

Early Diagnosis of Hip Joint Involvement of Ankylosing Spondylitis Using Magnetic Resonance Imaging in the Absence of Clinical and X-Ray Findings

Gökhan SÖKER¹, Bozkurt GÜLEK¹, Müge AYDIN TUFAN², Eda SÖKER³,
Bayram KELLE⁴, Agah Bahadır ÖZTÜRK⁵

¹Department of Radiology, Adana Numune Training and Research Hospital, Adana, Turkey

²Department of Rheumatology, Adana Numune Training and Research Hospital, Adana, Turkey

³Department of Physical Medicine and Rehabilitation, Adana Numune Training and Research Hospital, Adana, Turkey

⁴Department of Physical Medicine and Rehabilitation, Medical Faculty of Çukurova University, Adana, Turkey

⁵Department of Family Medicine, Adana Numune Training and Research Hospital, Adana, Turkey

Objectives: This study aims to describe magnetic resonance imaging (MRI) findings of hip joint involvement in ankylosing spondylitis (AS) in the absence of clinical and X-ray signs.

Patients and methods: Between January 2012 and June 2012, 23 patients with AS without hip pain symptoms who were admitted to Adana Training and Research Hospital, Department of Physical Therapy and Rheumatology were included in the study. The control group consisted of 20 healthy individuals. All patients underwent MRI examination of both hips.

Results: Of 23 patients, 10 (43.4%) had a pathological finding in at least one of the two sides based on the MRI findings. Seven patients demonstrated unilateral, and three patients demonstrated asymmetrically bilateral involvements. Bone marrow edema was present in six out of the 46 hip joints (13%). Eleven hip joints (24%) showed synovial fluid. One patient had bone marrow edema together with a subchondral cyst, while another patient demonstrated a combination of bone marrow edema and tendinitis.

Conclusion: There may be hip joint involvement in AS patients even in the absence of clinical and X-ray signs. Early detection of bony abnormalities may prevent both the damage to the bone and the development of ankylosis.

Key words: Ankylosing spondylitis; early diagnosis; hip joint; magnetic resonance imaging.

Ankylosing spondylitis (AS) is an autoimmune disease characterized by chronic inflammation, erosions, and a tendency for bone ankylosis.^{1,2} The disease affects the sacroiliac joints and the spine with possible involvement of other joints, entheses, and extra-articular structures.³ The hip is a frequently affected site in AS. Hip involvement in AS is encountered in 25-33% of patients.⁴ Involvement of the hip in AS is associated with a substantial restriction of the body functions, because of the importance of the hip joint. Clinical trials and follow-ups of

AS patients have demonstrated that involvement of the hip may seriously worsen prognosis of the disease.^{4,5} In the initial stage, AS cannot be shown by direct roentgenograms before irreversible structural changes take place. Due to its known advantages such as multiplanar imaging capabilities and excellent resolution, magnetic resonance imaging (MRI) is the method of choice for the evaluation of hip involvement in AS.^{5,6} The purpose of this study is to investigate the role of MRI in the diagnosis of hip joint involvement in patients with normal plain

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Correspondence: Gökhan Söker, M.D. Adana Numune Eğitim ve Araştırma Hastanesi Radyoloji Kliniği, 01240 Yüreğir, Adana, Turkey.

Tel: +90 505 - 929 34 70 e-mail: gsoker@hotmail.com

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radiographs and without hip pain. To the best of our knowledge, this present study is the first which investigates the very early findings of hip involvement in AS.

PATIENTS AND METHODS

This study was reviewed and approved by the Ethics Committee of Adana Training and Research Hospital. The principles of the Declaration of Helsinki were conducted. Written informed consents were obtained from all patients. Twenty-three patients (16 males and 7 females; mean age 35.9 ± 9.4) diagnosed with AS on the basis of the modified New York criteria were enrolled in the study. The study was planned as a cross-sectional case control work-up. Patients who presented at the Physical Therapy and Rheumatology Department of our hospital between January 2012 and June 2012 were enlisted in the study group. These patients had to comply with the inclusion criteria. A control group of 20 patients (14 males and 6 females, mean age 39.7 ± 12.3 years) was constructed from patients whose physical examinations and imaging and laboratory results were not consistent with AS. These patients had no rheumatological disease and no complaints of hip pain. On physical examination, no pain was noted during the range of motion and provocative tests. Patients with a disease duration of less than five years, patients with a history of local and systemic steroid and tissue necrosis factor blockers use for their diseases of less than five years were not included in the study. Patients were using NSAIDs, DMARDs or both. The consumption of disease modifying antirheumatic drugs (DMARDs) and/or nonsteroid antiinflammatory agents were not accepted as excluding criteria. Patients known to have tendinitis or bone marrow edema based on previous MR examinations were not included in the study. Other criteria for exclusion were as follows: ankylosis due to AS detected on conventional radiograms, osteoarthritis or other pathological findings diagnosed during conventional radiography, history of prior bony infection, pelvic surgery, brucellosis, reactive arthritis, salmonellosis, or other inflammatory diseases. Direct roentgenograms and MRI examinations of both hips in all patients both

