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Magnetic Resonance Imaging Evaluation of Temporomandibular Joint Involvement in Ankylosing Spondylitis Patients

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Learning Point of the Article:

TMJ involvement is a frequent yet underrecognized manifestation of ankylosing spondylitis, with MRI detecting early inflammatory changes such as bone marrow edema, synovitis, and effusion in nearly half of patients – findings that correlate strongly with higher disease activity, greater TMJ pain, and reduced mouth opening, despite normal CRP/ESR levels. This highlights the importance of MRI as the most sensitive tool for identifying subclinical TMJ inflammation, enabling early intervention to prevent functional impairment and emphasizing the need to routinely evaluate the TMJ as a significant extra-axial site in AS management.

Abstract

Background: Ankylosing spondylitis (AS) is a long-term inflammatory disease that involves the axial skeleton, and new evidence suggests that the temporomandibular joint (TMJ) has been involved. Magnetic resonance imaging (MRI) has been found to be more sensitive in terms of early inflammatory and structural alterations in the TMJ, but the prevalence and clinical associations with AS have not been well documented. Hence, the study was done to determine the prevalence, MRI characteristics, and clinical associations of TMJ involvement in patients with AS compared with healthy controls.

Materials and Methods: A case–control study was used, with 60 AS patients (who met ASAS criteria) and 30 age/sex-matched healthy controls. Each of the participants was taken through bilateral TMJ MRI in a 1.5T scanner. Two blinded radiologists decided on the presence of bone marrow edema (BME), synovitis, effusion, erosions, and disc displacement based on imaging. Clinical measures comprised of TMJ pain Visual Analog Scale, maximum mouth opening (MMO), Bath AS disease activity index (BASDAI), Bath AS functional index, C-reactive protein (CRP), and erythrocyte sedimentation rate (ESR).

Results: TMJ deviations were observed in 27/60 (45.0%) AS patients and 1/30 (3.3%) controls ($P < 0.001$). The most widespread observations were BME (30.0%), synovitis (25.0%), and effusion (20.0%). TMJ involved AS patients had an approximately 5.2 ± 1.8, 38 ± 6 mm, and 4.5 ± 2.1 higher BASDAI score, lower MMO (38 ± 6 mm vs. 45 ± 5 mm, $P < 0.001$), and higher TMJ pain (4.5 ± 2.1 vs. 1.8 ± 1.2, $P < 0.001$) as compared to those without. There was no correlation between the results of MRI and CRP/ESR.

Conclusion: TMJ involvement is common in AS patients and is strongly associated with clinical disease activity and functional limitation. MRI is useful in identifying subclinical inflammation of the TMJ, and it should be considered standard in the evaluation of AS.

Keywords: Ankylosing spondylitis, temporomandibular joint, magnetic resonance imaging, bone marrow edema, disease activity.

Introduction

Ankylosing spondylitis (AS) represents a classic spondyloarthropathy, which refers to the constant inflammation of the axial skeleton, resulting in pain, stiffness, and progressive

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ankylosis [1]. Even though the painful conditions of sacroiliitis and the spinal region represent the typical presentations, extra-axial manifestations such as peripheral arthritis, enthesitis, and uveitis are becoming more acknowledged [2]. The temporomandibular joint (TMJ), not actively researched, can also be involved in up to 35% of AS patients, and it leads to orofacial pain, masticatory impairment, and poor quality of life [3].

TMJ participation in AS presents difficult clinical indicators because of the lack of specific signs and the unnoticeable nature of structural lesions. Traditional radiography is not sensitive to early inflammatory changes, and computed tomography puts patients at risk of ionizing radiation. It is used to identify late-stage changes in the ossuous structure in the first place [4]. Magnetic resonance imaging (MRI) removes these drawbacks with a higher contrast of soft tissues and the ability to detect active inflammation (e.g., bone marrow edema [BME] and synovitis) before it causes any irreversible damage [5]. In recent research, the MRI has been employed in detecting subclinical TMJ pathology in rheumatic disease; however, the evidence related to AS is limited and disseminated [6, 7]. As an example, a meta-analysis demonstrated TMJ abnormalities in 4333% of AS patients, yet the differences in MRI procedures and diagnostic standards make it difficult to make a comparison [8].

