sequence (SE), T_1 weighted (T_1W), repetition time (TR) 850 ms, echo time (TE) 1.6 ms, section thickness (ST) 5.0 mm, field of view (FOV) 180×180 mm and a matrix of 256×256, number of excitations (NEX) 2, echo train length = 180°, radio frequency 4, flip angle 20°. Among these images, we

selected the side that showed the best view of the condyle. These images were called “localizer sections” and were used to determine the parasagittal and paracoronal sections (perpendicular and parallel, respectively, to the condyle).

2. Parasagittal images in SE in proton-density weighted (DP) (TR = 1200.0 ms, TE = 13.7 ms, ST = 3.0 mm, FOV = 150 × 150 mm and a matrix of 512 × 512). Six images from each side were obtained from lateral to medial positions. These images were first obtained with the patient in maximum intercuspation position and then with maximum opening.
3. Paracoronal images in SE in DP (TR = 1200.0 ms, TE = 13.7 ms, ST = 2.0 mm, FOV = 150 × 150 mm and a matrix of 512 × 512). Six images from each side were obtained from anterior to posterior. These images were obtained with the patient in maximum intercuspation position.
4. A real-time dynamic study in T2 fat in a parasagittal plane (TR = 9.4 ms, TE = 4.2 ms, ST = 10.0 mm, FOV = 211 × 211 mm and a matrix of 256 × 256). The patients were instructed to slowly open their mouths to maximal opening and then to slowly close to maximum intercuspation in a repetitive sequence. This was rehearsed with patients before imaging. Each dynamic recording (duration 18 s) covered a full sequence.

The MRIs were studied separately by two radiologists (SLPCL and ALFC) with 10 years of experience in maxillofacial radiology. The examiners were evaluated previously during a calibration session at which inter-observer reliability assessment revealed acceptable agreement ($\kappa = 0.9$) for evaluation of the dichotomous variables. During the interpretation of the images of the study, any disagreements were discussed until a consensus was reached.

Protocol for MRI interpretation

(a) The disc position, which was assessed through the parasagittal and the paracoronal images. Normal disc position was defined by the location of the posterior band of the disc at the superior, or 12 o'clock, position relative to the condyle, whereas disc displacement was defined as the posterior band of the disc being in an anterior, anteromedial, anterolateral, medial or lateral position relative to the superior part of the condyle.¹⁶

(b) The disc function, which was assessed through parasagittal images and the real-time dynamic study.¹⁶

(c) The condyle position in the mandibular fossa was assessed using parasagittal closed-mouth images first and then parasagittal maximum opening mouth images. We used the e-Film workstation program (e-Film Medical Inc., Toronto, Canada) and its measurement tool to trace the condyle position in the fossa. The condylar position determined the narrowest anterior and posterior interarticular distances on mid-sagittal MR images of the condyle. When the anterior distance was greater than the posterior distance, the condylar

position was considered to be posterior within the fossa. When the difference was zero, the condylar position was considered to be centric within the fossa and when the posterior distance was greater, the condylar position was considered to be anterior within the fossa. When the articular space was reduced and the condyle occupied most of the area, it was considered intrusion. When the articular space was increased and the condyle was inferiorly displaced, it was considered extrusion.^{17,18}

Statistical methods and analyses of the results

A statistical analysis was performed to evaluate the association of:

1. TMJ functional pain, disc function and disc position
2. muscular pain, disc function and disc position
3. disc position, condyle position, opening patterns and joint noises.

A statistical analysis was performed separately with variables using Fisher's exact test and χ^2 test with a significance level of 5% ($\alpha=0.05$).

Results

Four scans in the TMJ dynamic presented a motion artefact with image blurring owing to an abrupt jaw movement. These four patients were invited to come back for a new scan session and underwent a second sequence, all of which were performed correctly without generating artefacts.

The most frequent alteration was the presence of migraines: 52.5% of the patients reported they always had them and 47.5% had them occasionally. Bruxism was the second most frequent complaint: 35.0% of the MDD patients stated that it was always present and 47.5% said it was occasionally present. Mandibular protrusion was reported in 7.5% of the patients as always present and 30.0% had it occasionally, but 40.0% of patients were certain they did not have it.

The normal values of maximum mouth opening are more than 40mm, while the normal values of the laterotrusion and protrusion are more than 6mm. The mean maximum mouth opening in our study was 46 mm and laterotrusion and protrusion movements were normal, with means of 7.5 mm and 7.4 mm, respectively. An abnormal mandibular pathway was observed in 34 patients (85.0%), 62.5% had deviation and 22.5% had deflection; 70% of the patients with TMDs had joint noises, while 55 (69.0%) had clicking and only 1 had crepitation.

