CT and MR findings in synovial chondromatosis of the temporo-mandibular joint: Our experience and review of literature

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ARTICLE INFO

Article history:
Received 19 October 2009
Received in revised form 6 November 2009
Accepted 11 November 2009

Keywords:
Computed tomography
Magnetic resonance
Synovial Chondromatosis
Tumour
Temporo-mandibular joint

ABSTRACT

Objective: To compare Computed Tomography (CT) and Magnetic Resonance (MR) features and their diagnostic potential in the assessment of Synovial Chondromatosis (SC) of the Temporo-Mandibular Joint (TMJ).

Materials and methods: Eight patients with symptoms and signs compatible with dysfunctional disorders of the TMJ underwent CT and MR scan. We considered the following parameters: soft tissue involvement (disk included), osteostructural alterations of the joints, loose bodies and intra-articular fluid. These parameters were evaluated separately by two radiologists with a “double blinded method” and then, after agreement, definitive assessment of the parameters was given. CT and MR findings were compared.

Results: Histopathological results showed metaplastic synovia in all patients and therefore confirmed diagnosis of SC. MR resulted better than CT in the evaluation of all parameters except the osteostructural alterations of the joints, estimated with more accuracy by CT scan.

Conclusions: CT scan is excellent to define bony surfaces of the articular joints and flogistic tissue but it fails in the detection of loose bodies when these are not yet calcified. MR scan therefore is the gold standard when SC is suspected since it can visualize loose bodies at early stage and also evaluate disk condition and eventual extra-articular tissues involvement. The use of T2-weighted images and contrast medium allows identifying intra-articular fluid, estimating its entity and discriminating from sinovial tissue.

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1. Introduction

Synovial Chondromatosis (SC) is a benign tumour-like disorder of the joint characterized by chondrometaplasia of the synovial membrane, in which cartilaginous nodules form and may become pedunculated and then detach from the synovial membrane, becoming “loose bodies” within the joint space. Sometimes they may become also calcified.

SC mainly affects big synovial joints such as the knee and the elbow, being uncommon the onset within the Temporo-mandibular Joint (TMJ). About 100 cases have been published since first description by Axhausen [2]. It is a monoarticular arthropathy [3,4] with exclusive involvement of the superior compartment, being the finding of loose bodies inside the inferior compartment rare and due to a perforation of the articular disk [3].

The filling of the joint space with loose bodies leads to an inflammatory condition and progressive functional limitation of the TMJ. As a consequence degenerative phenomena affect the disk and metaplastic synovia.

Modern imaging modalities, Computed Tomography (CT) and Magnetic Resonance (MR), play an important role in identifying and making careful diagnosis of SC.

Aim of this study is to compare features and diagnostic potential of CT and MR in the assessment of SC of TMJ, defining the best diagnostic iter.

2. Materials and methods

The study group consisted of 8 patients (3 males, 5 females; age range: 18–67 years; mean age: 39 years) retrospectively selected from a larger group who were referred to our Department because of symptoms and signs compatible with dysfunctional disorders of the TMJ.

All patients underwent CT and MR scan. The unenhanced CT exam was performed by using a 4-detector row CT scanner...
Table 1
Milgram's staging of the SC.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Histological features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Metaplastic synovia without loose bodies</td>
</tr>
<tr>
<td>2</td>
<td>Metaplastic synovia with loose bodies</td>
</tr>
<tr>
<td>3</td>
<td>Only loose bodies</td>
</tr>
</tbody>
</table>

(Siemens Somatom, Erlangen, Germany) from the orbit floor to the hyoid bone. The scan parameters used were 120 kV, 150 mAs, 1 mm slice collimation, a table speed of 27.5 mm/s and 0.3 s rotation time. Coronal (parallel to the long axis of the mandible condyles) and sagittal scans were reformed from the volume dataset (multiplanar reformation, MPR) with 1 mm slice thickness and 1 mm gap increment, using standard soft tissue kernel (B30) and bone kernel (B60).

MR exam (Siemens Magnetom, Erlangen, Germany) was performed with a 1.5T superconductor magnet (Siemens Avanto, Erlangen, Germany) with a TMJ dedicated superficial coil; every joint was studied at closed and opened-mouth. For opened-mouth MR imaging, a mechanical mouth opener device was used to stabilize the opened-mouth at maximum opening position for each patient. First, a transverse scout of the TMJ was performed for both mouth positions. Subsequently, Turbo Spin Echo (TSE) double echo T2-Proton Density (PD)-weighted (TR/TE 2000/105 and 2000/15 ms respectively, FoV 256 mm × 189 mm, thickness 3 mm, gap 0.2 acquisitions) and Spin Echo (SE) T1-weighted (TR/TE 600/30, FoV 256 mm × 189 mm, thickness 3 mm, gap 0.2 acquisitions) parasagittal sections oriented perpendicular to the long axis of the condyle in the axial scout were obtained.

