Anterior Chest Wall Involvement in Early Stages of Spondyloarthritis: Advanced Diagnostic Tools

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ABSTRACT. ***Objective.*** Anterior chest wall (ACW) involvement is difficult to evaluate in patients with spondyloarthritis (SpA). Bone scan is sensitive to ACW involvement, while magnetic resonance imaging (MRI) detects early alterations in SpA. We compared the sensitivity and specificity of bone scans and MRI in assessing ACW in early SpA.

Methods. Out of 110 patients with early SpA attending the Outpatient Rheumatology Unit Clinic of Padua University from January 2008 to December 2010, the 40 complaining of pain and/or tenderness [60% with psoriatic arthritis (PsA), 12.5% with ankylosing spondylitis, and 27.5% with undifferentiated SpA] underwent bone scans and MRI.

Results. At clinical examination, sternocostoclavicular joints were involved in 87.5% on the right, 77.5% on the left, and 35% on the sternum. Bone scan was positive in 100% and MRI in 62.5% of these patients. Early MRI signs (bone edema, synovial hyperemia) were observed in 27.5%, swelling in 5%, capsular structure thickness in 37.5%, erosions in 15%, bone irregularities in 15%, osteoproductive processes in 12.5%, and osteophytes in 5%. A higher prevalence of Cw6, Cw7, B35, and B38 was found in 15%, 48%, 28%, and 12%, respectively, of the patients with PsA who had bone scans.

Conclusion. Noted mainly in women, ACW involvement was frequent in early SpA. Both bone scans and MRI are useful in investigating ACW inflammation. Bone scans were found to have high sensitivity in revealing subclinical involvement, but a low specificity. MRI provides useful information for therapeutic decision making because it reveals the type and extent of the process. The significant associations of HLA-Cw6 and Cw7 with PsA could suggest that genetic factors influence ACW involvement. (J Rheumatol First Release July 15 2012; doi:10.3899/jrheum.120107)

Key Indexing Terms:
ANTERIOR CHEST WALL SPONDYLOARTHRITIS MRI BONE SCAN

Timely therapeutic intervention before stable anatomical damage is established has become an important goal for rheumatologists. An optimal outcome can be expected when the diagnosis is made early and the affected site is localized and treated. Involvement of anterior chest wall (ACW), in particular of sternocostoclavicular joints (SCCJ), sternocostal joints (SCJ), the manubriosternal joint, and the third inferior medial portion of the sternum, has been reported in patients with spondyloarthritis (SpA)[1,2,3,4]. Its frequency and severity have been underestimated, mainly owing to the difficulty in determining the origin of pain during examination, because a wide variety of extraarticular disorders are possible in this anatomic region[1]. Conventional radiography is of limited value because uniplanar imaging of ACW joints has low sensitivity to initial pathological alterations[5,6,7,8]. Bone scanning has been found to be very sensitive in these cases, although its specificity as a diagnostic procedure is considered low[4,5,6,7,8,9]. Magnetic resonance imaging (MRI) appears to be more effective in assessing initial pathological processes in the early stages of SpA[10,11,12,13,14].

The aim of our study was to compare the reliability of these 2 methods in assessing ACW involvement in patients who have been diagnosed with SpA within 1 year, defined as "early SpA." Another aim was to study the prevalence of ACW involvement in these patients and to ascertain which joints are most frequently involved, and the frequency of human leukocyte antigen (HLA). Studies have reported a correlation between the frequency of ACW involvement and the course and the severity of SpA[15,16,17,18], and more recent data suggest that it is often the first symptom of the disease in undifferentiated SpA (uSpA)[4,9,19,20].

MATERIALS AND METHODS

Patients. One hundred ten consecutive outpatients with early stages of SpA attending the Early Arthritis Clinic of the Rheumatology Unit of the

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University of Padua Medical Center between January 2008 and December 2010 were evaluated for study. Forty who complained of pain and/or tenderness in ACW joints (22 women, mean age 46.5 ± 13.3 yrs) were enrolled. Approval by the local Ethics Committee was obtained and all subjects gave written informed consent.

