Psoriatic Arthritis Spondylitis Radiology Index: A Modified Index for Radiologic Assessment of Axial Involvement in Psoriatic Arthritis

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ABSTRACT. ***Objective.*** To develop and validate a modified index for assessing the radiologic axial involvement in psoriatic arthritis (PsA) in a group of patients with established disease.

Methods. Patients were included on clinical and/or radiologic criteria. The modified index combined features of existing radiologic indices for ankylosing spondylitis (AS) with the addition of scores for the facet joints of the cervical and lumbar regions. Scores for the Bath AS Radiology Index (BASRI), the modified Stoke AS Scoring System (mSASSS), and the new index were obtained from current radiographs. The construct validity of the new index was assessed by examining the correlation with patient reported outcomes, such as the Revised Leeds Disability Questionnaire (RLDQ) and Bath AS Functional Index (BASFI), and anthropometric measures.

Results. Radiographs were available for 73 patients (54 men, 19 women, mean age 49.4 ± 11.0 yrs, mean disease duration 14.0 ± 7.9 yrs). Due to difficulty in visualizing and interpreting the lumbar facet joints, only the cervical facet joints were included in the new score, called the PsA Spondylitis Radiology Index (PASRI). Overall, the PASRI resulted in less missing data than the mSASSS, but had less complete data than the BASRI. The PASRI also had fewer zero scores than the mSASSS and the score range for the PASRI exceeded that of the mSASSS and the BASRI. Correlation with anthropometric and patient reported outcomes was good for both the PASRI and BASRI, with both these measures outscoring the mSASSS.

Conclusion. The PASRI encompasses a greater range of the spinal radiologic features of PsA, provides a greater score range and fewer zero scores, and correlates well with anthropometric and patient reported measures. (J Rheumatol First Release April 1 2009; doi:10.3899/jrheum.080491)

Key Indexing Terms:
PSORIATIC ARTHRITIS SPINE RADIOGRAPHY OUTCOME ASSESSMENT

Axial involvement in psoriatic arthritis (PsA) differs, both quantitatively and qualitatively, from that found in ankylosing spondylitis (AS)[1]. The main radiographic features of psoriatic spondylitis, originally described by McEwen and colleagues[2], can be summarized as follows: (1) asymmetrical and less severe grades of sacroiliitis; (2) nonmarginal syndesmophytes; (3) asymmetrical syndesmophytes; (4) paravertebral ossification; and (5) more frequent involvement of cervical spine. Other authors have demonstrated a high frequency of fusion of the posterior elements (facet or zygo-apophyseal joints) of the cervical spine in PsA[3,4]. One additional feature that may distinguish psoriatic from classical AS is the occurrence of spondylitis without radiologic evidence of sacroiliitis[5].

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There are validated scoring methods developed for the assessment of the spine and sacroiliac joints in AS: the Bath AS Radiology Index (BASRI)[6], and a modification of the Stoke AS Spine Score (mSASSS)[7]. The BASRI was later modified as BASRI-total, which included an assessment of the hips. Both these instruments were developed on radiographs of people fulfilling classification criteria for AS, although patients with psoriasis may have been included. Chandran, *et al* have reported that the mSASSS correlates well with spinal mobility measurements in psoriatic spondylitis[8], but further data on the validity of these existing scoring methods for axial involvement and on their individual performance in psoriatic spondylitis are clearly needed.

The aim of our study was to develop a modified index (The PsA Spondylitis Radiology Index, PASRI) for the radiologic assessment of axial involvement in patients with PsA, and to compare the modified index with the 2 existing instruments for assessing AS — the BASRI and the mSASSS.

MATERIALS AND METHODS

Development of the modified index. Our aim was to combine features of the 2 existing measures for assessing AS (BASRI and mSASSS) and to add an assessment of the posterior elements.

The mSASSS scores every corner of the anterior site of the lumbar and cervical vertebrae on a scale from 0 to 3, where 0 indicates no abnormality; 1 indicates erosions, sclerosis, or squaring; 2 indicates a syndesmophyte; and 3 indicates a bridging syndesmophyte. The total score ranges from 0 to 72. The cervical spine is scored from the lower border of the second cervical vertebra to the upper border of the first thoracic vertebra, and the lumbar spine is scored from the lower border of the 12th thoracic vertebra to the upper border of the sacrum. To allow for poor visualization of the lower cervical and upper lumbar vertebrae, the adjustment suggested by Wanders, *et al* was employed so that if > 3 scoring sites were missing, the radiographs were excluded. If 3 or fewer sites were missing, the mean of the other scoring sites was used as a substitute for the missing sites[9].

