Psoriatic Arthritis Mutilans: Clinical and Radiographic Criteria. A Systematic Review

Amir Haddad, Sindhu R. Johnson, Mansour Somaily, Rouhi Fazelzad, Amie T. Kron, Cathy Chau, and Vinod Chandran

ABSTRACT. ***Objective.*** Research on psoriatic arthritis mutilans (PAM), the most severe form of psoriatic arthritis, is impeded by the lack of an accepted classification criteria. We performed a systematic review of the literature to identify and synthesize clinical and radiographic features associated with the definition of PAM.

Methods. A systematic literature search limited to human studies was conducted without language restriction. Abstracts were independently screened by 2 investigators and studies that reported information on patients with PAM were included. A standardized form was used to independently collect clinical and radiographic items defining PAM, patient's demographics, disease characteristics, and outcomes.

Results. There were 8570 citations searched to identify 112 articles for full review and 58 articles for data abstraction. We identified 8 definitions of PAM that were used in 283 subjects with a mean age ± SD at diagnosis of PsA of 33.9 ± 8.2 years. Disease manifestations (prevalence) included dactylitis (29–64%), enthesitis (29–32%), axial disease (14–27%), and nail lesions (47%). PAM definitions include 1 (n = 2 studies) or more (n = 14 studies) joints involving interphalangeal, metacarpophalangeal, or metatarsophalangeal joints. The most prevalent PAM clinical features were digital telescoping (34%), digital shortening (33%), and flail joints (22%). The most prevalent PAM radiographic items were bone resorption (41%), pencil-in-cup change (16%), total joint erosions (14%), ankylosis (21%), and subluxation (7%).

Conclusion. We have identified 8 definitions of PAM, and synthesized the clinical and radiographic items that are important for the classification of PAM. We have established the groundwork for future development classification criteria for PAM. (J Rheumatol First Release June 15 2015; doi:10.3899/jrheum.141545)

Keyword Indexing Terms:
PSORIASIS SPONDYLOARTHRITIS OSTEOLYSIS
ANKYLOSIS CLASSIFICATION CRITERIA

From the University of Toronto Psoriatic Arthritis Clinic, and Division of Rheumatology, Toronto Western Hospital; Institute of Health Policy, Management and Evaluation, and Division of Rheumatology, Department of Medicine, University of Toronto; University Health Network, Toronto, Ontario, Canada.

The Psoriatic Arthritis Program is funded in part by The Arthritis Society, Canadian Institutes of Health Research, and the Krembil Foundation. Dr. Chandran was supported by a Canadian Institutes of Health Research New Emerging Team Grant to the International Psoriasis and Arthritis Research Team. Dr. Johnson is supported by a Canadian Institutes of Health Research Clinician Scientist Award.

A. Haddad, MD, University of Toronto Psoriatic Arthritis Clinic, Toronto Western Hospital; S.R. Johnson, MD, PhD, Division of Rheumatology, Toronto Western Hospital, and Institute of Health Policy, Management and Evaluation, and Division of Rheumatology, Department of Medicine, University of Toronto; M. Somaily, MD, University of Toronto Psoriatic Arthritis Clinic, Toronto Western Hospital; R. Fazelzad, BSc, MISt, University Health Network; A.T. Kron, BSc (Honors); C. Chau, BMath, CIM, Division of Rheumatology, Toronto Western Hospital; V. Chandran, MBBS, MD, DM, PhD, University of Toronto Psoriatic Arthritis Clinic, and Division of Rheumatology, Toronto Western Hospital, and Division of Rheumatology, Department of Medicine, University of Toronto.

Address correspondence to Dr. V. Chandran, 1E 416, Toronto Western Hospital, 399 Bathurst St., Toronto, Ontario M5T 2S8, Canada. E-mail: vchandra@uhnresearch.ca

Accepted for publication April 7, 2015.