Inclusion criteria. The inclusion criteria were recent diagnosis of SpA (< 1 year), in accord with the European Spondylarthropathy Study Group classification[21], and presence of pain and/or tenderness in ACW joints during assessment.

Exclusion criteria. The exclusion criteria were as follows: SpA diagnosis established > 1 year previously; use of disease-modifying antirheumatic drugs, antitumor necrosis factor-α agents, or nonsteroidal antiinflammatory drugs before enrollment; or concomitant presence of other diseases potentially causing clinical involvement of ACW.

Clinical assessment. During the physical examination the patient was questioned about age, time of onset, and characteristics of joint symptoms, site of pain or discomfort, and family history of arthritis and/or psoriasis and other comorbidities. After the patient's medical history was evaluated by double-blinded trained rheumatologists, the number of tender/swollen joints was assessed using the American College of Rheumatology joint count (clinical evaluation scale of 44 joints). The right and left SCCJ (Figure 1), SCJ, sternal joint, and the inferior medial third of the sternum were also evaluated for presence/absence of spontaneous pain, pain evoked by digital pressure, swelling, and redness of skin.

The Bath Ankylosing Spondylitis Disease Activity Index and Bath Ankylosing Spondylitis Functional Index, the visual analog scale (VAS) for pain, the VAS for patient global health, and the Health Assessment Questionnaire (HAQ) were administered to all patients.

The 40 patients with pain and/or tenderness in ACW joints all underwent the following laboratory and instrumental assessments.

Laboratory assessments. Erythrocyte sedimentation rate and C-reactive protein were determined, along with HLA-A, -B, and -C (complement-dependent microlymphocytic assay).

Total-body bone scintigraphy. Total-body bone scintigraphy was performed at the Nuclear Medicine Service of the University of Padua. All 40 patients received a 740-MBq injection of 99m-Tc-methylene diphosphonate. Scintigraphic images were classified as positive or negative on the basis of the hypercaptation areas observed (Figure 2A).

MRI of anterior chest wall. MRI scanning was performed at the Radiology Service of the University of Padua to investigate underlying joint alterations during early disease phases (bony edema, synovial hyperemia, swelling, increase of thickness of capsular structure; Figure 2B) or advanced damage (bone sclerosis, hyperostotic process with osteophytes, erosions, ankylosis). Images were acquired in the sagittal and coronal planes with patients in prone or supine position (images were acquired during the expiration phase).

All MRI scans were performed using a 1.0-T unit equipped with a phased-array surface coil (Magnetom Harmony, Siemens AG Medical Solutions, Munich, Germany). MRI images were obtained without using tracer. All images were evaluated by double-blinded trained radiologists.

Statistical assessment. Kappa values were used to estimate agreement between clinical findings and the imaging results for each ACW joint site.

RESULTS

Forty (34%) of the 110 patients complained of pain and/or tenderness during the clinical assessment. Of these, 60% were diagnosed with PsA, 12.5% with ankylosing spondylitis (AS), and 27.5% with uSpA; 67.5% had axial/peripheral, 15% axial, and 17.5% peripheral involvement. Patients' demographic and clinical data including the results of questionnaires evaluating functional status and the distribution of inflammatory markers are outlined in Table 1.

On examination, we found spontaneous pain and/or swelling and/or skin redness and/or digital pressure reaction indicating right SCCJ involvement in 87.5% of patients, left SCCJ involvement in 77.5%, SCJ involvement in 20%, sternal joint involvement in 35%, and sternal involvement in 10%

