The Association of Syndesmophytes with Vertebral Bone Mineral Density in Patients with Ankylosing Spondylitis

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ABSTRACT. ***Objective.*** To determine bone mineral density (BMD) using the posteroanterior L2–L4 (PA) and lateral L3 (LAT-L3) projections of dual energy x-ray absorptiometry (DEXA) in patients with ankylosing spondylitis (AS), and to evaluate the relationship between BMD and the presence of syndesmophytes.

Methods. Twenty men with AS were studied. BMD was measured by femoral neck DEXA, PA DEXA, and LAT-L3 DEXA scans. Radiographs of lumbar spine were evaluated to obtain a lumbar spine score (LSS) for the presence of syndesmophytes. Twenty-three age matched healthy men served as controls.

Results. While there was no significant difference in BMD from PA DEXA results between AS patients and controls, BMD from the LAT-L3 DEXA was significantly reduced in AS patients ($p = 0.009$). LSS correlated significantly with BMD from PA DEXA ($r = 0.55$, $p = 0.013$), but not with BMD of LAT-L3 DEXA.

Conclusion. LAT-L3 DEXA was superior to PA DEXA in detecting a decrease of BMD in patients with AS. The presence of syndesmophytes had no distorting effect on BMD measured by LAT-L3 DEXA. (J Rheumatol 2005;32:292–4)

Key Indexing Terms:
ANKYLOSING SPONDYLITIS
BONE MINERAL DENSITY
OSTEOPOROSIS
SYNDESMOPHYTE

Ankylosing spondylitis (AS) is characterized by inflammation of entheses and paravertebral structures, leading in time to bone formation at those sites. As well, vertebral bone loss is also a recognized feature of AS[1]. The most popular modality to assess bone mineral density (BMD) in patients with AS is dual energy x-ray absorptiometry (DEXA). However, some features of late-stage disease, such as syndesmophytes and spinal ossifications as well as severe kyphosis that may lead to improper positioning of the patient during the procedure, may result in problems assessing the vertebral BMD by conventional posteroanterior projection (PA DEXA). It was reported that the lateral decubitus projection at the L3 vertebra (LAT-L3 DEXA) was a more sensitive indicator of vertebral BMD than the conventional PA DEXA[2]. It is possible that a LAT-L3 DEXA scan may be a more accurate indicator of the vertebral BMD not only in early but also in advanced disease, as this projection does not include syndesmophytes. To our knowledge, no association between syndesmophytes and BMD of LAT-L3 DEXA has been reported.

We investigated the association of syndesmophytes with vertebral BMD measured by PA and LAT-L3 DEXA scans in patients with long-standing AS.

MATERIALS AND METHODS

Subjects. Male patients with definite AS who met the modified New York criteria[3] were eligible for the study. Exclusion criteria were presence of spondyloarthropathy secondary to inflammatory bowel disease or psoriasis, hepatic and renal failure, hyperparathyroidism, hyperthyroidism, diabetes, alcoholism, malnutrition, obesity, and present or past use of corticosteroid or any other medication known to affect the bone metabolism. The control group comprised 23 age matched healthy men.

All subjects underwent a thorough physical examination. Duration of morning stiffness (in minutes) and spinal mobility (measured by Schober test) of the subjects were recorded. Spinal pain was assessed using a 100 mm visual analog scale.

Radiological assessment. An anteroposterior radiograph of the pelvis and anteroposterior and lateral radiographs of the lumbar spine were taken in all patients. For assessment of sacroiliitis, radiographs of the pelvis were scored on a 5-point scale to obtain a sacroiliac score (SIS), as described[3]. To obtain a lateral spine score (LSS), anterior and posterior margins of each intervertebral space from L1-L2 to L4-L5 were scored as follows: 0 = no syndesmophytes, 1 = nonbridging syndesmophytes, or 2 = bridging syndesmophytes[4]. Lateral radiographs were also assessed qualitatively for vertebral compression fractures. All radiographs were assessed and scored by a single investigator, who was not blinded to patients and controls.

Bone mineral assessment. BMD of the left femoral neck (in one patient with left total hip arthroplasty, measurement was performed at the right hip) and the lumbar spine (posteroanteriorly at the L2–L4 vertebrae and laterally at the L3 vertebra) were measured by DEXA (Norland XR-36, Fort

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Supported in part by the Turkish League Against Rheumatism (RASD) and Akdeniz University Scientific Research Projects Unit.

