Magnetic Resonance Imaging versus Musculoskeletal Ultrasound in Evaluation of Temporomandibular Joint in Rheumatoid Arthritis Patients

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Received date: January 13, 2017; Accepted date: February 20, 2017; Published date: February 27, 2017

Abstract

Purpose: The aim of this study was to evaluate Temporomandibular Joint (TMJ) affection in rheumatoid arthritis patients by MRI versus MSUS and to correlate between the findings of Magnetic Resonance Imaging (MRI) & Musculoskeletal Ultrasound (MSUS) with clinical manifestations and disease activity in rheumatoid arthritis (RA) patients.

Patients & Methods: Twenty RA patients were included in this study; all patients were subjected to assessment of disease activity by disease activity score 28 (DAS28) and functional assessment by Modified Health Assessment Questionnaire (MHAQ). The TMJs were subjected to clinical, functional assessment by Fonseca’s questionnaire and radiological assessment using panorama x-ray, MSUS and MRI.

Results: The percentage of abnormality of MRI, MSUS and panorama x-ray in detection of TMJ erosions was 80%, 57.5% and 27.5% respectively in our RA patients. The percentage of abnormality in MRI & MSUS for detection of TMJ effusion was 67.5 and 62.5 respectively, whereas the percentage of abnormality was 57.5% and 52.5% for detection of disc displacement by MRI and MSUS respectively.

Conclusions: MRI and MSUS had high sensitivity in radiographic diagnosis of TMJ abnormalities in RA patients with insignificant difference between both modalities. TMJ erosions, effusion and disc displacement were common in RA patients as detected by MRI and MSUS. Also both were helpful in detecting subclinical TMJ radiographic abnormalities in RA patients.

So Use of MSUS is recommended in diagnosis of TMJ radiographic abnormalities in rheumatic diseases as its sensitivity is high, inexpensive and easily applicable.

Keywords: Magnetic resonance imaging; Musculoskeletal ultrasound; Rheumatoid arthritis; Temporomandibular joint

List of Abbreviation

RA: Rheumatoid Arthritis; DAS28: Disease Activity Score28; MHAQ: Modified Health Assessment Questionnaire; ESR: Erythrocytes Sedimentation Rate; CRP: C-Reactive Protein; RF: Rheumatoid Factor.

Introduction

Rheumatoid arthritis (RA) is a chronic systemic inflammatory autoimmune disease characterized by articular and extra-articular involvement. The disease predominantly affects small joints in the hands, wrists and feet, but may involve any joint lined by a synovial membrane [1].

Temporomandibular joint (TMJ) is commonly involved in RA patients which is characterized by pain, tenderness, swelling and limited mandibular movement. Clicking of the TMJ may occur. Masticatory dysfunction and trismus can occur in severe affection of TMJ [2]. The reported prevalence of TMJ involvement in RA varies widely from 4.7% to 88% [3].

Different imaging techniques are used for TMJ evaluation. Conventional radiography is traditionally the first step in the radiologic evaluation [4]. Magnetic resonance imaging (MRI) has been considered an accurate method to examine disc position, configuration, attachment, mandibular marrow status and to assess the presence of joint effusion [5].

Musculoskeletal ultrasound (MSUS) has been widely employed in the assessment and monitoring of rheumatic diseases, particularly in patients affected by RA. This technique allows the evaluation of peri
and intra-articular structures of TMJ providing an accurate depiction of soft tissue and bony cortex changes at all stages of the disease [6].

Patients & Methods

Patients

This study included twenty patients with rheumatoid arthritis diagnosed according to the American College of Rheumatology (ACR) /European League against Rheumatism (EULAR) 2010 criteria for diagnosis of rheumatoid arthritis [7]. All patients were selected from the outpatient clinic of Physical Medicine, Rheumatology and Rehabilitation Department, Faculty of Medicine, Tanta University

Inclusion Criteria

Patients who have been diagnosed with Rheumatoid arthritis with symptomatic or asymptomatic affection of TMJ.

Exclusion Criteria

Patients with jaw-related trauma or surgery, teeth and gum diseases, trigeminal neuralgia or facial nerve paralysis, TMJ hyper mobility, other causes of TMJ arthritis. TMJ congenital abnormalities and patients who underwent TMJ injection in the last six months were excluded from the study.

Assessment for RA

Clinical assessment, laboratory examination complete blood count CBC [8], erythrocytes sedimentation rate ESR [9], C reactive protein CRP [10], rheumatoid factor RF [11], anti-cyclic citrullinated peptide Anti CCP [12], assessment of disease activity using DAS28 [13] and functional assessment using MHAQ [14].

TMJ Assessment

Complete Clinical Assessment

Assessment of TMJ pain by VAS [15].
Assessment of TMJ tenderness [15].
ROM of temporomandibular joint: [16].