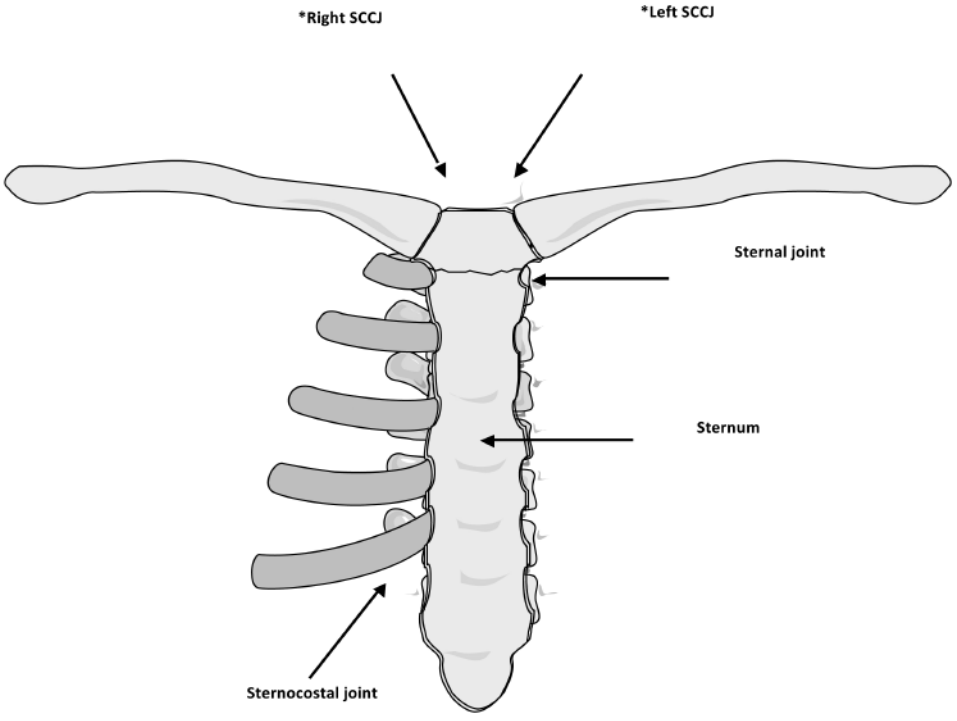

Figure 1. Anatomy of the anterior chest wall. SCCJ: sternocostoclavicular joint.

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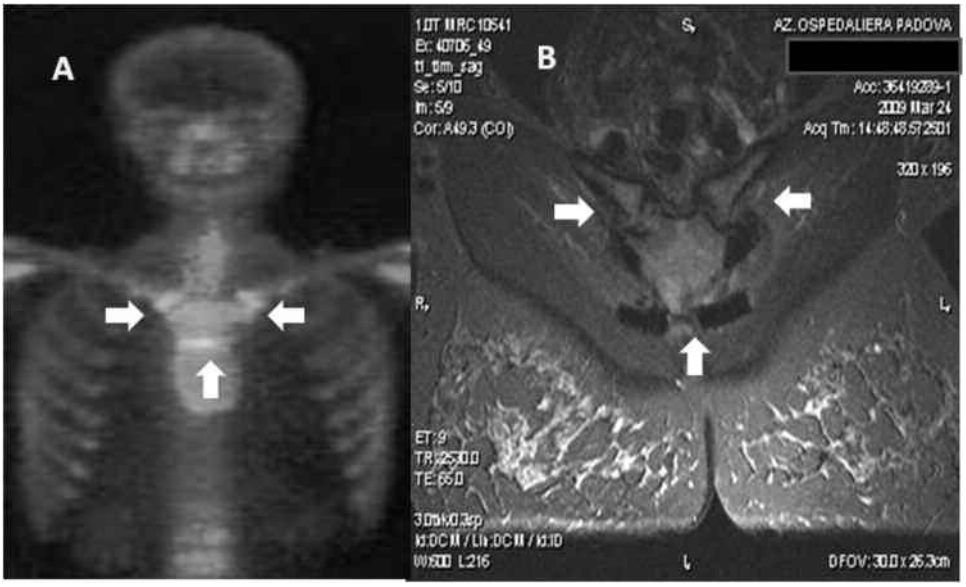

Figure 2. A. Bone scan shows sternocostoclavicular joint (SCCJ) and manubriosternal joint hypercaptation (arrows). B. T2 magnetic resonance imaging sequence shows bone edema of SCCJ (arrows).

(Figure 3). A bone scan result was positive in all patients: in the right SCCJ in 67.5%, in the left SCCJ in 52.5%, in the sternal joint in 35%, in the SCJ in 22.5%, and in the sternum in 12.5%.