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Submitted December 10, 2003; revision accepted October 15, 2004.

Atkinson, WI, USA). Scans were performed within the same week after the radiographs were taken. LAT-L3 DEXA was carried out using the decubitus method, in which subjects lie on their side. Calibration with a femoral and lumbar spine phantom was performed daily. In our laboratory, the coefficient of variation for repeated measurements is 1.0% for PA L2-L4, 2.7% for LAT-L3, and 1.2% for the femoral neck. T scores provided by the manufacturer were taken into evaluation.

Statistical analysis. Mann-Whitney U test was used to compare the variables of the patients and controls. The McNemar test was used to compare paired proportions. Spearman correlation coefficients were calculated for each group to test for associations of the BMD measurements with each other, with demographic and clinical variables, and with radiological scores. A p value < 0.05 was considered statistically significant. SPSS for Windows version 10.0 was used for these analyses.

RESULTS

Twenty-six patients were screened and 6 were excluded from the study (2 obesity, one taking corticosteroid, 2 diabetes, and one had excessive consumption of alcohol). Twenty patients aged between 25 and 63 years were enrolled in the study. Of these, 2 had juvenile onset AS. The duration of disease was 16.7 ± 11.0 years (range 4–43).

Eleven patients were taking nonsteroidal antiinflammatory drugs and 5 were taking sulfasalazine. Nine patients had peripheral joint involvement. The patients' mean Schober test result was 2.4 ± 1.1 cm (Table 1).

No patient had lumbar vertebral fractures. Lateral lumbar radiographs showed syndesmophytes in 12 patients. SIS and LSS were positively correlated with disease duration (r = 0.60 and 0.56, p = 0.011 and 0.006, respectively) and age (r = 0.62 and 0.58, p = 0.004 and 0.007, respectively).

BMD from the PA L2-L4 was not significantly different between the patients and controls. However, a significant reduction was observed in BMD of LAT-L3 of the patients compared to the controls (p = 0.009; Table 2). There was also a significant reduction in femoral neck BMD of the patients (p = 0.038). The corresponding T scores of LAT-L3 and the femoral neck were also decreased in the patients (Table 2); however, only one patient and no control was osteoporotic according to the LAT-L3 T score, whereas 4 patients and 3 controls were osteoporotic according to the T scores from PA DEXA. PA DEXA was more sensitive than LAT-L3 DEXA to detect the osteoporotic cases (p = 0.003).

In patients, BMD measurements at LAT-L3 were significantly correlated with PA L2-L4 and femoral neck: r (corrected for LSS) = 0.54 and 0.62, p = 0.018 and 0.005, respectively. In controls, BMD of LAT-L3 was significantly correlated with BMD of PA L2-L4 (r = 0.67, p = 0.001), but not with BMD of femoral neck.

LSS was significantly correlated with BMD of PA L2-L4 (r = 0.55, p = 0.013), but not with BMD of LAT-L3 or femoral neck. SIS was associated with none of the BMD measurements.

Spinal pain was significantly correlated with BMD of LAT-L3 (r = 0.49, p = 0.028). Neither morning stiffness nor Schober test score was found to be associated with BMD of any site. Disease duration was significantly correlated with BMD of PA L2-L4 (r = 0.52, p = 0.019), but not with BMD of LAT-L3 or femoral neck.

Table 1. Clinical, laboratory, and radiological characteristics of patients. Data presented as mean ± SD (range) or median (range).

Disease duration, yrs	16.7 ± 11.0 (4–43)
Spinal pain, 100 mm VAS	36.0 ± 25.6 (0–86)
Morning stiffness, min	28.5 ± 28.4 (0–90)
Schober test, cm	2.4 ± 1.1 (0.6–4.1)
Median sacroiliac score, 0–4	8 (4–8)
Median lumbar spine score, 0–8	1.5 (0–8)

VAS: visual analog scale.

