International Spondyloarthritis Interobserver Reliability Exercise — The INSPIRE Study: II. Assessment of Peripheral Joints, Enthesitis, and Dactylitis

DAFNA D. GLADMAN, ROBERT D. INMAN, RICHARD J. COOK, WALTER P. MAKSYMOWYCH, JURGEN BRAUN, JOHN C. DAVIS, ROBERT B.M. LANDEWÉ, PHILIP MEASE, JOACHIM BRANDT, RUBEN BURGOS VARGAS, VINOD CHANDRAN, PHILIP HELLIWELL, ARTHUR KAVANAUGH, FINBAR D. O'SHEA, MUHAMMAD A. KHAN, NICOLO PIPITONE, PROTON RAHMAN, JOHN D. REVEILLE, MILLICENT A. STONE, WILLIAM TAYLOR, DOUGLAS J. VEALE, and DESIRÉE van der HEIJDE

ABSTRACT. ***Objective.*** To determine whether the assessments of peripheral joints and enthesitis were reproducible for both AS and PsA with axial disease, and whether dactylitis assessment is reproducible in patients with PsA.

Methods. A group of 20 rheumatologists from 11 countries with expertise in spondyloarthritis (SpA) met for a combined physical examination exercise to assess 10 patients with PsA with axial involvement (9 men, 1 woman, mean age 52 yrs, disease duration 17 yrs) and 9 patients with AS (7 men, 2 women, mean age 38 yrs, disease duration 16 yrs). A modified Latin-square design that enabled assessment of patient, assessor, and order effect was used. Measures included were number of tender and swollen joints, presence of enthesitis using 6 different indices, and dactylitis score. Data were analyzed using intraclass correlation (ICC) adjusted for order of measurements.

Results. The majority of the variance was contributed by the patients. There was no order effect. The assessment of tender joints (ICC 0.69) was more reliable than the assessment of swollen joints (ICC 0.54). Moreover, there was better agreement in patients with PsA (ICC 0.78) than in patients with AS (ICC 0.62). There was excellent agreement on the number of active enthesitis sites (ICC 0.86). All the enthesitis indices provided substantial to excellent agreement among observers. Agreement for the dactylitis score was substantial (ICC 0.70).

Conclusion. The assessment of peripheral joints is more reliable in patients with PsA. Enthesitis instruments can be used reliably in patients with AS and patients with PsA with spinal involvement. The Leeds dactylitis instrument functions well in PsA. (First Release July 15 2007; J Rheumatol 2007;34:1740–5)

Key Indexing Terms:

SPONDYLOARTHRITIS	RELIABILITY	ASSESSMENT
PERIPHERAL JOINTS	ENTHESITIS	DACTYLITIS

From the Centre for Prognosis Studies in the Rheumatic Diseases, University of Toronto, Toronto, Ontario, Canada.

Supported by the SPARCC NRI grant from The Arthritis Society, Canada, the Krembil Foundation, and unrestricted funds from Abbott Canada, Amgen/Wyeth Canada, Schering Canada, Pfizer Canada, and Wyeth Global. R.J. Cook is Canada Research Chair in Statistical Methods for Health Research. W.P. Maksymowych is a Senior Scholar of the Alberta Heritage Foundation for Medical Research. V. Chandran is an Ogryzlo Fellow of The Arthritis Society, and Arthritis Centre of Excellence Fellow, University Health Network, Toronto. F.D. O'Shea is supported by an Irish Society for Rheumatology Traveling Fellowship. M.A. Stone is supported by the Cumming AS Visiting Professorship Award.