MRI result was normal in 37.5%, while it revealed pathologic findings of inflammatory processes in 62.5%. In SCCJ, MRI showed involvement respectively in the right and left in 47.0% and 40.0%, while both the sternal joint and sternum were affected in 20% of patients. The main pathological alterations on MRI scans were signs of active disease — bone edema and/or synovial hyperemia in 27.5%, swelling in 5%, and increased capsular structure thickness in 37.5%; and findings of advanced damage — erosion in 15%, bone irregularities in 15%, osteoproductive process in 12.5%, and osteophytes in 5%.

Immunogenetic HLA assessment was also performed. HLA-B27 was found in 58% of the bone scan-negative patients and in 20% of MRI-negative patients. A higher prevalence of Cw6, Cw7, B35, and B38 was found, respectively, in 15%, 48%, 28%, and 12% of bone scan-positive patients. A higher prevalence of Cw7 and B38 alleles was found, respectively, in 53% and 12% of the MRI-positive patients; the same alleles were found in 44% and in 0% of MRI-negative patients. That Cw7 was prevalent in PsA patients with positive bone scans (30%) was considered an interesting finding, and this was also confirmed in patients with PsA who were MRI-positive (18%); a frequent prevalence of Cw6 in the bone scan-positive PsA group (10%) was similarly noted. Details of HLA antigens found in our patients are outlined in Table 1.

Findings from the patients' clinical evaluations and bone scan and MRI data are outlined in Table 2.

Data for clinical findings and imaging results in ACW joints are described in Table 3.

DISCUSSION

Prevalence and type of involvement of the ACW in the early stages of SpA have not been clearly defined in clinical practice[1,2]. Out of 110 patients with recently diagnosed SpA attending our clinic, 40 subjects (36.4%) qualified for study because they manifested at least 1 symptom (pain or tenderness) in ACW joints. All these patients underwent bone scan and MRI testing and all were found to be bone scan-positive for at least 1 ACW joint site. As in a previous study[4,9], a bone scan in patients with PsA was found to be sensitive to subclinical lesions. The prevalence of ACW involvement was found to be different in the various SpA subsets. Active clinical signs such as pain or tenderness and bone scan positivity were, indeed, more frequent in the group with PsA (60%) than in the AS (12.5%) group, but prevalence in the 2 groups was similar: 15% in PsA and 17% in AS, as described[1]. However, Weber, *et al* recently reported that signs of ACW inflammation prevalently occurred in AS rather than in uSpA[22].

With regard to HLA typing, it was interesting that bone scanning gave a positive result in SpA patients with Cw6 and B38, while it was negatively associated with B27. There was, moreover, a higher prevalence of Cw7 and B38 alleles in the MRI-positive patients, while MRI was negative in the SpA patients with HLA-B27. That Cw7 was observed in bone scan-positive and MRI-positive patients with PsA (respectively in 30% and 18%) was considered an important finding, as was the high prevalence of Cw6 in bone scan-positive patients with PsA (10%). These results could be related to the higher prevalence of SpA in the patients studied and particularly in the PsA group. The significant association of HLA-Cw6 and Cw7 with PsA highlights the importance of genetic factors[23], which could play a pathogenic role in clinical manifestations and may represent a risk factor for ACW joint inflammation.

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Table 1. Main demographic and clinical characteristics, biomarkers, and functional data in patients with SpA.