There is a poor definition of the clinical significance of TMJ involvement in AS. Although there is evidence of the association of TMJ symptoms with disease activity [9], others show no relation between imaging and clinical outcome parameters [10]. This discontinuity hinders prompt treatment and individual care. In addition, there is no universal system of MRI scoring of TMJ in AS, which prevents the reproducibility of research [11].

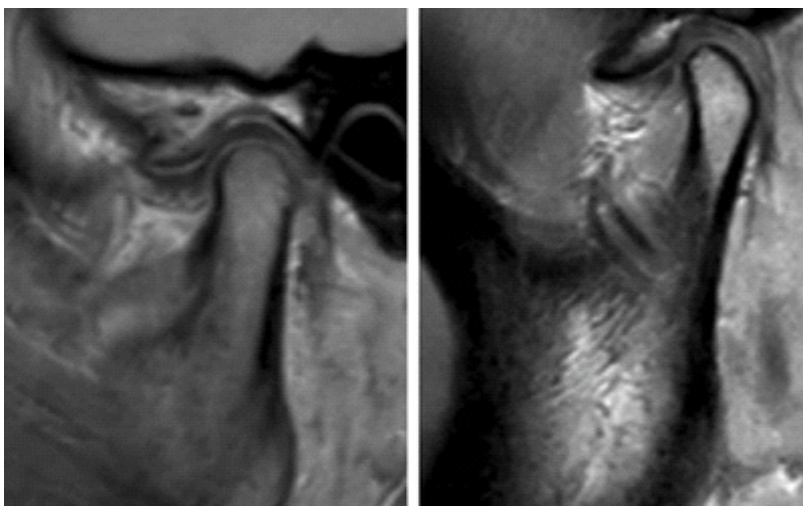

Figure 1: Temporomandibular joint magnetic resonance imaging evaluation with arthritis seen in the joint space.

Considering these constraints, the following questions were posed in this study: (1) to identify the prevalence and range of presence of TMJ abnormalities in AS patients applying standardized MRI protocols; (2) to compare the findings with clinical disease activity bath AS disease activity index (BASDAI), functional status bath AS functional index (BASFI), and TMJ-specific measures; and (3) to compare the results with healthy controls to determine disease-specific patterns.

Materials and Methods

Study design and participants

A case–control study was conducted in Rama Dental College and Research Institute. The sample size was determined using an expected TMJ involvement prevalence of 35% in AS patients, 5% in controls, 80% power, and a 5% significance level, resulting in 60 patients and 30 controls. Sixty consecutive AS patients (fulfilling the 2009 ASAS criteria) were recruited. Thirty age- and sex-matched healthy controls with no history of rheumatic disease or TMJ disorders were enrolled from hospital staff. Ethical clearance was taken from the Institute of Rama Dental College with ethical clearance number 02/IEC/RDCHRC/2023-24/195, approved on August 16th, 2023.

Inclusion criteria

- AS patients: Age 18–60 years; disease duration ≥1 year; no TMJ surgery or trauma in the past 5 years
- Controls: No systemic inflammatory conditions; normal TMJ function on examination.

Exclusion criteria

- Contraindications to MRI (e.g., pacemakers and claustrophobia)
- Pregnancy
- Other rheumatic diseases (e.g., rheumatoid arthritis and psoriatic arthritis)
- Recent TMJ infection or dental procedures (<3 months).

MRI protocol

Bilateral TMJ MRI was performed using a 1.5T scanner (Siemens Magnetom Aera) with a dedicated 8-channel TMJ coil.

MRI of the TMJ in healthy controls was performed to obtain normative reference images and allow valid

Table 1: Demographics and baseline characteristics

Variable	AS patients (n=60)	Controls (n=30)	P-value
Age (years)	38.5±10.2	36.8±9.5	0.48
Male sex (%)	70	66.7	0.72
Disease duration (years)	8.4±5.1	–	–
BASDAI (0–10)	4.5±1.7	0.8±0.3	<0.001
BASFI (0–10)	3.2±2.1	0.5±0.2	<0.001
CRP (mg/L)	12.4±8.7	3.1±1.5	<0.001
ESR (mm/h)	28.5±15.2	8.3±3.6	<0.001

BASDAI: Bath ankylosing spondylitis disease activity index, BASFI: Bath ankylosing spondylitis functional index, CRP: C-reactive protein, ESR: Erythrocyte sedimentation rate, AS: Ankylosing spondylitis

comparison with AS patients. As MRI involves no ionizing radiation and is considered a minimal-risk, non-invasive procedure, it was deemed ethically acceptable.

