A comparison of ultrasonography and magnetic resonance imaging in the evaluation of temporomandibular joint involvement in rheumatoid arthritis and psoriatic arthritis

D. Melchiorre, A. Calderazzi, S. Maddali Bongi, R. Cristofani, L. Bazzichi, C. Eligí, M. Maresca and M. L. Ciompi

Objective. To define the diagnostic value of ultrasonographic (US) examination in comparison with magnetic resonance imaging (MRI) for the assessment of temporomandibular joint (TMJ) involvement in rheumatoid arthritis (RA) and psoriatic arthritis (PsA).

Methods. MRI and US examinations were performed in 33 patients (22 with RA and 11 with PsA). Alterations of the disc, alterations of the condyle and joint effusion were evaluated.

Results. Pathological changes of the TMJ were observed by MRI in 24 patients and by US in 31 patients. The sensitivity and specificity of US were calculated in comparison with MRI. The sensitivity was 72.2% and the specificity was 60% in the assessment of pathological changes of the TMJ. The sensitivity was 69.6% with specificity of 30.0% in the assessment of alterations of the disc; the sensitivity was 70.6% with specificity of 75.0% in the assessment of joint effusion. Significant concordance was not observed in the assessment of condylar alterations.

Conclusions. US imaging appears able to detect different pathological changes of the TMJ and may be considered an important diagnostic tool for clinical evaluation of the TMJ in RA and PsA.

Keywords: Rheumatoid arthritis, Psoriatic arthritis, Temporomandibular joint, Ultrasound examination, MRI.

The temporomandibular joint (TMJ) may be affected in many rheumatic diseases but the study of this joint is often neglected in clinical practice. TMJ involvement is especially important in rheumatoid arthritis (RA) and in psoriatic arthritis (PsA), as in both conditions it may lead to severe disability.

Different imaging techniques may be used for TMJ evaluation. Conventional radiographic techniques and computed tomography allow accurate evaluation of bony components but are not useful for examining the disc and soft tissues [1–3]. The radiographic changes most frequently observed in RA are joint-space narrowing and marginal erosions, and, in advanced disease, extensive osteolysis and even complete destruction of the condyle. Ankylosis is rare; osteophytes may be observed but they are not a specific characteristic of RA as they may be present in other diseases, above all in osteoarthritis [4–6]. Usual radiographic findings are unilateral erosions of the condyle and, in advanced phases of the disease, flattening and sclerosis or complete destruction (‘burn-out’) of the condylar head [2, 7, 8].

Better images of all articular components may be provided by magnetic resonance imaging (MRI), the diagnostic accuracy of which is enhanced by the use of gadolinium as contrast agent [9, 10], which allows inflammatory pannus and joint effusions to be evaluated.

Department of Medical and Surgical Critical Care, Rheumatology Unit, University of Florence, 1Department of Radiology, 2Department of Pathology and Infectious Diseases, Medical Biotechnology and Epidemiology and 3Department of Internal Medicine, University of Pisa, Pisa and 4Radiology Unit, Campo di Marte Hospital, Lucca, Italy.

Submitted 18 October 2002; revised version accepted 4 November 2002.

Correspondence to: D. Melchiorre, Dipartimento di Area Critica Medico Chirurgica: Reumatologia, Università di Firenze, Viale G. B. Morgagni, 85-50134 Firenze, Italy. E-mail: s.maddali@dfc.unifi.it
Ultrasonography (US) has been introduced recently for the study of the TMJ. This technique allows evaluation of all the components of the TMJ: the condylar head, the glenoid fossa of the temporal bone, the disc, the joint capsule, the articular ligaments and the insertions of tendons \([11–13]\).

In the present study the diagnostic value of US for the assessment of TMJ involvement in RA and PsA was evaluated in comparison with MRI, which was considered the standard of reference. For this purpose, both MRI and US examination of the TMJ were performed in a group of patients with RA or PsA, in whom the involvement of the TMJ could be suspected. The results were analysed to establish the sensitivity and specificity of US in comparison with MRI.