Maximum ranges of vertical and horizontal mouth movements, retraction and protraction were assessed. Maximum mouth opening was measured with a ruler in centimeters and considered abnormal if less than 4 cm (it was measured from top tooth edge to bottom tooth edge).

Assessment of Joint Sounds: Clicking or Crepitus

Functional assessment of TMJ dysfunction by Fonseca’s questionnaire

In order to evaluate TMJ function, a questionnaire that was developed by Fonseca in 1992 to establish the symptoms and severity of temporomandibular joint diseases were filled in for the RA group. This questionnaire is comprised of 10 questions, and each question is replied as no (0 points), sometimes (5 points), and yes (10 points) [17].
Total score is obtained and normal TMJ function if between 0-15, mild TMJ dysfunction if between 20-40, and medium TMJ dysfunction if between 45-65, and severe TMJ dysfunction if between 70-100.

Radiological Assessment

Panorama X-ray

Both TMJs were examined by Sirona x-ray equipment using standard orthopantomography. All exams were performed with the patients mouth closed. We evaluated TMJ erosions. Erosions in condyles on the radiographs were scored from 0 to 4 [18].

Musculoskeletal Ultrasound

Ultrasoundography was carried out for both TMJs by using SAMSUNG MEDISON (UGE0 H60) with linear, high-frequency probes are used (7.5-12 MHz). The most optimal images are obtained with 9 MHz. US of the TMJs performed by radiologists and rheumatologist experienced in musculoskeletal imaging. The imaging protocol includes transverse and longitudinal scans. The scans are obtained both in the open mouth and in closed-mouth positions. Sonographic examination was performed with the patient in the supine position. The ultrasound probe was always positioned parallel to the mandibular ramus, directly over the temporomandibular joint and tilted until optimum visibility of the joint. The patient was asked to open and close the mouth slightly, to ensure that the correct structure has been observed. The ultrasonographic images were evaluated for presence of erosions, joint effusion and disc position. TMJ synovitis (effusion): by GSUS was analyzed semiquantitatively from 0–3 (Figure 1) [12]. TMJ erosion: was graded according to the semiquantitative scoring system based on the size of erosions: Small, moderate and large erosion (Figure 1). Anterior capsule–condyle distances have been used as indirect US signs to determine disc positions [19,20].

![Figure 1:](Image)

(A) MSUS: longitudinal scan of TMJ showing synovitis; (B) MSUS: transverse scan of TMJ showing synovitis; (c) MSUS: longitudinal scans of TMJ showing condylar erosion, MnCd: mandibular condyle.
Figure 2: MRI: sagittal oblique view of TMJ (A) closed and (B) open-mouth T2-weighted imaging showing anterior disc displacement without reduction with joint effusion and mandibular condylar erosions (cortical irregularity).

Magnetic Resonance Imaging

All patients had undergone bilateral TMJ MRI with GE 1.5-T system using special TMJ coil was applied for the examination. The images were evaluated for the presence or absence of TMJ erosions, effusion and disc displacement. MRI assessment was evaluated by a radiologist who was unaware of the clinical and laboratory information of the patients. Erosions in the condyle were graded into four grades: Grade I: A condyle showing abnormal signal intensity of the bone marrow without erosion or absorption. Grade II: A condyle with erosion in the cortex, Grade III: A condyle with bone absorption extending within half of the condyle, Grade IV: A condyle with bone absorption extending over half of the condyle. The presence of joint effusion was established by identifying thin lines or an area of high signal intensity inside the articular space on T2 WI: when such high signal was evident in at least two consecutive sections, it was considered positive for TMJ effusion (Figure 2) [21].

Statistical Analysis

Statistical analysis was carried out using the statistical package for social sciences (SSPS) software, version 17.0 for windows. Data of patients were expressed as mean ± standard deviation and categorical variables were shown as the number of cases and (%). Spearman’s Correlation test and Chi-square test were employed to determine correlation, P values <0.05 were considered statistically significant for differences and correlation [22].

Results

Twenty patients with rheumatoid arthritis were involved in our study (18 patients were females and 2 patients were males), all patients had low to high disease activity and most of them had mild to moderate functional impairment as detected by MHAQ (Table 1).

Table 1: Demographic, clinical and laboratory data of RA patients.

<table>
<thead>
<tr>
<th>N=20</th>
<th></th>
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<tbody>
<tr>
<td>Sex (M/F)</td>
<td>2/18</td>
</tr>
<tr>
<td>Age (years) (mean ± SD)</td>
<td>47.3 ± 10.03</td>
</tr>
<tr>
<td>Duration of RA (years) (mean ± SD)</td>
<td>11.47 ± 7.80</td>
</tr>
<tr>
<td>Morning stiffness (minutes) (mean ± SD)</td>
<td>60 ± 35.09</td>
</tr>
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Table 2: Clinical findings of TMJ of RA patients.