Patient	Sex, Age	Diagnosis	I	HLA A	HLA B	HLA Cw	Psoriasis, months	ESR	CRP	BASFI	BASDAI	HAQ	VAS	VASg
1	F 55	PsA	P/A	2–3	44–49	5–7	0	10	0.1	5.0	26.5	0.5	45	55
2	M 54	PsA	P/A	2	18–27	7	0	15	3.2	28.6	52.0	0.5	75	25
3	M 60	PsA	P	1–2	44–57	6–7	24	11	0.1	7.0	40.0	0.9	60	30
4	M 53	PsA	P	1–2	8–35	5–7	252	11	0.5	0.0	0.0	0.0	0	10
5	F 49	PsA	A	—	—	—	24	7	0.1	3.5	22.0	0.5	70	30
6	M 68	PsA	P/A	—	—	4–7	4	0	0.2	5.0	25.0	0.1	15	20
7	M 42	PsA	P	1–24	38–57	6–7	9	3	0.1	10.0	37.0	0.0	40	60
8	F 56	AS	A	28–29	44–27	4–16	0	10	0.1	27.0	57.5	0.8	50	50
9	F 59	PsA	P/A	23–24	35–55	—	348	10	0.0	19.5	48.0	0.0	32	32
10	F 33	PsA	P/A	—	—	—	252	0	0.5	8.2	18.5	0.5	30	65
11	F 49	uSpA	P/A	24–25	18–35	4–7	0	12	0.2	31.1	51.4	0.8	55	68
12	F 48	uSpA	P/A	—	35–51	6	24	21	1.1	9.0	74.0	0.2	20	60
13	M 63	PsA	P/A	2	39–51	7	0	20	3.0	9.0	68.0	0.3	40	40
14	F 42	AS	P/A	1–24	27–38	4	0	15	5.4	51.0	54.0	0.9	40	60
15	M 37	AS	A	2–28	13–27	2–6	0	43	54.0	18.0	22.0	0.8	20	30
16	F 57	PsA	P/A	24	7–35	4–7	6	0	3.5	42.0	80.0	1.3	50	50
17	F 26	uSpA	P/A	2	7–55	7	0	35	0.7	2.0	13.5	0.3	30	30
18	M 33	PsA	P/A	2–24	44–55	3–5	32	11	0.0	10.0	31.1	0.5	35	10
19	M 38	PsA	A	11	39–52	—	24	10	0.9	10.0	52.0	0.8	40	25
20	F 33	uSpA	P/A	—	65–44	8–16	0	4	4.1	40.0	54.0	0.5	25	30
21	M 26	AS	A	—	27	—	0	16	1.9	51.5	53.5	1.3	55	45
22	F 59	PsA	P/A	2–26	38–51	5–12	0	88	4.5	82.0	89.0	2.4	95	75
23	F 68	uSpA	P/A	1–2	15–35	2–7	0	2	0.0	1.0	14.0	0.1	5	5
24	M 38	PsA	P	—	—	—	240	15	0.2	28.5	66.5	1.0	10	10
25	F 62	uSpA	P/A	—	—	—	0	10	0.1	34.0	27.0	0.9	60	45
26	M 45	PsA	P	2	44–57	7	72	55	2.0	17.5	29.5	0.8	45	55
27	M 47	PsA	P	2–32	39–61	4	72	7	0.2	0.0	5.0	0.0	0	2
28	F 26	AS	P/A	2	18–27	—	2	18	0.6	24.0	15.0	0.9	30	25
29	M 40	uSpA	P/A	2–68	35–51	1–14	120	102	26.8	14.0	36.0	0.5	40	40
30	F 72	PsA	P	—	7–18	7	120	4	2.0	13.7	44.8	0.3	40	55
31	F 57	uSpA	P/A	—	18–39	6–7	0	25	3.0	3.0	22.0	0.6	30	20
32	F 42	PsA	P/A	2–24	8–44	5–7	0	13	0.1	18.0	28.0	0.3	35	20
33	M 58	uSpA	P/A	11–31	35–41	4–17	12	2	0.1	11.0	13.5	0.8	10	20
34	F 47	uSpA	A	2–11	7–56	1–7	24	7	0.3	24.0	46.0	0.9	20	50
35	F 48	PsA	P/A	30–68	13–51	6	0	10	3.4	7.0	31.0	0.9	55	30
36	M 19	PsA	P/A	3–11	14–35	4–8	5	50	78.8	30.0	65.0	2.3	70	65
37	F 51	PsA	P/A	3–26	18–35	4	48	34	4.8	25.0	52.5	1.0	50	28
38	M 36	PsA	P/A	2–24	18–63	7	23	9	0.3	3.0	52.0	0.4	20	27
39	F 40	PsA	P/A	1–33	14–52	7–8	312	33	0.1	17.0	38.0	0.4	30	45
40	M 22	uSpA	P/A	—	35	—	0	32	0.1	25.0	61.5	1.4	65	28

