Assessing joint effusion and bone changes of the head of the mandible in MR images of symptomatic patients

Abstract: The aim of the present study was to investigate the relationship between degenerative bone changes of the head of the mandible and the presence of joint effusion (JE). This study was based on sagittal magnetic resonance imaging (MRI) reports of 148 temporomandibular joints (TMJs) of 74 patients complaining of pain and/or dysfunction in the TMJ area. The mandible heads were surveyed for osteoarthritis characteristics, which were classified as osteophytosis, sclerosis or erosion. The presence of JE was checked whenever high signal intensity was observed in the articular space. The results evidenced the presence of bone changes in 30% of the sample. Osteophytes and erosions were the changes most commonly observed. JE was reported in 10% of TMJs. The results from the statistical tests revealed that bone changes in the head of the mandible are associated with the presence of JE.

Descriptors: Magnetic Resonance Imaging; Temporomandibular Joint; Osteoarthritis.

Introduction

Magnetic resonance imaging (MRI) provides an excellent representation of soft tissues in anatomical and semi-functional relationships. The multi-section images it generates allow a tridimensional analysis of the temporomandibular joint (TMJ), providing the most complete assessment of the relationship between TMJ components.\(^1\)

Examination by MRI may be used to analyze the articular disc position in the coronal and parasagittal planes, the translation movement of the head of the mandible, and the disc movement during mouth opening and closing. MRI may also be used to detect the presence of effusion, bone erosions and degenerative diseases.\(^2,3\)

Joint effusion (JE) is generally defined as a pathological collection of fluid in articular spaces. It appears in MR images as high signal intensity in the TMJ space, observed on T2-weighted images. It often appears accompanied by disc displacement (DD) and by pathological changes, such as inflammatory processes or synovitis, and is considered a very useful indicator in assessing the progression and severity of temporomandibular dysfunction (TMD).\(^4\)

Degenerative bone changes of the TMJ are significantly more frequent in the head of the mandible than in the articular eminence, and are characterized by the development of osteophytes, erosions, avascular necro-
ses, subchondrial cysts and intra-articular foreign bodies.4,5 These changes are considered radiological signs of osteoarthritis (OA), and have been observed in symptomatic TMJs.5,6

If a strong association between the presence of JE and OA were to be established, this could be the basis for valuable additional diagnostic information. The aim of this study was thus to investigate the relationships between OA in the head of the mandible and the presence of JE, by analyzing MR images of the TMJs of symptomatic patients.

Methodology

MR images of 148 TMJs from 74 adult patients submitted to this examination after indication by their dentists or physicians were used. The images were retrieved from the archives of a private institution. The inclusion criterion was the presence of at least one sign or symptom of TMD reported during clinical examination. Patients who reported any systemic involvement or who were using medication that could entail bone changes were disregarded.

The exams were performed with a Signa apparatus (GE Medical Systems, Madison, USA) with 1.5 Tesla field strength, using T2 and PD weighted sequences, with the aid of a double surface coil 20 cm in diameter (GE Medical Systems, Madison, USA). The images were obtained in the sagittal plane with 3-mm-thick cuts, saved in DICOM format and evaluated by two experienced radiologists (a physician and a dentist). Each of them evaluated the images only once and the resulting reports were obtained by consensus.

The mandible heads were surveyed for OA characteristics, which were classified as osteophytosis, sclerosis or erosion.

The presence of JE was checked in the T2-weighted images whenever high signal intensity was observed in the articular space (Figure 1).

The study was approved by the Research Ethics Committee, University of São Paulo, under protocol 119/2009.

The conditions assessed were recorded as present or absent, and then submitted to descriptive statistics. The data regarding gender, OA of the mandible head and presence of JE were analyzed through absolute and relative frequency calculation, and then plotted in charts. Following the descriptive analysis, Fisher’s exact test was performed to ascertain whether the OA characteristics of the mandible heads were associated with the presence of JE, at a significance level of 5% (P < 0.05). The statistical analyses were conducted with Statistical Package for Social Sciences software (SPSS for Windows, version 11.0, Chicago, USA).

Results

From the 74 patients evaluated (148 TMJs), 51 (68.9%) were female, and 23 (31.1%) were male. The mean age of female patients was 40.4 ± 14.5 years (range: 13–69 years). The mean age of male patients was 35.9 ± 11.2 years (range: 17–58 years).

The TMJs were assessed bilaterally for the occurrence of OA and JE. OA characteristics were observed in 30% of the samples (Figure 2), the most frequent of which were osteophytosis (n = 13, 9%) and sclerosis (n = 8, 5%); erosion was the least frequent change observed (n = 1, 1%). The OA characteristics observed were associated, as follows:

- erosion and osteophytosis (n = 8, 6%);

Figure 1 - T2-weighted image presenting signal loss of medullary bone of the head of the mandible and temporal articular eminence (osteoarthritis - white filled arrow), as well as high signal intensity in the posterior articular space (joint effusion - white empty arrow). Erosion of the superior pole of the head of the mandible may also be observed (arrow head).
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- erosion, sclerosis and osteophytosis (n = 6, 4%);
- erosion and sclerosis (n = 5, 3%); and
- sclerosis and osteophytosis (n = 3, 2%).

JE was observed in 10% of the samples, as shown in Figure 3.