D.D. Gladman, MD, FRCPC; R.D. Inman, MD; V. Chandran, MD; F.D. O'Shea, MD, University of Toronto, Toronto, Ontario, Canada; R.J. Cook, MD, Department of Statistics and Actuarial Science, University of Waterloo, Waterloo, Ontario, Canada; W.P. Maksymowych, FRCPC, Department of Rheumatology, University of Alberta, Edmonton, Alberta, Canada; J. Braun, MD, Rheumazentrum, Ruhrgebiet, Herne, Germany; J.C. Davis, MD, Department of Rheumatology, Allergy and Immunology, University of California, San Francisco, California, USA; R.B.M. Landewé, MD, PhD, Department of Rheumatology, University Hospital Maastricht, Maastricht, The Netherlands; P. Mease, MD, Swedish Medical Center, Seattle, Washington, USA; J. Brandt, MD, Rheumatologische, Praxisgemeinschaft, Berlin, Germany; R. Burgos Vargas, MD, Rheumatology Unit, Hospital General de Mexico, Mexico City, Mexico; P. Helliwell, MD, PhD, University of Leeds, Leeds, United Kingdom; A. Kavanaugh, MD, Department of Rheumatology, Allergy and Immunology, University of California, San Diego, California, USA; M.A. Khan, MD, Department of Medicine, Case Western Reserve University, Cleveland, Ohio, USA; N. Pipitone, MD, U.O. di Reumatologia, Arcispedale S. Maria Nuova, Reggio Emilia, Italy; P. Rahman, MD, Department of Rheumatology, Memorial University, St. John's, Newfoundland, Canada; J.D. Reveille, MD, University of Texas Health Sciences Centre, Houston, Texas, USA; M.A. Stone, MD, Department of Rheumatology, University of Toronto, Toronto, Royal National Hospital for Rheumatic Diseases, Bath, United Kingdom; W. Taylor, MBChB, FRACP, FAFRM, Rehabilitation Teaching and Research Unit, Wellington School of Medicine and Health Sciences, University of Otago, Wellington, New Zealand; D.J. Veale, MD, Rheumatology, St. Vincent's University Hospital, Dublin, Ireland; D. van der Heijde, MD, PhD, Department of Rheumatology, Leiden University Medical Center, Leiden, The Netherlands.

Address reprint requests to Dr. D.D. Gladman, Toronto Western Hospital, University Health Network, 399 Bathurst Street, 1E410B, Toronto, Ontario M5T 2S8, Canada. E-mail: dafna.gladman@utoronto.ca

Accepted for publication April 6, 2007.

Ankylosing spondylitis (AS) is an inflammatory arthritis affecting primarily the joints of the spine and the sacroiliac joints[1]. Psoriatic arthritis (PsA) is an inflammatory arthritis associated with psoriasis[2]. Clinical and genetic differences between these 2 entities have been documented[3]. Radiological differences in spinal disease have also been documented[3,4]. While patients with AS have more severe spondylitis, patients with PsA have more severe peripheral arthritis. Peripheral joint assessment in PsA has been shown to be reliable both in a single clinic study[5] and in the SPondyloArthritis Research Consortium Canada (SPARCC) study[6]. However, systematic evaluation of dactylitis and enthesitis has not been performed. Moreover, the reliability of peripheral joint assessment in AS has not been described.

At OMERACT 7 (Outcome Measures in Rheumatology; Asilomar, California, May 2004) the PsA workshop identified domains to be included in clinical trials and observational cohort studies in PsA[7]. In addition to the assessment of peripheral joint disease, participants recognized the importance of enthesitis and dactylitis in PsA. However, the instruments to assess these domains were not identified. Indeed, the randomized controlled trials in PsA to date have included peripheral arthritis[8-13], but the assessment of dactylitis and enthesitis was included in only 3 of these trials[11-13], and used methods that had not been validated. A PsA module at OMERACT 8 did not include dactylitis and enthesitis as core domains that must be included in clinical trials and observational cohorts in PsA, but did recommend that enthesitis and dactylitis be further investigated[14].