The new score for our study, a modification of the mSASSS and the BASRI, assessed the sacroiliac joints using the New York scale[10] and utilized the mSASSS scoring system from the lower border of C2 to the upper border of C6 and the lower border of T12 to the upper border of S1. In addition, scores for cervical facet joints at 4 levels (C2/3, C3/4, C4/5, C5/6) and lumbar facet joints at 6 levels (T12/L1, L1/L2, L2/L3, L3/L4, L4/L5, L5/S1) were included. The cervical facet joints were evaluated on a plain lateral view without flexion and extension: the overlapping left and right facet joints were scored in pairs, at the same level, as 1 (fused) or 0 (not fused). An example is given in Figure 1. The lumbar facet joints were evaluated on both plain lateral and antero-posterior (AP) views: oblique radiographs were not obtained. The modified index had a score range of 0–78.

Study design. This was a multicenter study involving patients with PsA. Inclusion criteria were: (1) satisfaction of ClASsification of Psoriatic ARthritis (CASPAR) classification criteria[11]; and (2) the presence of clinical (spinal inflammatory pain by the Calin criteria[12]) and/or radiologic axial involvement, regardless of the disease duration.

The study was carried out in 6 rheumatology units throughout Italy and the patients were recruited consecutively at the outpatient clinics from January to December 2006. All patients gave their written informed consent and the study protocol was approved by the local ethical committees.

Standard AP and lateral radiographs of the cervical and lumbar spine, and AP radiographs of the pelvis were performed in all patients enrolled. The radiographs were mostly hard copy (3 were digital images) and were sent to a central point where each radiograph was evaluated simultaneously by 3 rheumatologists, each with many years' experience in scoring spinal radiographs in PsA (EL, AM, PSH). The radiographs were assessed using the BASRI-total, the mSASSS (both on 2 separate occasions), and the modified index. Clinical and functional assessments included cervical rotation, tragus to wall distance, occiput to wall, modified Schöber's method for lumbar flexion, chest expansion, inter-malleolar distance, and finger to floor distance, Bath AS Metrology Index (BASMI)[13], in addition to the patient reported measures the Bath AS Functional Index (BASFI)[14], Health Assessment Questionnaire (HAQ)[15], and Revised Leeds Disability Questionnaire (RLDQ)[16].

Statistical analysis. Descriptive data were expressed, if not otherwise specified, as mean ± standard deviation (SD). The construct validity of the existing and modified indices was assessed by examining correlation (Spearman rho) with measures of spinal mobility and patient reported measures. Statistical significance was accepted at $p < 0.05$. Test-retest reliability for the BASRI and the mSASSS was evaluated with the intraclass correlation coefficient (ICC), using a mixed model in the reliability procedure in SPSS v15.0.

RESULTS

Seventy-seven patients were enrolled but analyzable spinal radiographs were only available for 73 (54 men, 19 women), mean age 49.4 ± 11.0 years, disease duration 14.0 ± 7.9 years. This group was characterized by the following clinical measurements (median and range): cervical rotation, degree (45, 0–90); tragus to wall, cm (13, 7–28); occiput to wall, cm (2, 0–24); chest expansion (xiphisternum), cm (3.3, 0.5–5.5); chest expansion (nipple), cm (3, 1–7); modified Schöber, cm (4, 0–9); finger to floor distance, cm (20, 0–70); inter-malleolar distance, cm (98, 45–126); BASMI (3, 0–8); BASFI (2.5, 0–9.2); HAQ (0.75, 0–2.875); and RLDQ (1, 0–3).

Some missing data resulted in the following numbers with complete data for full evaluation: PASRI 60 (82%) and BASRI 64 (88%). Without invoking the Wanders modification only 43 patients had complete data for the mSASSS; using the modification enabled 56 (77%) patients to be evaluated. Cervical spine involvement was found in 27 (37%) and lumbar in 29 (40%).

PASRI facet joint scores. Table 1 gives the individual scores for the facet joint involvement in the cervical and lumbar spine. Although the cervical facet joints were relatively easy to see and interpret, the lumbar joints were more difficult owing to projection problems, despite having both AP and lateral views. As a result of this it was decided to omit the lumbar facet joints from the modified score. The final modified index, named the PsA Spondylitis Radiology Index (PASRI) is given in Table 2.