I: involvement; P/A: peripheral/axial; ESR: erythrocyte sedimentation rate (mm/h); CRP: C-reactive protein (mg/dl); BASFI: Bath Ankylosing Spondylitis Functional Index; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; HAQ: Health Assessment Questionnaire; VAS: visual analog scale for pain; VASg: visual analog scale for health; SpA: spondyloarthritis; PsA: psoriatic arthritis; AS: ankylosing spondylitis.

Two important findings emerging from our study were (1) that 60% of the newly diagnosed patients complaining about pain or tenderness were indeed affected with PsA; and (2) that ACW involvement was associated with morphological structural alterations, and in particular bone edema with synovial hyperemia and increased capsular structure thickness in the uSpA subset (27.5% of our patient population), a group in which ACW involvement has not been studied extensively. Another relevant finding was the higher prevalence of ACW involvement in women (55%). Our results also indicated frequent involvement of the right and left SCCJ (57.5%) according to the clinical, bone scan, and MRI assessments. A minor yet significant involvement was also observed in sternal joint patients (10%; Table 2). Analysis of agreement between clinical findings and the 2 imaging procedures (bone scan and MRI) showed a high level of agreement overall for each ACW joint, especially between MRI and bone scans and between clinical findings and bone scans. While there was a lower level of agreement between clinical evaluations and MRI data, the highest level of agreement concerned the sternal joint and sternum (Table 3). Previous reports have not clearly identified what ACW sites are most frequently involved: some studies have shown that SCCJ and sternal joints are similarly affected[2,15], while others suggest that the sternal joint is affected

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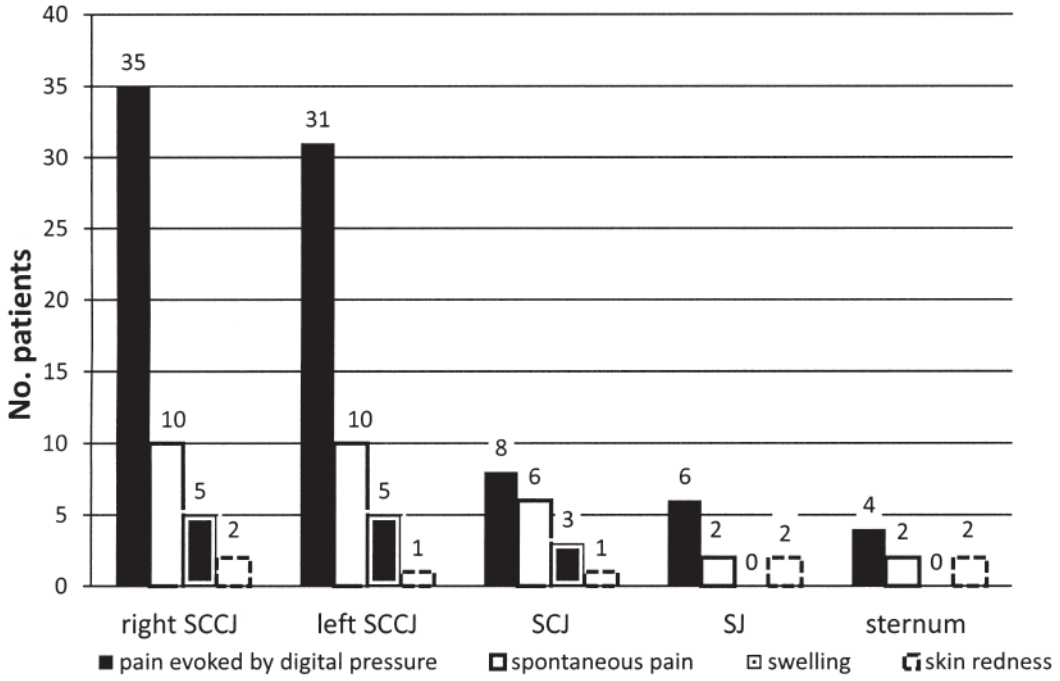

Figure 3. Clinical assessments in anterior chest wall joints. SCCJ: sternocostoclavicular joint; SCJ: sternocostal joints; SJ: sternal joints.