The ASsessment in Ankylosing Spondylitis International Society (ASAS) core outcome measures for AS do include enthesitis, although the specific measure remains to be determined[15]. This may be partly due to the fact that although several methods are used to define enthesitis, none has been extensively validated. Several different instruments have been proposed to measure enthesitis in AS. The Mander index[16], which includes 66 sites, is considered cumbersome to use and does not adequately distinguish enthesitis sites from fibromyalgia tender points. The Maastricht Ankylosing Spondylitis Enthesis Score (MASES) was developed from the Mander index, and the number of sites was reduced to 13[17]. However, its reliability was only assessed indirectly, and responsiveness was proven in a clinical trial[18]. The SPARCC group assessed 8 enthesitis sites (all included among the MASES sites) in its reliability study[6], and these sites showed fair to moderate reliability. An 18-site enthesitis index has now been developed and validated by SPARCC investigators, but comparative studies with other indices have yet to be reported[19]. The Berlin group used a 12-site enthesitis index to assess enthesitis in recent studies[20]. The San Francisco group also introduced an enthesitis index, which includes several other sites not present in the other indices. Recently, an enthesitis index specific for PsA was derived from patient data and termed the Leeds Enthesitis Index (LEI)[14]. A simple enthesitis measure including only 4 sites was included in the infliximab trials in psoriatic arthritis (IMPACT and IMPACT 2[11,12]). Table 1 gives the sites included in the various instruments.

Dactylitis is described as a swelling of the whole digit and is thought to reflect synovitis as well as extraarticular inflammation (i.e., tenosynovitis, enthesitis) in the affected digit[21]. In clinical trials only the numbers of digits with dactylitis have been measured, and only in a limited number of trials. Recently a new method to assess dactylitis has been reported, the Leeds Dactylitis Index[22,23].

The purpose of this study was to determine the reproducibility of peripheral joint and enthesitis assessment among patients with AS and with PsA with spinal involvement. In addition we aimed to determine the reliability of the assessment of dactylitis in patients with PsA.

MATERIALS AND METHODS

Patient selection. Nine patients with AS with varying degrees of mobility and presence of peripheral joint involvement and enthesitis were selected from the AS clinic at the Toronto Western Hospital, Toronto, Canada. These included 7 men and 2 women, with a mean age of 38 years and mean disease duration 16 years. All met the modified New York criteria for the classification of AS[24]. Ten patients with PsA and radiological evidence of spinal disease including at least grade 2 sacroiliitis, with or without syndesmophytes, were selected from the PsA clinic in the same institution to reflect variable extent of joint inflammation and spinal mobility. These included 9 men and 1 woman, with mean age 52 years and mean disease duration 17 years.

Observers. Observers consisted of a group of 20 rheumatologists from 11 countries with expertise in spondyloarthritis (SpA), including 10 with expertise in AS and 10 with expertise in PsA. These were members of the Assessment in Ankylosing Spondylitis (ASAS) International Society, GRAPPA (Group for Research and Assessment of Psoriasis and Psoriatic Arthritis), SPARCC (SPondyloArthritis Research Consortium Canada), and SPARTAN (SPondyloArthritis Research and TreAtment Network).

Clinical assessments. The patients and observers were divided into 2 groups. Within each group all patients were evaluated by the same 10 observers. The following clinical measurements were performed by each observer on each patient.

Peripheral joint assessment. Sixty-eight joints were assessed for tenderness and 66 joints were assessed for swelling. These included the temporomandibular joints, sternoclavicular joints, shoulders (glenohumeral and acromioclavicular), wrists, all metacarpophalangeals, proximal interphalangeals (PIP) and distal interphalangeals of the hands, hips, knees, ankles (tibiotalar and mid-tarsal), and all metatarsophalangeals and PIP of the toes.

Enthesitis. Enthesitis sites included in the MASES, SPARCC, Berlin, Leeds, and San Francisco indices were assessed (Table 1). A total of 38 sites were included.