Sequences included:

- Sagittal and coronal T1-weighted (TR/TE: 450/15 ms)
- Sagittal and coronal T2-weighted fat-saturated (TR/TE: 3000/70 ms)
- Sagittal STIR (TR/TE: 4000/60 ms; TI: 150 ms)
- Contrast-enhanced T1-weighted fat-saturated (0.1 mmol/kg gadobutrol) in patients with suspected synovitis.

Image analysis

Two musculoskeletal radiologists (10+ years' experience), blinded to clinical data, independently evaluated images. Discrepancies were resolved by consensus. The following features were assessed:

- BME: Hyperintensity on STIR/T2-FS in subchondral bone
- Synovitis: Post-contrast enhancement ≥2 mm in the joint capsule
- Effusion: T2-hyperintense joint fluid >2 mm
- Erosions: Focal cortical defects on T1-weighted images
- Disc displacement: Anterior/posterior disc position relative to the condyle (Fig. 1).

Clinical assessment

- TMJ pain: Visual Analog Scale (0–100 mm).
- Maximum mouth opening (MMO): Interincisal distance (mm).
- Disease activity: (BASDAI; 0–10).
- Functional status: (BASFI; 0–10).
- Laboratory markers: C-reactive protein (CRP; mg/L) and erythrocyte sedimentation rate (ESR; mm/h).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences v26.0. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test or Mann–Whitney U-test. Categorical variables were reported as percentages and analyzed through the Chi-square or Fisher's exact test. Spearman's correlation assessed relationships between MRI findings and clinical parameters. Inter-observer agreement was measured using Cohen's kappa. P < 0.05 was considered significant.

Results

Sixty AS patients (42 males, 18 females; mean age 38.5 ± 10.2 years) and 30 controls (20 males, 10 females; mean age 36.8 ± 9.5 years) were enrolled. AS patients had a mean disease duration of 8.4 ± 5.1 years. BASDAI and BASFI scores were significantly higher in AS patients than in controls (P < 0.001) (Tables 1 and 2).

Patients with AS had 23.7 times higher odds of having TMJ abnormalities on MRI compared with healthy controls. MRI detected TMJ abnormalities in 27/60 (45.0%) AS patients versus 1/30 (3.3%) controls (P < 0.001). BME was the most common finding (18/60, 30.0%), followed by synovitis (15/60, 25.0%), effusion (12/60, 20.0%), erosions (9/60,

Table 2: MRI findings in AS patients versus controls

Finding	AS patients (n=60) (%)	Controls (n=30) (%)	P-value
Any abnormality	27 (45.0)	1 (3.3)	<0.001
Bone marrow edema	18 (30.0)	0 (0)	<0.001
Synovitis	15 (25.0)	0 (0)	0.002
Effusion	12 (20.0)	1 (3.3)	0.03
Erosions	9 (15.0)	0 (0)	0.02
Disc displacement	6 (10.0)	0 (0)	0.09

AS: Ankylosing spondylitis, MRI: Magnetic resonance imaging

Table 3: Clinical parameters in AS patients with versus without TMJ involvement

Parameter	With TMJ involvement (n=27)	Without TMJ involvement (n=33)	P-value
BASDAI (0–10)	5.2±1.8	3.8±1.5	0.002
BASFI (0–10)	3.8±2.3	2.7±1.9	0.08
TMJ pain (Visual Analog Scale)	4.5±2.1	1.8±1.2	<0.001
MMO (mm)	38±6	45±5	<0.001
CRP (mg/L)	13.2±9.1	11.8±8.4	0.56
ESR (mm/hr)	30.1±16.3	27.2±14.5	0.47

BASDAI: Bath ankylosing spondylitis disease activity index, BASFI: Bath ankylosing spondylitis functional index, CRP: C-reactive protein, ESR: Erythrocyte sedimentation rate, AS: Ankylosing spondylitis, TMJ: Temporomandibular joint, MMO: Maximum mouth opening