Table 2. Clinical assessment, bone scans, and MRI in anterior chest wall joints.

Joint	Clinical Involvement (%)	Bone Scan (%)	MRI (%)
Right SCCJ	37 (87.0)	27 (67.5)	19 (47.5)
Left SCCJ	31 (77.5)	21 (52.5)	16 (40.0)
Sternocostal	4 (10.0)	5 (12.5)	4 (10.0)
Sternal/manubriosternal	8 (20.0)	9 (22.5)	4 (10.0)
Sternum	14 (35.0)	14 (35.0)	8 (20.0)
Total	40 (100)	40 (100)	25 (62.5)

SCCJ: sternocostoclavicular joint; MRI: magnetic resonance imaging.

more frequently[16,17,18,24,25,26], particularly in AS. This is in agreement with findings that inflammatory processes in ACW are similar to those in sacroiliac joints, with regard to the type of disease process and the timing of early development. Older studies described a positive relationship between ACW involvement and disease severity[16,17,18], whereas more recent findings indicate that it is the first disease manifestation in the uSpA subgroup[4,9,19,20]. In our study, bone scan assessment confirmed ACW involvement in all patients evaluated, even in those with inappreciable symptoms, while MRI results were positive in only 62.5% (Table 2).

Our findings indicate that MRI is a useful tool to study ACW joint involvement as it often confirms diagnosis and provides specific information about disease activity and severity. While bone scan is sensitive, if not specific, to early

Table 3. Agreement between clinical findings and each imaging modality (K values).

Joint	MRI/Bone Scan		Clinical Evaluation/ Bone Scan		Clinical Evaluation/MRI	
	N* (total)	K	N* (total)	K	N* (total)	K
Right SCCJ	25 (40)	0.46	31 (40)	0.48	22 (40)	0.23
Left SCCJ	26 (40)	0.56	27 (40)	0.47	21 (40)	0.31
Sternocostal	29 (40)	0.72	25 (40)	0.61	32 (40)	0.80
Sternal/manubriosternal joint	27 (40)	0.64	28 (40)	0.68	27 (40)	0.66
Sternum	33 (40)	0.82	37 (40)	0.92	32 (40)	0.80

* Number of patients with concordance of 2 methods (++ and – –). SCCJ: sternocostoclavicular joint; MRI: magnetic resonance imaging; total: total patients studied.

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inflammation, MRI better defines pathological processes and their effects on adjacent structures; it also detects early signs of active disease, outlines the disease processes, and delineates advanced alterations.

The ACW in SpA has not received much attention to date, for a variety of reasons. In clinical practice, patients may mention ACW symptoms, but various explanations for them are possible because there are numerous anatomical structures in that area. During an examination the physician may note the typical signs of tenderness, pain, swelling, or redness, but may not connect these symptoms to joint disorders and may not order appropriate investigations, and even when a simple radiograph is prescribed, little valuable information emerges because uniplanar imaging is unable to visualize ACW joints[5]. More sensitive, although less specific, bone scanning can uncover a general pattern of affected joints, but provides little detailed information on local joint pathology[4,9]. A multiplanar imaging procedure, MRI can visualize all thoracic structures[10,11,12,13,14].

ACW involvement is a frequent finding in the early stages of SpA. More than a quarter of 110 patients with recently diagnosed SpA attending our clinic, primarily women, were found to have ACW involvement. Bone scans and MRI were both found to be useful to investigate these joints. Bone scanning was found to have a higher sensitivity in comparison with other procedures, and although less specific, it identified precocious subclinical joint involvement. MRI was found to be effective in confirming the diagnosis of SpA[12,13,14,15,16,17,18,19,20,26,27] and in providing information useful for the therapeutic approach, revealing the type, extent, and duration/time of joint involvement.

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