Dactylitis. The presence of dactylitis was recorded in patients with PsA only. Digits with dactylitis were recorded, and in addition, the Leeds dactylitis score was recorded for each patient thought to have dactylitis[22]. Briefly, on a diagram of fingers and toes the assessor

Table 1. Enthesitis sites included in the various indices.

Descriptor	MASES	Berlin	SPARCC	San Francisco	Leeds	IMPACT
C1/C2	—	—	—	X	—	—
C7/T1	—	—	—	X	—	—
T12/L1	—	—	—	X	—	—
1st costochondral	R L	—	—	—	—	—
7th costochondral	R L	—	—	—	—	—
Lateral epicondyle humerus	—	—	R L	—	R L	—
Medial epicondyle humerus	—	—	R L	—	—	—
Posterior superior iliac spine	R L	—	—	—	—	—
Anterior superior iliac spine	R L	—	—	R L	—	—
Iliac crest	R L	R L	—	—	—	—
5th lumbar spinous process	X	—	—	X	—	—
Ischial tuberosity	—	—	—	R L	—	—
Proximal Achilles	R L	R L	R L	R L	R L	R L
Greater trochanter	—	R L	R L	R L	—	—
Medial condyle femur	—	R L	—	—	R L	—
Lateral condyle femur	—	R L	—	—	—	—
Insertion plantar fascia	—	R L	R L	R L	—	R L
Supraspinatus insertion	—	—	R L	—	—	—
Quadriceps insertion patella	—	—	R L	—	—	—
Inferior pole patella	—	—	R L	—	—	—
Tibial tubercle	—	—	R L	—	—	—

X: site present.

marked which digit was involved. A special instrument was used to measure the circumference of the affected digit as well as the contralateral digit at the same level of the digit. The difference in measurements contributed to the score. If both sides were thought to be affected, the number was compared to data provided in a table. In addition, each affected digit was scored on a 0–3 scale for tenderness. Total dactylitis scores were calculated for each patient[24].

Study design. A modification of the Latin-square design was used since one patient with AS did not attend the session, leaving 9 patients with AS and 10 with PsA, while all 20 observers attended. This method allows determination of the observer, patient, and order effects at the same time. Before beginning the clinical assessments the participants discussed the measures to be performed and reviewed the method for each measure, but there was not a formal training session.

Statistical analysis. Variance components analyses were conducted for continuous measurements based on ANOVA models with random observer, random patient, and both excluding and including fixed order effects to account for temporal trends in the responses while assessing the reliability. Estimates of intraclass correlation coefficients (ICC) and associated 95% confidence intervals were obtained[25]. Sackett, *et al*[26] suggest that values of kappa in the intervals (0.80, 1.00) represent excellent agreement beyond chance, (0.60, 0.80) substantial agreement, (0.40, 0.60) moderate agreement, (0.20, 0.40) fair agreement, and (0.0, 0.20) poor agreement beyond chance. For the purpose of interpreting our results we adopted this same classification for the ICC.

RESULTS

Table 2 provides the median scores for the measures included in the study. The results are presented in Tables 3 to 5. Table 3 gives ICC values for the various measures for patients with AS and PsA. As shown, the number of tender joints provided substantial agreement among patients with AS and PsA, although the agreement was higher for patients with PsA [ICC 0.62 (95% CI 0.39, 0.87) for AS and 0.78 (95% CI 0.61, 0.93) for PsA]. The agreement for the number of swollen joints was poor for AS [ICC 0.04 (95% CI –0.04, 0.31)] and was only moderate for PsA [ICC 0.50 (95% CI 0.27, 0.78)]. From the variance components it can be seen that the variance by the assessor is similar in patients with AS and PsA, but the difference is due to the difference in the variance by the patients, indicating that especially for the swollen joint count very little variation between patients was present in patients with AS. This influences ICC measures negatively.