Comparison of PASRI, mSASSS, and BASRI. The scores are compared in Table 3. Overall, the PASRI resulted in fewer missing data than the mSASSS but had less complete data than the BASRI. The PASRI also had fewer zero scores than the mSASSS and the score range for the PASRI exceeded that of the mSASSS and the BASRI. In 4 cases the cervical radiologic subscores for the BASRI and mSASSS were zero in the presence of cervical facet joint ankylosis. However, in

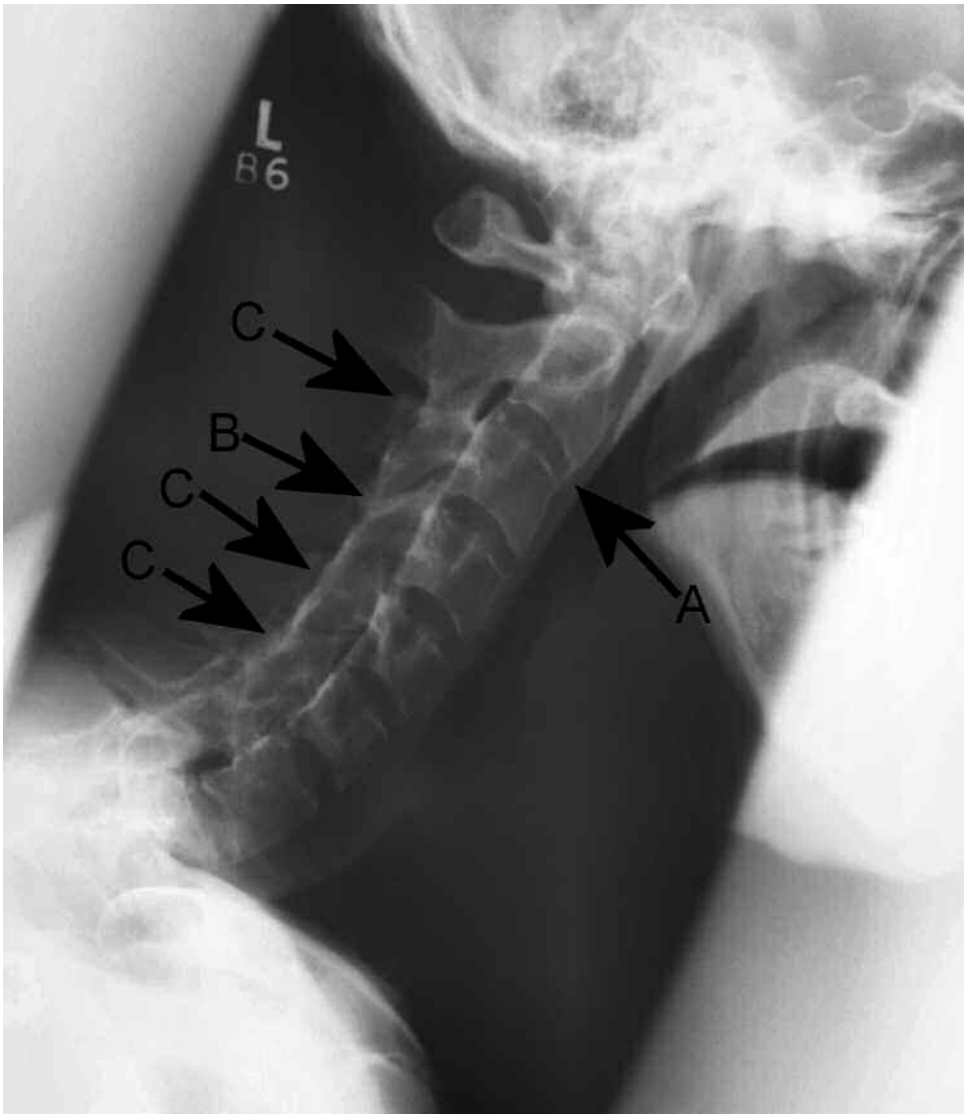

Figure 1. Lateral cervical spine radiograph in psoriatic arthritis. For the purposes of scoring, the syndesmophyte at C2/C3 (A) was scored as grade 3 for both vertebral corners. The other vertebral bodies do not show any abnormalities. The pair of facet joints at B were scored 0, whereas the facet pairs at the other levels (C) were scored 1. Total score for the cervical spine = 9.