in the study and control groups performed. All radiological images were evaluated by a single radiologists who was blinded to information of patients. The MRI examinations were performed with a 1.5 Tesla MRI system (Gyrosan Intera, Philips Medical Systems, Netherlands). A vertebral coil was used for the examinations. The T_1 -weighted spin echo and T_2 -weighted Spectral Attenuated Inversion Recovery (SPAIR) and Short-TI Inversion Recovery (STIR) sequences were used for the examinations, all of which were performed in the axial and coronal planes. The MRI parameters used in the studies were as follows: T_1 -weighted spin echo axials [repetition time (TR): 500 ms, echo time (TE): 18 ms, matrix size: 280×374 , field of view (FOV): 385 mm, slice thickness: 4 mm, minimum slice gap: 0 mm, scan time: 1.5 min]; T_2 -weighted SPAIR axials (TR: 4864 ms, TE: 60 ms, matrix size: 224×186 , FOV: 388 mm, slice thickness: 4 mm, minimum slice gap: 0 mm, scan time: 2.4 min); fat-suppressed STIR axials (TR: 3824 ms, TE: 20 ms, matrix size: 152×204 , FOV: 403 mm, slice thickness: 4.4 mm, minimum slice gap: 0.88 mm, scan time: 4.2 min).

The main pathological findings of MRI were as follows: pathologically increased fluid in the joints, bone marrow edema, subchondral cysts, tendinitis, and soft tissue edema. Bone marrow areas, which demonstrated low signal intensities on the T_1 -weighted images, and high signal intensities on the T_2 -weighted images, were evaluated as bone marrow edema.⁷ Sites of fluid collections at the subchondral regions, which showed high signal intensities both in the T_2 -weighted and STIR sequences were evaluated as subchondral cysts.¹ A high signal intensity obtained at the T_2 -weighted and STIR sequences in the coxofemoral joints exceeding 5 mm in thickness was noted as a pathologically increased fluid collection in the hip joints.⁸ Enthesitis was diagnosed when sites of ligamentous attachments to the bones demonstrated high signal intensities at the STIR sequences.¹ Tendinous thickenings together with increases in focal signal intensity on both the T_1 and T_2 -weighted sequences were evaluated as tendinitis.¹

The SPSS for Windows version 15.0 software program (SPSS Inc., Chicago, IL, USA) was used for statistical analyses of the

data. Categorical measurements were defined as numbers and percentages, whereas quantitative measurements were indicated as mean values and standard deviations (median, minimum, and maximum values, when necessary). The chi-square test was used for the comparison of categorical measurements of the patient and control groups. The T test was administered for comparison of the ages of the patient and control groups. The statistical criterion for significance was appointed as 0.05 in all tests.

RESULTS

No statistically significant difference was found between the two groups in terms of mean ages. Table 1 gives demographic and clinical properties of the patient group. In the patient group, a pathological condition in at least one of the two sides was detected on the MRI images in 10 of the 23 patients (43.4%). Bone marrow edema was present in six out of the 46 hip joints (13%). None of the patients had bilateral bone marrow edemas. Eleven hip joints (24%) demonstrated synovial fluid. Synovial fluids were bilateral in three (6%) of these patients. Among the 10 patients with a pathological finding based on the MRI images, seven (70%) demonstrated unilateral, while three (30%) demonstrated asymmetrically bilateral involvements. In the remaining 13 patients (56.5%), the MRI of the hip joints was normal. One of the 23 patients had bone marrow edema together with a subchondral cyst, while another patient demonstrated a combination of bone marrow edema and tendinitis. Edema was present in the gluteal muscles in three patients (13%), which was thought to be secondary to an impairment in walking. This edema was bilateral in two of

Table 1. Clinical and demographic features of patients

	Mean±SD	Median	Min.-Max.
Age (years)	35.9±9.4	33	18-52
Disease duration (years)	8.3±1.44	8	6.5-12
BASDAI	3.25±1.28	3.54	1.24-5.55
Visual analog scale	31.08±7.79	31	20-51

SD: Standard deviation; Min.: Minimum; Max.: Maximum; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index.

the patients. In the control group, 20 patients demonstrated no pathological MRI findings (Table 2). When the patients were evaluated according to the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) scorings, the following results were obtained: four of the six patients (66.7%) with BASDAI scores of four and over had unilateral or bilateral hip involvement, whereas only six of the 17 patients (35.3%) with BASDAI scores below four demonstrated unilateral involvement of the hip.