There was excellent agreement among the observers with regard to the number of active enthesitis sites per individual patient (ICC 0.84–0.88). The individual indices provided substantial to excellent agreement for all patients (ICC 0.67–0.82), except for the IMPACT, which provided only moderate agreement (ICC 0.43). In AS, the MASES, Berlin, SPARCC, and San Francisco instruments provided substantial to excellent agreement (ICC 0.75–0.81), whereas the Leeds and IMPACT provided a lower degree of agreement. In PsA, the MASES, IMPACT, and San Francisco provided less agreement (ICC of 0.56, 0.54, and 0.40 respectively), while the Berlin, Leeds, and SPARCC provided substantial to excellent agreement (ICC 0.70, 0.81, and 0.81, respectively). It should be noted, however, that there was considerable overlap in the confidence intervals.

None of the patients with AS had evidence of dactylitis. Among the patients with PsA there was substantial agreement on the presence of dactylitis and the dactylitis score provided an ICC of 0.70 (95% CI 0.49, 0.89).

Table 2. Disease characteristics in study patients.

Measure	AS	PsA
No. of patients with actively inflamed joints (%)		
With tender or swollen joints	8 (88.9)	10 (100.0)
With tender and swollen joints	4 (44.4)	10 (100.0)
No. of tender joints*	1.1 (0.0, 9.3)	0.9 (0.0, 12.3)
No. of swollen joints*	0.3 (0.0, 1.7)	2.6 (0.1, 10.8)
No. of patients with enthesitis (%)	8 (88.9)	7 (70.0)
No. of enthesitis sites*	4.0 (1.0, 20.8)	1.8 (1.0, 10.6)
No. of patients with dactylitis (%)	0 (0.0)	7 (70.0)
No. of digits with dactylitis*	—	0.3 (0.0, 5.8)

* Median (range).

Table 3. ICC (95% CI) for measurements by disease.

Measurement	AS	PsA with Axial Disease	All Patients
No. of tender joints	0.62 (0.39, 0.86)	0.78 (0.61, 0.93)	0.69 (0.54, 0.84)
No. of swollen joints	0.05 (–0.04, 0.31)	0.50 (0.27, 0.78)	0.54 (0.37, 0.73)
No. of tender or swollen joints	0.65 (0.42, 0.88)	0.63 (0.42, 0.86)	0.63 (0.47, 0.80)
No. of enthesitis sites	0.84 (0.69, 0.95)	0.88 (0.76, 0.96)	0.86 (0.77, 0.93)
Enthesitis MASES	0.80 (0.61, 0.94)	0.56 (0.34, 0.82)	0.82 (0.71, 0.91)
Enthesitis Berlin	0.80 (0.62, 0.94)	0.70 (0.50, 0.89)	0.77 (0.64, 0.88)
Enthesitis SPARCC	0.74 (0.53, 0.92)	0.81 (0.64, 0.93)	0.76 (0.62, 0.88)
Enthesitis San Francisco	0.75 (0.56, 0.92)	0.40 (0.19, 0.71)	0.72 (0.58, 0.86)
Enthesitis Leeds	0.60 (0.36, 0.85)	0.81 (0.65, 0.94)	0.67 (0.52, 0.82)
Enthesitis IMPACT	0.41 (0.19, 0.74)	0.54 (0.31, 0.81)	0.43 (0.27, 0.65)
Dactylitis score	NA	0.70 (0.49, 0.89)	NA

NA: not applicable.

Table 4. Variation in patients with AS.

Measure	Percentage of Total Variance Due to		
	Patient	Assessor	Order
No. of tender joints	63.1	14.4	1.6
No. of swollen joints	12.8	17.8	2.2
No. of tender or swollen joints	65.8	11.6	1.2
No. of enthesitis sites	84.9	4.0	0.3
Enthesitis MASES	80.2	4.6	0.4
Enthesitis Berlin	79.9	4.7	1.1
Enthesitis SPARCC	74.1	6.2	1.5
Enthesitis San Francisco	76.3	5.5	0.5
Enthesitis Leeds	59.8	9.0	3.7
Enthesitis IMPACT	43.7	12.4	3.5
Dactylitis score	NA	NA	NA

NA: not applicable.