15.0%), and disc displacement (6/60, 10.0%). The single control exhibited effusion. AS patients with TMJ involvement had significantly higher BASDAI scores (5.2 ± 1.8 vs. 3.8 ± 1.5, P = 0.002), reduced MMO (38 ± 6 mm vs. 45 ± 5 mm, P < 0.001), and greater TMJ pain (4.5 ± 2.1 vs. 1.8 ± 1.2, P < 0.001) than those without TMJ abnormalities (Table 3). No significant differences were observed in BASFI, CRP, or ESR between groups. BASDAI correlated moderately with TMJ pain (r = 0.48, P < 0.001) and MMO (r = −0.42, P = 0.001). Cohen's kappa values ranged from 0.82 (BME) to 0.91 (erosions), indicating excellent agreement (Table 3).

Discussion

This paper shows that TMJ involvement is very high (45.0%) among patients of AS as observed in the MRI, with BME and synovitis being the most common. The findings are consistent with previous studies that indicated TMJ anomalies in 3350% of AS groups [6, 12], albeit at a higher prevalence than was found in previous cross-sectional studies, which used radiography or clinical examination as the prevalence measure [13]. These changes are disease-specific as they are starkly different from controls (3.3%).

In spondyloarthropathies, BME, which is a characteristic of alive osteitis, is detected in 30.0% of patients [14]. The fact that it is present in the TMJ implies the possibility of subclinical axial inflammation spreading to craniofacial locations, which might be instigated by common enthesopathic pathways [15]. An additional indication of active inflammation is synovitis (25.0%) and effusion (20.0%), and it aligns with the MRI studies in rheumatoid arthritis [16]. It is important to note that erosions (15.0%) and disc displacement (10.0%) were less common, and suggestive structural damage could also be a secondary effect. This justifies the use of MRI in the detection of arthritis at an early stage before joints are irreversibly damaged [17].

One of the most interesting findings was that the TMJ abnormalities had a strong correlation with the clinical disease activity. The patients with the MRI-detected involvement had much higher scores of BASDAI, lower scores of MMO, and more TMJ pain than those without. This is in line with the data provided by Hernandez et al., who associated TMJ synovitis with high BASDAI in AS [18]. Nevertheless, the non-correlation with CRP/ESR is indicative of the potential compartmentalization of inflammation at TMJ, which is also seen in peripheral joint arthritis [19]. As a result, systemic biomarkers are not enough to examine the participation of the TMJ, so specific imaging is necessary.

The presence of functional impairment, which was shown by a low MMO, was severe in patients with TMJ pathology. This is in line with the research findings that depict masticatory inefficiency in up to 40% of AS patients [20], although our group showed a more severe limitation (38 ± 6 mm vs. population norms of 5055 mm). The relationship of TMJ pain to BASDAI (r = 0.48) also points to the quality of life being affected, and thus routine TMJ assessment should be considered as part of AS management [21].

Limitations consist of the cross-sectional design, which does not allow making causal conclusions with regard to TMJ progression. Although its sample size is larger than most of the previous works [7, 10], this can be detrimental to subgroup analysis. The study should be confirmed by future longitudinal studies, which might also determine the effect of biologic treatments on TMJ inflammation.

Conclusion

This paper demonstrates that the involvement of TMJ is widespread in patients with AS, and MRI revealed active inflammation (BME, synovitis) in almost half of the sample. These results are highly associated with clinical disease activity and functional impairment, and this highlights the TMJ as a clinically significant extra-axial location. MRI is essential in the discovery of subclinical TMJ pathology, especially in patients with high BASDAI scores or limited mouth opening. The introduction of regular TMJ MRI to AS evaluation can be used to provide early intervention, prevent functional disability, and enhance composite disease treatment.

Clinical Message

Early detection of TMJ involvement in AS is essential because nearly half of affected patients may exhibit subclinical inflammatory changes detectable only on MRI, which strongly correlate with increased disease activity, higher pain levels, and functional mouth-opening limitation despite normal CRP and ESR values. Incorporating routine TMJ MRI evaluation – especially in patients with high BASDAI scores or restricted mouth opening – can facilitate timely intervention, prevent irreversible joint damage, and significantly improve overall functional outcomes and quality of life in AS management.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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