Table 1. Scores for facet joint ankylosis at each level. Missing data were due to difficulties interpreting the radiographs (n = 73).

Facet Level	No Ankylosis	Ankylosis	Missing Data
C2–C3	53	16	4
C3–C4	54	14	5
C4–C5	58	10	5
C5–C6	57	11	5
T12–L1	52	5	16
L1–L2	52	6	15
L2–L3	53	6	14
L3–L4	52	8	13
L4–L5	52	8	13
L5–S1	47	6	20

5 cases the facet joints were normal but abnormalities of the vertebral bodies were seen.

Correlation with anthropometric and other measures. Table 4 gives the Spearman rho values for the correlation between the 3 radiologic scores and the anthropometric and other data. For this analysis only patients with non-zero radiologic scores were included. A number of significant correlations were found between the PASRI, BASRI, anthropometric, and patient reported outcome measures as indicated. However, mSASSS demonstrated fewer significant correlations in this analysis.

Time to complete the scoring. No formal measurements of the time taken to complete each of the scores were made, but

Table 2. The PASRI (Psoriatic Arthritis Spondylitis Radiology Index) score.

Sacroiliac joint
- score each sacroiliac joint individually from 0–4 (using the New York criteria) and sum the score
- score range 0-8

Lumbar spine:
- score the lower border of T12 to the upper boarder of S1
- use both antero-posterior and lateral views
- use the mSASSS grading: 0–3 (0 normal; 1 erosion, sclerosis, squaring; 2 syndesmophyte non-bridging; 3 bridging syndesmophyte)
- score range 0–36

Cervical spine
- score the lower border of C2 to the upper border of C6
- use only lateral views
- use the mSASSS grading: 0–3 (0 normal, 1 erosion, sclerosis, squaring; 2 syndesmophyte non-bridging; 3 bridging syndesmophyte)
- add 1 point for every level fused posteriorly (C2/C3, C3/C4, C4/C5, C5/C6)
- score range 0–28

Total score range: 0–72

Table 3. Scores on the 3 measures.

Measure	n	Excluded due to Missing Data, n (%)	Zero Scores, n (%)	Score Range	Median	IQR	Minimum to Maximum
BASRI	73	9 (12)	29 (48)	2–16	2.25	7.9	0–14
mSASSS	73	17 (23)	37 (62)	0–72	0	4.0	0–42
PASRI	73	13 (18)	28 (47)	0–72	4	15.5	0–64

IQR: interquartile range; BASRI: Bath Ankylosing Spondylitis (AS) Radiology Index; mSASSS: modified Stoke AS Spine Score; PASRI: Psoriatic Arthritis Spondylitis Radiology Index.

Table 4. Relationship between PASRI, BASRI, and mSASSS, anthropometric measures, and patient reported measures.

	PASRI	BASRI	mSASSS
N	32	30	19
PASRI		0.80***	0.94***
Cervical rotation	–0.30	–0.41*	–0.15
Tragus to wall	0.40*	0.46*	0.36
Occiput to wall	0.41*	0.38*	0.30
Chest expansion (xiphisternum)	–0.15	–0.34**	0
Chest expansion (nipple)	–0.28	–0.61**	–0.33
Modified Schöber	–0.49**	–0.54**	–0.49**
Finger to floor	0.54**	0.44**	0.42
Intermalleolar distance	–0.36*	–0.69**	–0.01
BASNI	0.60**	0.65**	0.46
BASFI	0.50**	0.51**	0.36
RLDQ	0.47**	0.46**	0.22

Note: patients who scored zero on the radiologic measures were excluded from this analysis. Reported data are Spearman rho. BASMI: Bath AS Metrology Index; RLDQ: Revised Leeds Disability Questionnaire. For other abbreviations, see Table 3. *** Correlation is significant at the 0.0001 level (2–tailed). ** Correlation is significant at the 0.01 level (2–tailed). * Correlation is significant at the 0.05 level (2–tailed).

the PASRI was comparable to the mSASSS in time taken to make the complete assessment. The detailed scoring of the vertebral corners involved in the PASRI and the mSASSS ensured that these measures took longer to complete than the BASRI.

Test-retest reliability. Test-retest reliability figures were available for the BASRI-total and mSASSS. The scores for the ICC were 0.97 [95% confidence interval (CI) 0.907–0.963] for the BASRI and 0.98 (95% CI 0.966–0.987) for the mSASSS.