When the TMD patients were examined by palpation in the rest position, 15 (18.75%) complained of pain. However, when they were examined while opening and closing their mouth, this number increased to 49

(61.2%). It was observed that the MM group reported pain during palpation in the sternocleidomastoid muscle followed by pain in the masseter (both sides were examined).

As to the disc positions in the closed mouth position in the MRIs, 26 (32.5%) of the articular discs were in their normal position and 54 (67.5%) were displaced. The most frequent type of disc displacement was the partial anterolateral displacement, present in 26 TMJs (32.5%), followed by anterior displacement in 17 TMJs (21.2%) and partial anteromedial displacement in 5 TMJs (6.2%), while medial displacements and lateral displacements were observed in 3 TMJs (3.75%). Rotational, anterolateral displacement, anteromedial displacement and posterior displacements were not observed in our study.

Table 1 Association between position/function of the temporomandibular joint (TMJ) disc and TMJ functional pain, masticatory muscles pain, joint noise, mandibular pathway and condyle position

Disc position	TMJ functional pain		
	Absent	Present	Total
Normal	12 (15%)	14 (17.5%)	26
Abnormal	19 (23.7%)	35 (43.7%)	54
Total $p=0.34$ (χ^2 test)	31	49	80

Disc function	TMJ functional pain		
	Absent	Present	Total
Normal	30 (37.5%)	45 (56.2%)	75
Abnormal	1 (1.2%)	4 (5%)	5
Total $p=0.32$ (Fisher's exact test)	31	49	80

Disc position	Muscle pain		
	Absent	Present	Total
Normal	3 (3.7%)	24 (30%)	27
Abnormal	3 (3.7%)	50 (62.5%)	53
Total $p=0.4$ (Fisher's exact test)	6	74	80

Disc function	Muscle pain		
	Absent	Present	Total
Normal	6 (7.5%)	68 (85%)	74
Abnormal	1 (1.2%)	5 (6.2%)	6
Total $p=0.42$ (Fisher's exact test)	7	73	80

Disc position	Joint noise		
	Absent	Present	Total
Normal	19 (23.7%)	7 (8.7%)	26
Abnormal	5 (6.2%)	49 (61.2%)	54
Total $p=0.00$ (χ^2 test)	24	56	80

Disc position	Mandibular pathway		
	Normal	Abnormal	Total
Without disc displacement	6 (15%)	2 (5%)	8
With disc displacement	0 (0%)	32 (80%)	32
Total $p=0.00$ (Fisher's exact test)	6	34	40

Disc position	Condyle position		
	Normal	Abnormal	Total
Normal	4 (5%)	6 (7.5%)	10
Abnormal	19 (23.7%)	51 (63.7%)	70
Total $p=0.30$ (Fisher's exact test)	23	57	80

Considering the functional disc categories, the exams revealed that 75 (93.75%) of the discs had reduction when the patients were in maximum opening mouth activity, while 5 (6.25%) of them did not assume a normal position and remained displaced while in the maximum opening mouth activity and had displacement without reduction.

We found the central condyle position in the mandibular fossa in 23 (28.75%) TMJs and the non-central positions in 57 TMJs (71.25%), divided into the following groups: 43 (53.78%) in the posterior position, 7 (8.75%) in the anterior position, 4 (5.0%) in the intrusion position and 3 (3.75 %) in the extrusion position.

The frequency of the different kinds of condyle mobility in the images showed that 22 (27.5%) of the condyles had a normal motion position and 58 (72.5%) had hyper- or hypomobility: 32 (40.0%) with hypermobility and 6 (7.5%) with hypomobility.

There was no relationship between the disc function and joint functional pain ($p=0.32$) and MM pain ($p=0.42$) as well as between disc position and joint functional pain ($p=0.34$) and MM pain ($p=0.40$). We found no relationship between disc position and condyle position in the mandibular fossa ($p=0.30$). When disc position was related to joint noise, we observed a relationship between both of them ($p=0.00$) as

Figure 1 Real-time dynamic MRI of a temporomandibular joint movement with anterior disc displacement without reduction and discontinuous condyle movement. C, condyle; T, temporal bone; DD, disc displacement

Figure 2 Static sagittal MRI slices showing disc displacement without reduction in (a) closed mouth and (b) open mouth

well as between disc position and mandibular pathway ($p=0.00$) (Table 1). Table 2 demonstrates the relationship between the signs and symptoms of TMD and disc displacement.

Figure 1 shows a series of images from real-time dynamic study in fiesta fat in a parasagittal plane of a subject with disc displacement without reduction and Figure 2 shows disc displacement without reduction during mouth closing and opening.