Tables 4 and 5 provide information on the sources of variance in these patient groups.

DISCUSSION

Reliability of peripheral joint assessment in PsA has previously been demonstrated through a study by observers from a single center[5], and in a study with observers from multiple Canadian centers[6]. In this INSPIRE study, 20 observers from 19 centers from 11 different countries participated. It is expected that observers from the same center would exhibit greater agreement than individuals from different centers. Indeed, the agreement among the observers from the single center was 98%, whereas among the various Canadian centers it was only 78%. In our study we did not spend time on training for peripheral joint assessment. There was much better agreement for patients with PsA than for those with AS with

Table 5. Variation in patients with PsA.

Measure	Percentage of Total Variance Due to		
	Patient	Assessor	Order
No. of tender joints	78.5	5.2	1.6
No. of swollen joints	51.7	24.9	2.6
No. of tender or swollen joints	63.4	11.5	3.0
No. of enthesitis sites	88.6	2.1	0.1
Enthesitis MASES	58.1	9.2	1.4
Enthesitis Berlin	70.9	6.0	1.9
Enthesitis SPARCC	81.1	3.1	0.6
Enthesitis San Francisco	42.6	13.3	3.9
Enthesitis Leeds	81.5	3.3	0.7
Enthesitis IMPACT	56.1	11.6	1.4
Dactylitis score	70.8	5.8	1.2

regard to tender and overall joint counts, but the assessment of swollen joints provided very poor agreement for patients with AS and only moderate agreement in patients with PsA. This might be largely due to the relatively small number of patients with a low number of swollen joints per patient, especially in the AS group. However, discussion following the exercise revealed that a major issue was the distinction between swelling due to active inflammation and swelling due to damage. In individuals with joint subluxation, some observers would count those as swollen, despite the fact that these were clearly bony swellings rather than the soft tissue swelling usually associated with active joint inflammation. Other situations that led to disagreement were those where there was soft tissue swelling that was felt by some observers to be chronic synovial thickening whereas others considered those to reflect active inflammation. Thus, the fact that there was no training session for peripheral joint assessment in this exercise likely contributed to the lower agreement achieved in the study. Such a session is clearly required in future studies. Unfortunately, a clinically damaged joint count was not included in this exercise. In the previous SPARCC study, the assessment of damaged joints provided excellent agreement, even better than the assessment of actively inflamed joints[6]. Moreover, imaging was not included as part of INSPIRE, thus we cannot confirm the presence of synovitis in those joints that might be damaged but still active. We suggest that future studies of this type include either imaging (magnetic resonance imaging or ultrasound) or an expert opinion/consensus assessment of the actively inflamed joints to serve as a "gold standard." However, in a recent MRI study that included reliability of clinical assessments by 5 expert observers of 5 patients with PsA, in a design similar to the INSPIRE study, it was also concluded that there was a higher agreement on tender joint count[27]. Interestingly, that study demonstrated that the MRI correlated better with the tender joint count in these patients.

This is the first study to assess the comparative reliability of enthesitis indices among patients with AS and PsA with spinal involvement. We assessed a total of 38 sites for enthesitis. Using the total enthesitis tender sites there was excellent agreement among the observers both for patients with AS [0.84 (95% CI 0.69, 0.95)] and with PsA [0.88 (95% CI 0.76, 0.96)]. The individual indices provided substantial agreement. There was substantial to excellent agreement using all instruments except for the IMPACT for all the patients combined. It is of interest that the IMPACT index has been proven responsive in the IMPACT studies, showing a significant reduction in the presence of enthesitis in patients with PsA treated with infliximab compared to placebo. Thus, it appears that all the instruments are reliable. However, some do not function as well in PsA (San Francisco, MASES, and IMPACT). The SPARCC enthesitis index includes 18 sites, of which only 8 sites were used in the SPARCC study[6]. If we included only the 8 sites that had previously been tested in the SPARCC study the agreement was not as good, with ICC of 0.49. Thus, if the SPARCC enthesitis index is included in future studies, the complete SPARCC enthesitis index should be included. The Leeds enthesitis index functioned well in PsA and had the advantage of including only 6 sites, all easily accessible. In a recent study the Leeds enthesitis index showed good sensitivity to change, as did the 8 sites assessed in the SPARCC study and the Berlin index (effect sizes 0.82, 1.22, and 0.8, respectively)[21], and the MASES in a clinical study[18].