Table 1 illustrates the descriptive analysis of the association between OA characteristics and the presence of JE.

The results of the statistical tests revealed that the OA characteristics of the head of the mandible were associated with the presence of JE (p = 0.006). Subjects with JE on at least one side presented the same OA profile (p = 0.835). Subjects with no JE on either side presented a higher rate of TMJs with no OA, on both sides, when compared to patients with JE on at least one side (p = 0.048).

Discussion

MRI is considered a choice method to assess the soft components of joints, as well as changes in the quantity of articular fluid.5,7

The present study assessed the relationship between mandibular condyle OA and the presence of JE. MRI is a reliable method to detect JE.8 Bone changes may be assessed by viewing the TMJ in the position used in this examination with an accuracy of 93%.3

The inclusion criterion was the presence of pain in the TMJ or in the neighboring temporal, frontal or auricular regions. Studies found in the related literature show a strong correlation between TMJ pain, disc displacement and JE.6,9 Pain persisting after TMJ arthrocentesis is generally related to a great amount of JE and erosive condylar OA.9 There are, however, several studies showing a weak correlation between JE and TMJ pain.10,11 Furthermore, JE has also been detected in asymptomatic TMJs, with no observable pathology.12

We also observed a predominance of female over male subjects, an observation consistent with a tendency reported in the related literature.5,6,13,14

Osteoarthritis, on the other hand, was observed in 30% of the samples, which is in agreement with other studies stating that bone abnormalities are not always related to symptom reports by patients.5,9 We also observed that the condylar OA characteristics were associated, predominated by the erosion/osteophyte combination. This finding is corroborated by a study reporting a higher frequency of osteophytes and erosions combined.5

JE was found in 10.1% of subjects, which agrees with the findings of another study reporting this same percentage in symptomatic patients.12
Table 1 - Distribution of subjects according to bone changes of the head of the mandible and the presence of intra-articular effusion.

<table>
<thead>
<tr>
<th>Bone change status</th>
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<tr>
<td>ErS ErS</td>
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<tr>
<td>ErS N</td>
<td>3 (4.8%)</td>
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<td>3 (4.1%)</td>
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<td>ErSO S</td>
<td>–</td>
<td>1 (20.0%)</td>
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<td>–</td>
<td>1 (1.4%)</td>
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<tr>
<td>ErSO N</td>
<td>2 (3.2%)</td>
<td>–</td>
<td>1 (50.0%)</td>
<td>1 (25.0%)</td>
<td>4 (5.4%)</td>
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<tr>
<td>ErSO O</td>
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<td>1 (50.0%)</td>
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<td>1 (1.4%)</td>
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<td>ErO ErO</td>
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<td>ErO S</td>
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<td>1 (25.0%)</td>
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<td>ErO N</td>
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<td>SS</td>
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<td>SO S</td>
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<td>SO N</td>
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<td>N S</td>
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<td>1 (1.4%)</td>
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<td>N N</td>
<td>39 (61.9%)</td>
<td>2 (40.0%)</td>
<td>–</td>
<td>1 (25.0%)</td>
<td>42 (56.8%)</td>
</tr>
<tr>
<td>N O</td>
<td>4 (6.3%)</td>
<td>1 (20.0%)</td>
<td>–</td>
<td>–</td>
<td>5 (6.8%)</td>
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<tr>
<td>O O</td>
<td>3 (4.8%)</td>
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<td>–</td>
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<td>3 (4.1%)</td>
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<tr>
<td>Total</td>
<td>63 (100.0%)</td>
<td>5 (100.0%)</td>
<td>2 (100.0%)</td>
<td>4 (100.0%)</td>
<td>74 (100.0%)</td>
</tr>
</tbody>
</table>

AA: absent on both sides; AP: absent on the right side and present on the left side; PA: present on the right side and absent on the left side; PP: present on both sides; ErS: erosion and sclerosis on one side; ErS N: erosion and sclerosis on the other side; ErSO S: erosion, sclerosis and osteophytosis on one side and sclerosis on the other side; ErSO N: erosion, sclerosis and osteophytosis on one side and normal on the other side; ErSO O: erosion, sclerosis and osteophytosis on one side and osteophytosis on the other side; ErO S: erosion and osteophytosis on both sides; ErO N: erosion and osteophytosis on one side and normal on the other side; ErO O: erosion and osteophytosis on one side and osteophytosis on the other side; SS: sclerosis on both sides; SO: sclerosis and osteophytosis on one side and sclerosis on the other side; SO N: sclerosis and osteophytosis on one side and normal on the other side; N Er: normal on one side and erosion on the other side; N S: normal on one side and sclerosis on the other side; N N: normal on both sides; N O: normal on one side and osteophytosis on the other side; O O: osteophytosis on both sides.

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The statistical results showed that condylar OA characteristics were associated with the presence of TMJ effusion (p = 0.006). However, JE was also observed in normal TMJs. Hence, additional data may be necessary to confirm this relationship and to ascertain whether OA characteristics are initial or contributing factors in the onset of JE.

Conclusion

According to the results obtained in this study, the incidence of JE was correlated to OA characteristics of the head of the mandible. Erosions and osteophytes were the most frequently observed mandibular condyle OA characteristics. However, most symptomatic patients evaluated showed neither bone alterations nor signal intensity consistent with joint effusion.

References