Discussion

A recurrent migraine was the most common symptom reported. Migraines are normal among TMD patients, suggesting that they may be correlated with TMDs.^{2,19} Conversely, migraines are frequently associated with MDD patients and are an important additional finding in MDD diagnosis.²⁰ Approximately 75.0% of MDD patients complained about migraines in their first MDD episode and the highest index was among the women;²¹ in our study, 65.0% were women. This explains the high presence of recurrent migraines. Besides the high levels of recurrent migraines, bruxism was the second most common complaint observed during the exams. Some of the patients in our study answered negatively when asked about it, but when the clinical exam was performed, we noted the occurrence of abrasion in the dental elements which suggested the presence of bruxism. There is evidence suggesting the psychological alterations is an important aetiological factor in bruxism.²²

In the present study, the association between disc position and pain (TMJ and MM) was not observed, but the literature shows a correlation between these findings.^{23–26} In addition, pain as an isolated symptom

was frequently observed. This can be explained by the MDD patients used in this sample. The MM pain was mainly observed in MDD subjects as a characteristic symptom. Besides this finding, we must remember that TMD patients have acute and chronic phases, with different signs and symptoms that can be responsible for the lack of relationship between pain and TMDs.

We did find a relationship between disc position and joint noise. According to some authors, there is a higher incidence of TMJ noise in the female gender.²⁷ Our findings confirm other works²⁸ which concluded that clicking occurs frequently in patients with disc displacement with reduction. In our study, 67.5% of those with TMD had disc displacement and, among these, 75% TMJs had disc reduction. The most prevalent disc noise found was clicking, except for one patient with crepitation. This suggests an association between joint sounds (clicking/crepitation) and disc displacement. Crepitation is frequently associated with disc displacement without reduction and, although there were five TMJs with disc displacement without reduction, just one presented crepitation. This emphasizes the non-specific noise presence as a TMD indicator since joint noise can be caused by different alterations, such as disc displacement, irregularities of surface of joint bone and hypermobility of the condyle.²⁹ We found a high percentage (52%) of TMJ patients who presented hypermobility.

There was no relationship between disc position and condyle position, even though in the present study 53.7% of the TMJ patients had the condyle in a posterior position and the proportion of disc displacement was high (67.5%). Some authors^{30,31} have associated the posterior position of the condyle with the anterior displacement of the disc. However, they did not make clear if the posterior

Table 2 The relationship between the signs and symptoms of temporomandibular disorder (TMD) and disc displacement

Disc position	Sign/symptom								Total
	Abs	Pain	LM	Noise	Pain + LM	LM + noise	Pain + noise	Pain + noise + LM	
Normal	3 (3.75%)	16 (20%)	0	0	0	0	8 (10%)	0	27
Displaced	0	1 (1.2%)	0	2 (2.5%)	3 (3.75%)	0	46 (57.5%)	1 (1.2%)	53
Total	3	17	0	2	3	0	54	1	80

Abs, no sign and symptom; LM, limited mandibular movements; noise, joint noise present (clicking/crepitation); pain, pain in the temporomandibular joint and/or masticatory muscles.

position of the condyle could be the cause or is the consequence of the anterior disc displacement. Other authors^{32,33} have questioned the real significance of the condyle position affecting disc displacement.

Dynamic assessments of TMJ function remain a great challenge. The diagnostic provided by dynamic MRI includes disc deformation and movement under loading and an evaluation of dynamic condylar translation.³⁴ The use of techniques that offer dynamic studies of the TMJ with short examination time requires avoidance of the artefact and may reduce the quality of examinations.^{34–36} The real-time dynamic study in fiesta fat was chosen for the reduced time for scan and quality of images acquired. Fiesta fat sequences are relatively insensitive to motion artefacts.³⁷ However, in our study this sequence generated 10% of artefacts in the exams, degrading the image quality and hampering the diagnostic accuracy.

For TMD diagnosis, two signs/symptoms (pain and limited mandibular movements) that could really affect the patients were taken into consideration. In our study, only three of the TMJs presented these two alterations. Our results corroborated the data reported by others that depression was not associated with chronic myofascial pain or chronic disc displacement.³⁸

The number of subjects included may be considered as a limiting factor in this study. Therefore, additional research in larger groups seems necessary to explore dynamic imaging of the TMJ in these patients.

Our results suggest that the psychological mood, MDD, was not a strong factor to predispose or to initiate TMDs in our group. Further investigations involving pooled patient data are necessary before relationships between clinical TMD and psychological variables can be confirmed.

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