Patients and methods

Patients

Thirty-three Caucasian patients (11 females and 22 males) were examined. Their ages ranged from 30 to 81 yr (mean 68.5 yr). Twenty-two patients were affected by RA (according to the American Rheumatological Association criteria) and 11 patients by PsA. The design of the study had been approved by the local ethics committee. All patients had active disease, as defined by an erythrocyte sedimentation rate (ESR) > 30 mm in the first hour. TMJ involvement was suspected in all the patients because at least one painful episode involving one TMJ was reported in the history. In 20 patients (12 with RA and eight with PsA) pain and functional impairment of one TMJ were present in the period in which the study was performed. In 20 patients disease duration was less than 10 yr and in 13 patients it was more than 10 yr. Functional ability was rated as Steinbrocker functional class 1 in 10 patients, class 2 in nine patients, class 3 in seven patients and class 4 in seven patients. The mean ESR was 43.8 mm/h in RA and 30.8 mm/h in PsA patients (normal range 1–15 mm/h). The mean concentration of C-reactive protein was 7.05 mg/dl in RA and 2.68 mg/dl in PsA patients (normal range 0.0–0.5 mg/dl). The ESR was considered an index of disease activity and C-reactive protein concentration an index related to the progression of joint damage, according to Sharp et al. [5]. Disease-modifying anti-rheumatic drugs (DMARDs) and non-steroidal anti-inflammatory drugs were administered to all the patients; in 23 patients the treatment also included corticosteroids.

Imaging

MRI and US examination were performed in all the patients. The interval between the two investigations was 1 month. MRI was performed on the TMJ that was painful or had been affected by more episodes of pain. TMJ was analysed with the mouth open and closed. A surface coil and a 0.5 T magnet with a cuneiform spacer were used. Various sequences were performed: a first axial scout sequence to define the location of the mandibular condyle, a weighted spin-echo T1 sequence in the mandibular branch, and a weighted double-echo T2 sequence. After the T1 sequence, gadolinium was infused, and 1–2 min later another weighted T1 sequence was performed with characteristics the same as in the previous sequence [9]. It was possible to evaluate the alterations of the condyle and of the disc and the presence of inflammatory pannus or joint effusion. The effusion appeared as a thin intense line above and below the profile of the disc, its location corresponding to the superior and inferior articular process.

The reliability of MRI as a reference technique was evaluated by the following procedure. The MRI of every patient was evaluated twice by the same operator, the first time soon after the examination was performed and the second time when all the patients had been examined and all the images had been collected. During the second evaluation the operator was blinded. Results were analysed with the statistical test of concordance and Cohen’s \(\kappa\) coefficient was calculated. US examination was performed on both temporomandibular joints, in static and dynamic phases, by means of Diagnostic Ultrasound System 3535 (Brüel and Kjær, Bremen, Germany) with a 7.5 MHz linear probe and a spacer of 1 cm. Tests were performed for intra-observer reliability. Pathological alterations observed in the joint that had been examined by MRI were compared with the alterations detected by MRI.

MRI and US examinations were performed by two different operators and each operator was blinded to the results obtained with the other method. Pathological alterations were evaluated with reference to the following list of elementary lesions: (i) alterations of the disc; (ii) structural changes and morphological changes; (ii) alterations of the condyle (erosions, osteophytes and other morphological changes); and (iii) joint effusion.

Statistical analysis

The \(\chi^2\) test was used to compare MRI and US findings. Sensibility, specificity, positive predictive value (PV+) and negative predictive value (PV−) of US were calculated (with 95% confidence limits) in comparison with MRI for the different structures examined. The relationships among pathological alterations of the TMJ, disease duration and C-reactive protein concentrations were also investigated.

Results

Concordance of two examinations of MRI performed by the same operator on different occasions

Tests were performed for intra-observer reliability. A total concordance of 88% was observed between the two examinations (\(\kappa\) coefficient −0.76; standard error 0.17; \(P < 0.0001\)).

Evaluation of the diagnostic value of US in comparison with MRI

Pathological changes of the TMJ were observed by MRI in 24 patients and by US in 31 patients. The sensitivity and specificity of US were calculated in comparison with MRI. Sensibility was 72.2% and specificity 60%. The results obtained in the evaluation of different pathological alterations were also analysed.