DISCUSSION

Hip involvement is one of the most frequently encountered signs of AS. Hip involvement is very important in the definition of prognosis of the disease, and it is also definitive in demonstrating the intensity of the disease, and alternatives of therapy. A number of studies have shown that hip involvement worsens the prognosis of the disease and impairs quality of life.⁹⁻¹² The real prevalence of hip involvement depends on the type of definition used to describe the involvement. Three definitions may be used for involvement of the hip joint in AS: clinical hip involvement, radiologic hip involvement, and end-stage hip disease. The hip joint is affected in some stages of the disease in

Table 2. Magnetic resonance imaging features of patients

	Groups				p
	Patient		Control		
	n	%	n	%	
Bone marrow edema					
No	40	87	40	100	0.166
Yes	6	13	0	0	
Synovial fluid					
No	30	65	40	100	0.012
Yes	16	35	0	0	
Tendinitis					
No	45	98	40	100	0.999
Yes	1	2	0	0	
Subchondral cyst					
No	45	98	40	100	0.999
Yes	1	2	0	0	
Gluteal muscle edema					
No	41	89	40	100	0.166
Yes	5	11	0	0	

25-35% of all AS patients. The major risk factor is juvenile onset of the disease, which indicates an onset before the age of 16.⁴ Hip involvement in juvenile AS patients has been reported to be as high as 50%.¹³ In juvenile-onset cases, bilateral involvement in which one side is more affected is frequently encountered.¹³ In our study group, there was also bilateral synovial fluid and bone marrow edema in a patient who was 18 years old and who had been affected by the disease for four years. In the patient group, the rate of early signs of hip involvement was found as 43.4%. This was a little higher than the hip involvement rates reported in the literature.

The typical MRI findings of AS are enthesitis and ankylosis. However, at the very early stage of the disease, synovitis and subcortical bone marrow edema are important diagnostic features. A number of studies have shown that subchondral bone marrow edema develops as a result of inflammation in various sites such as the sacroiliac joints, femoral heads, and the shoulders.¹⁴⁻¹⁶ The sign of early involvement in AS is subcortical edema. Subcortical edema may be seen at the femoral head, symphysis pubis, and other sites of entheses (Figure 1, 2). Histological studies have shown that the bone marrow edema in AS is in correlation with osteitis.¹⁷ The femoral head bone marrow edema in AS differs from the diffuse form seen in septic arthritis, and it is more focal, frequently encountered in tendinous and ligamentous insertion sites. A similar pattern was present in the cases of our study (Figure 3). In one study, it was reported that 23% of cases with juvenile AS demonstrated subcortical edema at the symphysis pubis.¹⁷ In our study, no bone marrow edema was encountered at the sites of the symphysis pubis of the patients. This fact

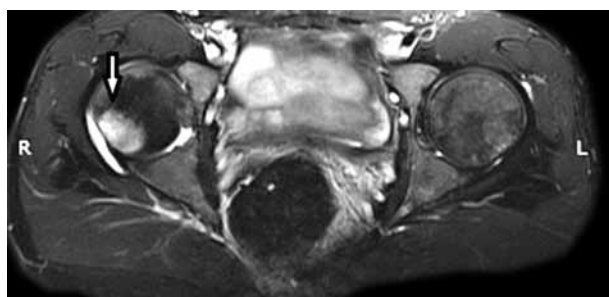


Figure 1. Axial T₂-weighted turbo spin-echo shows bone marrow edema at the right femur (arrow) and synovial fluid at the right hip joint.

may be due to the limited number of the patients enlisted in our study, and also to the difference in the patient age groups between our study and the study mentioned above.

The site of insertion of the tendons, ligaments, joint capsules, and the fascia is known as the entheses.^{18,19} Involvement of these sites are defined as enthesopathy, while inflammatory conditions are more precisely referred to as enthesitis. Enthesitis is the major finding in spondyloarthropathies. Chronic alterations which take place in the process of enthesitis may be demonstrated by means of direct roentgenography and computed tomography. On the other hand, early signs of the disease may be demonstrated by ultrasonography and MRI.¹⁸ While ultrasonography can only detect soft tissue alterations, MRI can also demonstrate intraosseous abnormalities.²⁰⁻²⁴ In our patient group, six patients (13%) had bone marrow edema. Three of these patients had bone marrow edema at the acetabulum, and the other three at the lateral aspects of the femoral heads and the tuberculum majus.