On MR and CT images the following parameters were evaluated: soft tissue involvement (disk included), bony changes of the joint, loose bodies in the soft tissue of the joint and intra-articular fluid.

Two experienced radiologists in head and neck imaging (30 and 5 years of expertise), independently, analyzed CT and MR images obtained in all patients; interpretation discrepancies were resolved by consensus.

CT and MR findings were compared with histopathological results as reference standard that confirmed the diagnosis of synovial chondromatosis.

The above mentioned parameters, on CT and MR, were evaluated using the following visibility scale: – null; + insufficient; ++ enough; +++ excellent.

3. Results

Considering the staging criteria proposed by Milgram [5] for the Synovial Chondromatosis (Tables 1 and 2), the patients resulted classified as follows:

- 4 patients (50%) corresponded to the 2 stage
- 4 patients (50%) corresponded to the 3 stage

Table 2
Classification of the patients included in the study.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Milgram’s staging</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.C.</td>
<td>55</td>
<td>M</td>
<td>3</td>
</tr>
<tr>
<td>Z.M.</td>
<td>31</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>G.U.</td>
<td>67</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>V.M.</td>
<td>42</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>P.F.</td>
<td>62</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>P.A.</td>
<td>18</td>
<td>F</td>
<td>2</td>
</tr>
<tr>
<td>A.M.</td>
<td>24</td>
<td>M</td>
<td>2</td>
</tr>
<tr>
<td>P.A.M.</td>
<td>34</td>
<td>F</td>
<td>3</td>
</tr>
</tbody>
</table>

As for the MR exam all the considered parameters were detected in an excellent way (Figs. 1 and 2) except for the second parameter (bony changes of the joint) which was visible in an enough way. As for the CT images only the second parameter appeared excellent (Fig. 3) while the third one presented a good visibility only if loose calcified bodies were present (Figs. 4–6); CT images showed the first one in an insufficient way and the fourth one was not seen (Table 3).

In all patients we found loose bodies, with degeneration of the disk that was always displaced. In 6 patients (75%), fibrosis involved the retrodiscal tissue and intra-articular fluid was present, while in 4 patients (50%) articular surfaces changes were observed.

Table 3
Visibility of the radiological features considered in the study (referred to all patients in the study).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MRI</th>
<th>CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—soft tissue involvement (disk included)</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>2—alterations of the articular surfaces</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>3—presence of loose bodies</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>4—intra-articular fluid</td>
<td>+++</td>
<td>–</td>
</tr>
</tbody>
</table>
4. Discussion

Synovial chondromatosis of the TMJ is reported to affect women more than men with a ratio of 1.6:1 in the age range between 40 and 50 years [6–9]. In spite of smallness of the sample we observed, as in literature, a F/M of 1.6:1 and mean age of 39.

Even if no more than 100 cases are known, the effective prevalence is underestimated, since SC can be suspected only by CT and MR scan, modalities that are not easily available on a first approach.

Symptoms associated with SC are pre-aesthetic swelling [3,4,6,8,10,11], either spontaneous or after palpation pain [6,8,11–13], inflammation, limitation of motion, crepitation and articular noises [3,8,9,11,12,14]. Sometimes deviation of the mandible at the opening, either from the affected side or on the opposite, can be presented [3,11–13]. In our sample all cases presented pain and articular noises.

This study considered SC of the TMJ because it is a tumour-like disease with aggressive potential, able to invade adjacent tissues [10,14–16] and because it represents a problem of differential diagnosis. Diagnosis of SC in fact is not easy either because it is a rare pathology or because it can often mimes other more frequent pathologies such as parotid cancer [4,15,17–19], chondrocalcinosis [11,20], osteoarthrosis [6,12,13,16,21] and TMJ disorders [22].

For this reason often months or either years pass before diagnosis is suspected and moreover histological exam is required in order to make definitive diagnosis. As a consequence, imaging is important as diagnostical aid. A step forward early diagnosis of SC has been possible by MR evolution, because this modality is the only one which permits the visualization of not yet calcified loose bodies (stage 1 according to Milgram classification) and so it makes possible to identify those cases missed by X-ray modalities, CT included.

Noyek et al. [23] first and other authors after [3,4,6,7,14,16] pointed out some radiological features correlated with SC; they are: soft tissue swelling, calcified loose bodies, widening of the articular spaces, limitation of motion, irregularity of the joint surface, sclerosis or hyperostosis of the glenoid fossa and mandibular condyle.