<table>
<thead>
<tr>
<th>N=40 (100%)</th>
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<tr>
<td>Panoramic findings</td>
</tr>
<tr>
<td>Erosions:</td>
</tr>
<tr>
<td>Grade I</td>
</tr>
<tr>
<td>Grade II</td>
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<tr>
<td>Grade III</td>
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<tr>
<td>Grade IV</td>
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<tr>
<td>MSUS findings</td>
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<tr>
<td>Erosions</td>
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<tr>
<td>Small</td>
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<tr>
<td>Moderate</td>
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<tr>
<td>Large</td>
</tr>
<tr>
<td>Effusion</td>
</tr>
<tr>
<td>Disc displacement</td>
</tr>
</tbody>
</table>

MRI was superior in detection of TMJ radiographic abnormalities (erosions, effusion and disc displacement) when compared with results of MSUS with percentage of abnormality (82.5%) and (77.5%) respectively but the difference between both modalities was statistically insignificant (Tables 3 and Table 4).
Any of above abnormalities 31 (77.5)

MRI findings:
Erosions 32 (80%)
Grade I 17 (42.5%)
Grade II 12 (30%)
Grade III 3 (7.5%)
Grade IV 0
Effusion 27 (67.5%)
Disc displacement 23 (57.5%)

Table 3: Radiological findings in TMJ of RA patients

The percentage of abnormality of MRI, MSUS and panorama in detection of TMJ erosions was 80%, 57.5% and 27.5% respectively. MRI was the best in detection of TMJ erosions when compared with MSUS and panorama with significant difference between MRI and both of MSUS and panorama. MSUS percentage of abnormality was significantly better than panorama x-ray in detection of TMJ erosions in RA patients with significant difference between them (Table 4).

The percentage of abnormality of MRI and MSUS in detection of TMJ effusion was 67.5% and 62.5% respectively and the difference between them was statistically insignificant (Table 4).

Table 4: Percentage of abnormality of panorama x-ray, MSUS and MRI in detection of TMJ erosions, effusion and disc displacement in RA patients.

The percentage of abnormality of MRI in detection of TMJ disc displacement was 57.5% while by MSUS was 52.5% and the difference between both modalities was statistically insignificant in detection of TMJ disc displacement (Table 4).

There was significant positive correlation between MRI and MSUS findings (erosions, effusion and disc displacement) with TMJ pain, disease activity and Fonesca's questionnaire, while there was negative significant correlation with degree of mouth opening. Erosions and disc displacement detected by MRI and MSUS had also significant positive correlation with TMJ sounds while there was significant positive correlation between disease duration and disc displacement detected by MRI and MSUS and erosions detected by MRI. Disc displacement and effusion detected by MRI and MSUS and erosions detected by MRI had significant positive correlation with functional impairment as detected by MHAQ (Tables 5 and Table 6).

Table 5: Correlation between clinical and functional data of RA patients with TMJ findings detected by MSUS.

Table 6: Correlation between clinical and functional data of RA patients with TMJ findings detected by MRI.

Out of 40 TMJs studied in our RA patients 27 were symptomatic (67.5%) and 13 (32.5%) were asymptomatic. The percentage of abnormality of MRI and MSUS in detection of subclinical radiographic abnormalities in TMJ was 54% and 46% respectively with insignificant difference between them.
Discussion

In the current work, the most common clinical manifestations were TMJ pain and tenderness representing 67.5%. Previous studies have reported that the prevalence of TMJ pain and tenderness in RA patients was ranged from (24–88.8%) [18]. Presence of TMJ pain or tenderness in RA patients usually associated with disease activity, condylar changes and synovitis or stretching of joint capsule caused by RA [16]. Disc displacement also may be source of pain [23].

In our study TMJ sounds (clicking, crepitus) were reported in 47.5% of examined TMJs of our RA patients studied. Aliko et al. [24] reported in their study that TMJ sounds were observed in more than half of RA patients. Helenius et al. [16] and Wuitski et al. [25] found that TMJ sounds were 58% and 33% respectively in their RA patients. The most common causes of clicking are considered to be poor coordination in lateral pterygoid muscle function, displacement of the articular disc especially with ADDwr which is characterized by clicking of the TMJ on opening and closing. Deviations in condylar form (remodeling) and adhesions may be also another causes of clicking [26,27]. TMJ crepitant often indicates structural damage to the joint and mainly caused by roughened, irregular articular surfaces of the joint [28,29].

In our study, limitation in mouth opening was reported in 65% of RA patients studied. Helenius et al. [16] found 46% of their RA patients were unable to open mouth sufficiently. Wuitski et al. [25] and Aliko et al. [24] found that difficulty in mouth opening were present in 13% and 15.6% respectively of their RA patients [3,25,30].