DISCUSSION

Although differences between PsA and AS have been described, clinicians can readily appreciate that some patients with PsA have axial involvement that is indistinguishable from AS, while other patients appear to show characteristic features: asymmetry, non-marginal syndesmophytes, paravertebral ossification, and fusion of the cervical posterior elements. Clearly, any instrument designed to assess radiologic severity and progression has to take into account both the classical and differential features. The new index for assessing psoriatic spondylitis additionally and separately considers the posterior elements of the cervical spine, and thus is a simple modification of one of the existing instruments. The PASRI therefore extends and improves the radiologic assessment of axial PsA. However, ours is a preliminary study and further validation of this index is clearly required.

Incorporation of other distinctive and distinguishing features of psoriatic spondylitis was considered, but was rejected on the following grounds. There is no clear radiologic definition of non-marginal syndesmophytes: although these have been described as more bulky and distinct from the corner of the vertebral body[1], including a scoring system for these was considered to introduce too much interobserver bias. Should a valid and reliable definition be introduced it may be possible to incorporate this feature into a new radiologic score. Paravertebral ossification was also considered, but rejected on the grounds that this feature is too infrequent to be of use in such a radiologic score[17]. A method of scoring asymmetry (based on that suggested for peripheral joints[18]) was also considered but not included, as it was felt that this was a quantitative rather than a qualitative difference, as suggested for the peripheral joint involvement of PsA.

Visualization of the spinal facet joints on plain AP and lateral radiographs is sometimes difficult. This is particularly so for the thoraco-lumbar spine. However, we found little difficulty in visualizing and interpreting the cervical facet joints, probably because of the orientation of these joints to the incident beam of the radiation. The cervical facet joints are more horizontal and face slightly inferior and posterior in the transverse plane, making them easier to see in the standard lateral view. For the lumbar spine, the more vertical orientation with overlapping anterior and posterior edges makes them hard to interpret in the standard lateral radiograph. However, it is possible to visualize some of the lumbar facet joints on the AP view, but degenerative changes and the necessary oblique angle of the incident radiation (the beam is usually focused on L4) in many of the joints make complete assessment difficult. For this reason it is usual to conduct plain radiography of the lumbar facet joints with standard oblique views. Although taking oblique views of the lumbar spine would have enabled us to visualize the lumbar facet joints, we did not consider the additional radiation exposure to be justified. For the same reasons, additional views of the cervical spine were not carried out.

Although the BASRI was quicker to perform than both the PASRI and mSASSS, the scoring rules for the BASRI do not allow detailed assessment of the posterior elements. Further, if the BASRI were used it would need further modification, as it was designed to have a minimum score of 2 (at least bilateral sacroiliitis grade 2), but in PsA it is possible to have axial involvement without radiologic sacroiliitis[5,19], thus creating the chance of zero scores. In our study, nearly 10% of patients had radiologic changes in the cervical and lumbar spine in the absence of radiologic sacroiliitis.

The ASessment in Ankylosing Spondylitis (ASAS) group has endorsed the mSASSS as the preferred method to assess structural change and to assess progression of structural damage in clinical trials. This decision was based on such factors as floor and ceiling effects, validity, and sensitivity to change[9]. It is appropriate, therefore, to have a modified index for PsA based on the mSASSS. The addition of the posterior elements is a relatively minor modification, but it clearly enhances the correlations with anthropometric and, in particular, the patient reported outcomes compared to the mSASSS (Table 4). In fact, correlations between mSASSS and anthropometric measures were much worse than those reported by Chandran, *et al*[8], where mean scores for both clinical and radiographic measures were comparable. However, the correlations between mSASSS and clinical measures were largely comparable to those reported by Wanders, *et al*[9], where patients had both a longer duration of disease and more severe impairment. In our study the correlations between the PASRI and clinical measures were not so different from the BASRI, which is of interest, as the BASRI scoring system can incorporate an evaluation of fusion in the posterior elements, albeit in an ordinal manner.

Our study has provided information on a new radiologic score for assessing spinal structural damage in PsA that extends and incorporates features of both the BASRI and mSASSS. Both the PASRI and BASRI appear valid for the radiologic assessment, but the PASRI offers more scope for measuring change and has greater face validity. Further information is required on progression with time as it is not anticipated that improvement, due to efficacious treatment, for example, will occur in these scores.

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