Synovitis is an important finding in the early involvement of the hip joint in AS, and it is characterized by mild to moderate thickening of the synovial membrane and increased joint fluid on MRI.¹ In our study, eight patients (34.7%)

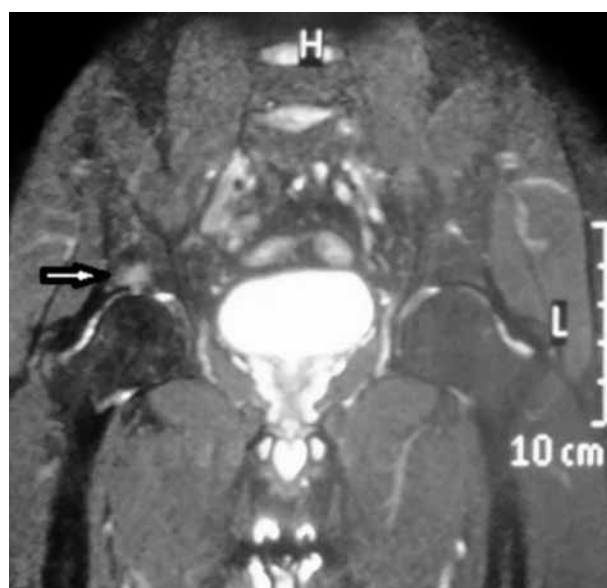


Figure 2. Coronal fat saturated T₂-weighted image shows subchondral marrow edema at the right acetabulum (arrow).

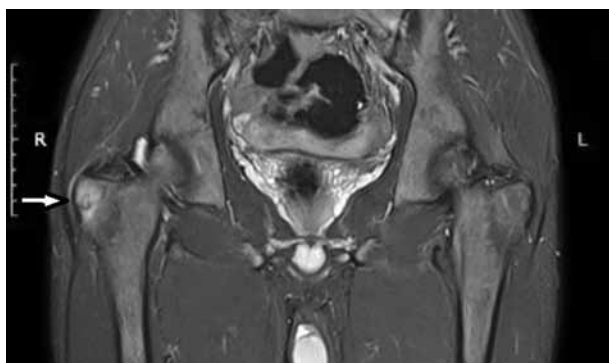


Figure 3. T₂-weighted coronal image demonstrates subcortical bone marrow edema at the right trochanter major (arrow).

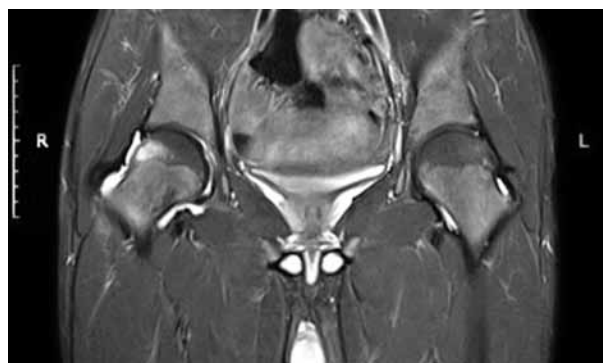


Figure 4. T₂-weighted coronal image demonstrates synovial fluid at the right hip joint and bone marrow edema at the lateral side of femur head (arrow).

showed unilateral synovial fluid (Figure 4). Three patients, on the other hand, demonstrated bilateral synovial fluid. These findings were found to be statistically significant when compared with those of the control group. No intravenous contrast agents were used in our study; but we think that the administration of gadolinium may contribute to the demonstration of the inflamed synovial membrane.

Patients with BASDAI scores of four and over in this study were found to demonstrate a higher rate of involvement of their hips by AS. This result clearly indicates the need to keep the disease process in strict control. Furthermore, another important outcome of the study was that 35.3% of those patients who were not defined as being actively affected by the disease also had involvement of one of their hips by AS. This is an important finding and it confirms our suggestion that AS patients with negative physical examination and conventional radiography findings must also undergo an MRI evaluation at least for once, with the purpose of early detection of hip involvement. This is very important for the course of therapy of the disease.

In this study, the MRI findings of early stage hip involvement in AS were investigated in AS patients with no clinical findings of hip involvement and whose hip X-rays were within normal limits. The major limitation of our study was small sample size in the patient group. Magnetic resonance imaging is a non-invasive imaging modality with advantages of multiplanar imaging, together with a high spatial and contrast resolution capacity. Even the patients without

any clinical or X-ray signs may have hip joint involvement. Therefore, early detection of bony abnormalities may prevent both damage to the bone and the development of ankylosis.

Declaration of conflicting interests

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