Impairment of TMJ function was found in 90% of our patients. This was in agreement with Hiza et al. [17] who had reported that TMJ dysfunction using Fonesca’s questionnaire was found in 96.7%. Decrease in TMJ function in our study may be caused by TMJ pain, presence of fibrous adhesions, internal derangement, inflammation, muscular contraction and with severe degeneration of the joint. It also may be associated with RA masticatory dysfunction [2,24].

In the present work, the percentage of abnormality of MRI, MSUS and panorama x-ray in detection of TMJ erosions was 80%, 57.5% and 27.5% respectively in our RA patients. MRI was the best in detection of TMJ erosions when compared with MSUS and panorama. MSUS percentage of abnormality was significantly better than panorama x-ray in detection of TMJ erosions in RA patients. Helenius et al. [16] found that 17% of their RA studied patients had TMJ erosions. Panorama radiograph has been recommended as a screening tool with low price in patients with TMJ complaints and may be used to determine gross bony changes in the condyle as fractures or dislocation while there is lacking in giving information about soft tissues [7]. Alabideen et al. [31] had found that 77.5% had TMJ osseous changes (in form of erosions) by MRI in their RA patients. Manfredini et al. [32] reported that the accuracy of MSUS in detection of TMJ erosions was 69.7% in their patients they had studied. Erosions in RA can be explained mainly by vasculitis of the synovial membrane and may be also caused by increased activity by osteoclasts [35].

In our work, the percentage of abnormality of MRI and MSUS in detection of TMJ effusion was 67.5% and 62.5% respectively with insignificant difference between them. Uchiyama et al. [2] found 70% of their RA patients had TMJ effusion by MRI respectively. Manfredini et al. [32] reported that the accuracy of MSUS in detection of TMJ effusion was 48.5% in their patients they had studied. Rheumatoid arthritis of the temporomandibular joint is usually begins as inflammatory synovitis with edema and cellular accumulation resulting in a macroscopic evident thickened synovial membrane with synovial villous formation and joint effusion [34].

In the present study, the percentage of abnormality of MRI in detection of TMJ disc displacement was 57.5% while by MSUS was 52.5% and the difference between both modalities was statistically insignificant in detection of TMJ disc displacement. Kretapriom et al. [21] found by MRI that TMJ disc displacement was observed in 55% of their RA patients respectively. Also, Manfredini et al. [32] reported that the accuracy of MSUS in detection of disc displacement was 42.4% in their patients they had studied.

In rheumatoid arthritis, the inflammatory synovial pannus destroys the articular disc and bilaminar zone, resulting in abnormal disc position and morphologic features on cross sectional imaging which may be also associated with complete disc destruction [35].

The percentage of abnormality of MRI and MSUS in detection of overall TMJ radiographic abnormalities was 82.5% and 77.5% respectively and the difference between them was statistically insignificant. Helenius et al. [36] and Larheim et al. [37] reported that MRI had detected TMJ abnormalities in 75% of their rheumatic patients. The reported abnormalities included joint effusion, disc abnormalities and condylar degeneration. While Melchiorre et al. [4] had found TMJ radiographic abnormalities were observed in 93.9 % and 72.7% of their patients by MRI and MSUS respectively.

In our RA studied patients, there was correlation between TMJ clinical and radiographic abnormalities of TMJ with functional assessment of TMJ, disease duration and activity. These correlations were supported by Hiza et al. [17] who found correlation between radiographic findings detected by MRI with disease activity, duration of disease and Fonesca’s questionnaire in their RA patients. Also, Uchiyama et al. [2] found that a prolonged duration of rheumatoid arthritis may be associated with more progressive bony changes in the mandibular condyle. This is also in agreement with Helenius et al. [36] who found that there was correlation between TMJ erosions detected by MRI with pain in TMJ and limited mouth movement in their patients. Jank et al. [38] had found significant correlation between MSUS findings (erosions, effusion and disc displacement) with TMJ pain and between TMJ erosions and disc displacement with TMJ clicking in their patients with chronic polyarthritis.

The percentage of abnormality of MRI and MSUS in detection of subclinical radiographic abnormalities in TMJ was 54% and 46% respectively with insignificant difference between them.

Conclusion

We found that MRI and MSUS had high percentage of abnormality (82.5%) and (77.5%) in radiographic diagnosis of TMJ abnormalities in RA patients with insignificant difference between both modalities. TMJ erosions, effusion and disc displacement were common in RA patients as detected by MRI and MSUS. MRI and MSUS were helpful in detecting subclinical TMJ radiographic abnormalities in RA patients. We also found that TMJ radiographic abnormalities were correlated with disease duration, activity and functional impairment. Also, they were correlated with clinical and functional assessment of TMJ.
References