Alterations of the disc were observed by MRI in 18 patients (13 with RA and five with PsA) (Fig. 1). Displacement of the disc was observed in seven patients, structural changes (e.g. inhomogeneity) were present in nine patients and morphological changes (e.g. flattening) were evident in two patients. Alterations of the disc were evident in US images of 14 patients (seven with RA and seven with PsA); the disc was displaced anteriorly and was hypoechoic. Morphological changes of the disc were not
well defined by US imaging. Concordance between US and MRI was 57.58%. The sensitivity of US in comparison with MRI was 69.6% [confidence interval (CI) 47.0–85.9%, specificity was 30.0% (CI 8.1–64.6%), PV+ was 69.6% (CI 47.0–85.9%) and PV– was 30.0% (CI 8.1–64.6%).

Alterations of the condyle were detected by MRI in 18 patients (12 with RA and six with PsA) (Fig. 1) and by US imaging in 23 patients (16 with RA and seven with PsA). Condylar alterations were detected both by MRI and US examination only in eight patients. Therefore, significant concordance between US and MRI was not observed in the assessment of condylar alterations.

In MRI joint effusion was evident in 18 patients (12 with RA and six with PsA) (Fig. 1). Joint effusion was detected by US imaging as a hypoechoic image. In most cases the joint space was widened and appeared hypoechoic, in some cases a pseudocystic image connected with the joint space was observed (Fig. 2); increased thickness of the joint capsule was also present in some cases; the joint capsule was clearly distinct from the condylar head, which appeared as a linear hypoechoic image. Joint effusion was detected by US imaging in 16 patients (12 with RA and four with PsA). Concordance of 72.2% was observed between US and MRI. The sensitivity of US in comparison with MRI was 70.6% (CI 44–88.6%), specificity was 75.0% (CI 47.4–91.7%), PV+ was 75.0% (CI 47.4–91.7%) and PV– was 70.6% (CI 44–88%). No relationship was observed between pathological alterations detected by MRI or US imaging and disease duration or C-reactive protein values.

**Discussion**

Involvement of the TMJ was detected by MRI and US imaging in most patients examined, both in the group with RA and in the group with PsA. High sensitivity and specificity of US were observed in comparison with MRI. Bony erosions, flattening of the condylar head and a reduced range of motion have been considered typical lesions provoked by RA and PsA in the TMJ [2, 4–8]. According to the results of the present investigation, other pathological changes are frequently present both in patients with RA and in patients with PsA. In particular, joint effusion was detected in 54.5% of the patients by MRI and in 48.4% by US examination; alterations of the disc were shown in 54.5% of our cases by MRI and in 42.4% by US, while alterations of the condyle were observed in 54% of the patients by MRI and in 70% by US. The diagnostic value of US imaging was especially evident for the assessment of joint effusion: results obtained by US were similar to those obtained by MRI, which has been considered to be the most specific technique for the evaluation of this type of alteration.
The role of US imaging in the assessment of disc displacement deserves special consideration. In the present investigation, structural changes and displacement of the disc were detected by US examination in a higher percentage of patients in comparison with MRI. The specificity of US in comparison with MRI was 30% and the sensitivity was 69.6%. These last results are consistent with the data of Emshoff et al. [11]. However, it must be noted that Emshoff et al. detected disc displacement by US imaging in a low percentage of patients suffering from TMJ disorders. Our patients were all suffering from inflammatory disease of the TMJ. It is not easy to evaluate whether and how chronic inflammation might induce disc alterations; however, our findings show that dislocation of the disc was always accompanied by structural changes. Further investigations are necessary to confirm and clarify our results.

Alterations of the condyle in the patients examined were observed more frequently by US than by MRI. It must be noted that US imaging is today considered a highly specific technique not only for demonstrating soft tissue alterations but also for the visualization of bone abnormalities, especially in examination of the small joints [14, 15]. Moreover, in patients with arthritis of the finger joints, Backhaus et al. [14] observed that disruption of the cortical plate is difficult to assess by MRI since there is no direct visualization of cortical structures. Similar observations were reported by McQueen et al. [16].

The results of the present investigation indicated that US evaluation of the TMJ may play an important role in the clinical assessment of RA and PsA and is especially useful for the assessment of joint effusion. Moreover, it must be observed that, in comparison with MRI, US imaging is not expensive, it may always be performed and may be repeated easily, it does not need a long time and allows the static and dynamic evaluation of joints.

References