However none of these elements is indicative of SC because they are commonly seen in many other pathologies of the TMJ. The review of the literature assesses that the soft tissue swelling (related to inflammation and intra-articular fluid) and the loose
bodies are constantly present in SC. Just loose bodies, even if present in chondrocalcinosis and osteoarthrosis [21], could be evaluated considering their number, according to von Arx and others [11,15,18]: a number >10 is suggestive for SC, a number <10 orients towards other pathologies. Anyway, if loose bodies are not present, SC cannot be excluded because the patient could be in an early stage (Milgram stage 1) with loose bodies not yet calcified and consequently not visible on CT (or other techniques employing X-ray). So it is useful to pay attention to the soft tissue swelling, evidence seen in CT scan, not usually present in osteoarthrosis or TMJ disorders, which are pathological conditions to be differentiated from SC [14,16,24].

Actually we know only another study that underlines the importance of this evidence directing towards SC diagnosis [25].

In CT scan a mixed density mass is observed because it is composed of both liquid (fluid) and solid (loose bodies) components [14]. In MR scan such components show, respectively, high signal and low signal intensity on T2-weighted images [4].

Widening of joint spaces, due to the progressive stretching of the capsule caused by the fluid is an important diagnostic element; for some authors if it is very abundant, this is enough to make the capsule caused by the fluid is an important diagnostic element and low signal intensity on T2-weighted images [4]. In MR scan such components show, respectively, high signal and low signal intensity on T2-weighted images [4].

First, CT, thanks to its high contrast resolution, can detect not only loose bodies and the synovial tissue [1,3], plastic synovia: many surgeons prefer arthrotomy to arthroscopy during the diagnosis but also to program the modalities of the surgery.

It is important to underline the necessity of both coronal and sagittal reformations and the diagnostic value of double acquisition with Kernel B60 for the bony window and B30 for the soft tissues, allowing (without administration of an extra-dose) better depiction of fluid and peri-articular tissues and achieving better comparison with corresponding MRI findings [14,11,27].

Several authors emphasized MR as preferential in the study of SC [4,7,9,17,22]; surely it presents some advantages as regard CT, first of all the absence of radiation and the harmlessness for the patient; furthermore loose bodies can be seen either if not yet calcified (low signal in T2-weighted images) allowing to anticipate the diagnosis at an early stage of the pathology [1,9,15].

Moreover MR is the only non-invasive method able to visualize articular disk, either in normal position or displaced, condition often associated with SC [4,6,7,12,13], and also the retrodiscal tissue, that could be involved in the degenerative phenomena caused by SC.

Our experience validates this argument: all our patients show, in association with SC, disk displacement and their disk was always involved by degenerative phenomena while the retrodiscal tissue was interested in 75% of cases. Clinical studies demonstrate that retrodiscal fibrosis is seen like a signal diminution in PD and in T2w images.

Finally MR permits exact definition of boundaries of the lesion [9,10] and the possibility to research eventual extension of the pathological process to extra-articular structures, with particular attention to the floor of the cranial fossa [4,16].

All patients included in the study were classified by Milgram's staging (Table 2) and moreover CT findings were used to make a radiological correlative of Milgram staging (Tables 1 and 4).

We made a comparison between our results and the ones of a recent study [7] about SC studied only by MR and with a recent analysis of eleven cases studied by both CT and MR [28]. We specify that this last one is the only other recent study in literature about SC in which the two modalities are confronted, being other works prevalently case reports. Differently from Kim et al. we found alterations of articular surfaces, and differently from Ardekian et al. we evaluated the intra-articular fluid and the condition of the disk, emphasizing the value of these evidences in narrowing differential diagnosis of SC. Furthermore all our patients underwent both CT and MR scan in order to make correlation between radiological findings of the two modalities for each patient.

### 5. Conclusion

Referring to data literature and our experience we can conclude that the diagnosis of SC of TMJ is not simple, since it implies a careful evaluation of symptoms and often it is “for exclusion”. Therefore imaging is important: CT is excellent to evaluate the articular surfaces and the presence of flogistic tissue but it does not find loose bodies not calcified. MR can be considered the reference for SC for the following reasons: it finds the loose bodies assessing the diagnosis at an early stage, can evaluate the disk, often involved in degenerative processes due to SC, can identify the intra-articular fluid distinguishing it from synovial tissue and can evaluate extra-articular tissues involvement. Moreover, since surgical therapy is needed, accurate radiological evaluation is necessary not only for the diagnosis but also to program the modalities of the surgery.

### References