The assessment of dactylitis based on the number of digits with dactylitis provided an ICC of 0.56 in the SPARCC study[6]. Nonetheless, the assessment of dactylitis based on the number of digits involved and the degree of tenderness was shown to be responsive in clinical trials with infliximab[11,12]. In the INSPIRE study, a dactylitis score was used and provided substantial agreement, with ICC of 0.70. The Leeds dactylitis score has been shown to be reliable in a British study, and has also been shown to be sensitive to change[22,23].

The INSPIRE study has thus provided evidence for the reliability of the measures used to assess enthesitis in both AS and PsA, and dactylitis in PsA. The assessment of peripheral joints requires further study, particularly with regard to the assessment of swollen joints. Since most studies require tender and swollen joints as a prerequisite for enrollment, there is

a need to standardize the methods of joint assessment. The more reliable the assessments are, the lower the number of patients required for clinical trials, since the assessment of true change is subject to less "noise."

ACKNOWLEDGMENT

The authors acknowledge Ker-Ai Lee for helping with the statistical analysis; Catherine Schentag for organizing the study and database support; Anne MacKinnon for administrative support; Dr. Sergio Toloza, Fawnda Pellett, Ruby Syal, Sutharshini Shanmugarajah, and Sue Gilchrest for organizational support.

REFERENCES

1. Van der Linden S, van der Heijde D, Braun J. Ankylosing spondylitis. In: Harris ED, Budd RC, Firestein GS, et al, editors. Kelley's textbook of rheumatology. 7th ed. Philadelphia: W.B. Saunders; 2005:1125-41.
2. Gladman DD. Psoriatic arthritis. In: Harris ED, Budd RC, Firestein GS, et al, editors. Kelley's textbook of rheumatology. 7th ed. Philadelphia: W.B. Saunders; 2005:1155-64.
3. Gladman DD, Brubacher B, Buskila D, Langevitz P, Farewell VT. Differences in the expression of spondyloarthropathy: a comparison between ankylosing spondylitis and psoriatic arthritis. Genetic and gender effects. Clin Invest Med 1993;16:1-7.
4. Helliwell PS, Hickling P, Wright V. Do the radiological changes of classic ankylosing spondylitis differ from the changes found in the spondylitis associated with inflammatory bowel disease, psoriasis, and reactive arthritis? Ann Rheum Dis 1998;57:135-40.
5. Gladman DD, Farewell V, Buskila D, et al. Reliability of measurements of active and damaged joints in psoriatic arthritis. J Rheumatol 1990;17:62-4.
6. Gladman DD, Cook RJ, Schentag C, et al. The clinical assessment of patients with psoriatic arthritis: Results of a validation study of the SpondyloArthritis Research Consortium of Canada (SPARCC). J Rheumatol 2004;31:1126-31.
7. Gladman DD, Mease P, Krueger G, et al. Outcome measures in psoriatic arthritis. J Rheumatol 2005;32:2262-9.
8. Mease PJ, Goffe BS, Metz J, et al. Etanercept in the treatment of psoriatic arthritis and psoriasis: a randomised trial. Lancet 2000;356:385-90.
9. Kaltwasser JP, Nash P, Gladman D, et al, for the TOPAS Study Group. Efficacy and safety of leflunomide in the treatment of psoriatic arthritis and psoriasis. Arthritis Rheum 2004;50:1939-50.