DISCUSSION

Syndesmophytes and ankylosed zygapophyseal joints in advanced AS are included in conventional DEXA scans. A spinal bone mass measurement of this kind may deceptively prove to be normal[2,5] or even increased[6,7]. Such an increase of BMD in advanced AS may mislead clinicians about the bone mineral status of patients with AS. Our results confirm the findings of previous studies that BMD measured by PA DEXA did not differ significantly between the patients with AS and controls. Although El Maghraoui, *et al*[8] found an insignificant association between syndesmophyte score and lumbar spine T score, we observed that BMD measured by PA DEXA was significantly correlated with LSS. Only in a few of previous studies have syn-

Table 2. BMD of patients and controls. Data presented as mean ± SD.

	AS	Controls	p*
Posteroanterior lumbar spine (L2–L4)			
BMD, g/cm^2	0.99 ± 0.19	0.99 ± 0.13	0.981
T score	–1.07 ± 1.55	–1.07 ± 1.12	1.000
Lateral lumbar spine (L3)			
BMD, g/cm^2	0.64 ± 0.13	0.73 ± 0.10	0.009
T score	–0.64 ± 1.37	0.40 ± 1.10	0.009
Femoral neck			
BMD, g/cm^2	0.87 ± 0.13	0.93 ± 0.10	0.038
T score	–0.03 ± 1.02	0.47 ± 0.81	0.041

* Mann-Whitney U test. BMD: bone mineral density.

desmophytes been scored to determine their association with BMD measured by conventional DEXA; however, these studies lacked BMD measurements by LAT-L3 DEXA[8,9]. Patients with syndesmophytes were even excluded from several studies to decrease their confounding effects on lumbar spine BMD measurements[10,11]. Our results confirm the theory that BMD measurements by LAT-L3 DEXA in patients with AS are not falsified by the presence of syndesmophytes.

The proximal femur is another site commonly measured by DEXA. We observed a significant difference in femoral neck BMD between patients and controls. Bronson, *et al*[2] found that BMD at the femoral neck was significantly lower in the patients with AS compared to controls. It has been suggested that BMD of femoral neck is significantly decreased in late AS, but it is debatable whether this is so in early disease[5,10,12]. Because of the controversy whether DEXA of the femoral neck can detect bone loss in patients with AS, this method is not accepted universally for measurement of BMD in patients with AS. Moreover, it is impossible for patients with bilateral total hip arthroplasty to undergo this method.

As for the LAT-L3 DEXA scan, it has the advantage of isolating the body of L3 vertebra from the ankylosed zygapophyseal joints, anterior or posterior syndesmophytes, the ribs, and the ilium. In this method, patients lie on their side, thus kyphotic patients can undergo an easier procedure. While our patients did not have lateral superposition of ribs or iliac crest on vertebral body of L3, one should be cautious interpreting a LAT-L3 DEXA of a severely kyphotic patient. Consistent with our findings, Bronson, *et al*[2] demonstrated as well that the LAT-L3 projection was more sensitive in detecting decreased vertebral BMD in AS patients. In their study they enrolled patients with longstanding disease; however, they did not describe the radiographic features of their patients regarding the status of syndesmophytes. Our findings suggest that syndesmophytes do not give rise to misinterpretations in evaluating the BMD of LAT-L3 DEXA. Although we did not score the zygapophyseal joints separately, it is well established that zygapophyseal joint involvement and the presence of syndesmophytes in AS are correlated[13].

Not using well known indices such as the Bath AS Disease Activity Index (BASDAI) and the Bath AS Functional Index (BASFI) to evaluate disease activity and functional status may be regarded as a drawback of our study; however, validated Turkish versions of those indices are not available at present. Nor did we use the Bath AS Radiology Index, because it hardly changes with each additional syndesmophyte[14]. Instead, we used a specific scoring with regard to the PA DEXA scan, that is, L2–L4 vertebral levels.

Although we found that osteoporotic cases were identified more easily by PA DEXA than LAT-L3 DEXA, osteoporosis detected and BMD measured by PA DEXA did not differ significantly between patients and controls. On the other hand, the official position of the International Society for Clinical Densitometry for the lateral spine is not to use it for the diagnosis of osteoporosis[15]. Similarly, we found fewer osteoporotic cases by LAT-L3 DEXA compared to PA DEXA. However, only vertebral BMD measured by LAT-L3 DEXA differed significantly between patients and controls.

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