10. Mease PJ, Kivitz AJ, Burch FX, et al. Etanercept treatment of psoriatic arthritis: safety, efficacy, and effect on disease progression. Arthritis Rheum 2004;50:2264-72.
11. Antoni C, Krueger GG, de Vlam K, et al. Infliximab improves signs and symptoms of psoriatic arthritis: results of the IMPACT 2 trial. Ann Rheum Dis 2005;64:1150-7.
12. Antoni CE, Kavanaugh A, Kirkham B, et al. Sustained benefits of infliximab therapy for dermatologic and articular manifestations of psoriatic arthritis: Results from the Infliximab Multinational Psoriatic Arthritis Controlled Trial (IMPACT). Arthritis Rheum 2005;52:1227-36.
13. Mease PJ, Gladman DD, Ritchlin CT, et al, for the ADEPT Study Group. Adalimumab in the Treatment of Patients With Moderately to Severely Active Psoriatic Arthritis: Results of The ADEPT Trial. Arthritis Rheum 2005;52:3279-89.
14. Gladman DD, Mease PJ, Strand V, et al. Consensus on a core set of domains for psoriatic arthritis. J Rheumatol 2007;34:1167-70.
15. van der Heijde D, van der Linden S, Dougados M, Bellamy N, Russell AS, Edmonds J. Ankylosing spondylitis: plenary discussion and results of voting on selection of domains and some specific instruments. J Rheumatol 1999;26:1003-5.
16. Mander M, Simpson JM, McLellan A, Walker D, Goodacre JA, Dick WC. Studies with an enthesis index as a method of clinical assessment in ankylosing spondylitis. Ann Rheum Dis 1987;46:197-202.
17. Heuft-Dorenbosch L, Spoorenberg A, van Tubergen A, et al. Assessment of enthesitis in ankylosing spondylitis. Ann Rheum Dis 2003;62:127-32.
18. van der Heijde D, Kivitz A, Schiff MH, et al. Efficacy and safety of adalimumab in patients with ankylosing spondylitis: results of a multicenter, randomized, double-blind, placebo-controlled trial. Arthritis Rheum 2006;54:2136-46.
19. Maksymowych WP, Mallon C, Morrow S, et al. Development and validation of the Spondyloarthritis Research Consortium of Canada (SPARCC) Enthesitis Index. (submitted for publication)
20. Braun J, Brandt J, Listing J, et al. Treatment of active ankylosing spondylitis with infliximab: a randomised controlled multicentre trial. Lancet 2002;359:1187-93.
21. Brockbank J, Stein M, Schentag CT, Gladman DD. Characteristics of dactylitis in psoriatic arthritis (PsA). Ann Rheum Dis 2005;62:188-90.
22. Helliwell PS, Firth J, Ibrahim GH, Melsom RD, Shah I, Turner DE. Development of an assessment tool for dactylitis in patients with psoriatic arthritis. J Rheumatol 2005;32:1745-50.
23. Healy PJ, Helliwell PS. Measuring dactylitis in clinical trials: Which is the best instrument to use? J Rheumatol 2007;34:1302-6.
24. van der Linden S, Valkenburg HA, Cats A. Evaluation of diagnostic criteria for ankylosing spondylitis. A proposal for modification of the New York criteria. Arthritis Rheum 1984;27:361-8.
25. Burdick RK, Graybill FA. Confidence intervals on variance components. Statistics: a series of textbooks and monographs. New York: Marcel Dekker; 1992:127.
26. Sackett DL, Haynes RB, Guyatt GH, Tugwell P. Clinical epidemiology: a basic science for clinical medicine. 2nd ed. Toronto: Little, Brown and Company; 1991.
27. Stone MA, White L, Gladman D, et al. Reliability of physical examination in inflammatory arthritis: Rope Study [abstract]. Arthritis Rheum 2005;52 Suppl:S116.