Psoriatic arthritis (PsA) is an inflammatory musculoskeletal disease associated with psoriasis[1]. Moll and Wright were the first to define PsA as "psoriasis associated with inflammatory arthritis (peripheral arthritis and/or spondylitis) and usually a negative serologic test for rheumatoid factor"[2]. Because of the phenotypic variability of the clinical presentations of PsA, they suggested that PsA could be classified into 5 predominant patterns: asymmetric oligoarthritis, symmetric polyarthritis similar to rheumatoid arthritis, spondylitis, distal interphalangeal joint arthritis, and arthritis mutilans[2]. PsA mutilans (PAM) is considered the most severe form of PsA, affecting about 5% of patients[2]. Although the occurrence of arthritis mutilans associated with PsA is often described as a relatively rare event, studies have reported a wide prevalence of 2–21%, mainly because of differences in the definition used by investigators[3].

Affected patients experience severe joint destruction and functional disability. It is therefore important that we identify clinical predictors and biomarkers for PAM so that patients at risk are identified early, and appropriate therapeutic inter-

ventions are instituted to prevent joint destruction and loss of function and to preserve quality of life[4]. However, studies aiming to identify clinical predictors or biomarkers for PAM have been impeded by the lack of consensus on the definition[3]. The Group of Research and Assessment of Psoriasis and Psoriatic Arthritis (GRAPPA) is now aiming to develop a consensus definition of PAM[5].

Concurrently, it has been recognized that in the absence of a single diagnostic test, rheumatic diseases with a variety of manifestations would benefit from classification criteria. Classification criteria facilitate the inclusion of more homogeneous groups of patients into clinical trials and facilitate more even comparisons across studies. There have been recommendations for increased methodological rigor in classification criteria development and advanced methodology resulting in a new era of classification criteria[6,7,8,9,10,11,12,13]. As the first phase of PAM classification criteria development, we performed a systematic review of the literature to identify and synthesize the clinical and radiographic criteria that are used to characterize PAM.

MATERIALS AND METHODS

Data sources. A systematic search of the published literature was conducted using Medline (1946–October 2013), Embase (1974–October 2013), Cochrane Central Register for Controlled trials (1993–2013), Cochrane databases of Systematic Reviews (2005–October 2013), and Cumulative Index to Nursing and Allied Health Literature, 1984–2013 (CINAHL) by an information specialist through the University Health Network library services (RF) without language restriction, but limited to human studies.

Search terms. The keyword terms used in the search of each database are outlined in Appendix 1 (available online at jrheum.org).

Search strategy. A protocol was developed and a systematic review performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement[14]. Two investigators (AH, MS) independently screened titles and abstracts and included studies that had reported patients with PsA and arthritis mutilans. The selected articles were retrieved for extraction of the data with source de-identification. Machine translation software was used to translate articles to English. The bibliography of the eligible articles was searched and eligible studies were included for data extraction. Two investigators independently used a standardized form (Appendix 2, available online at jrheum.org) to collect items used in the definition of PAM, including the presence of shortening of digits, digital telescoping, flail joints, number and type of joints affected, time to joint destruction, the presence of total erosions at both sides of the joint, bone resorption, pencil-in-cup change, ankylosis, and subluxation. These are illustrated in Figure 1. The demographics, disease characteristics, and clinical and radiographic outcomes of study subjects were recorded. Discrepancies were resolved by consensus or involving a third investigator (VC).

Citation index. Many sets of criteria have been proposed for PAM. We were interested in evaluating those that were commonly used to classify patients with disease. Web of Science (version 5.13.1, Thomson Scientific) was used to search the Science Citation Index Expanded (1945–2013) to identify the number of times each article was cited. This approach has been used to evaluate classification criteria for other rheumatic diseases[15,16].

Analysis. Descriptive statistics were used to aggregate the data without weighting. If the clinical and radiographic features were mentioned in the definition, they would be marked as present; the sum of the total studies reporting the specific items was divided by the total studies reported to calculate the proportion.

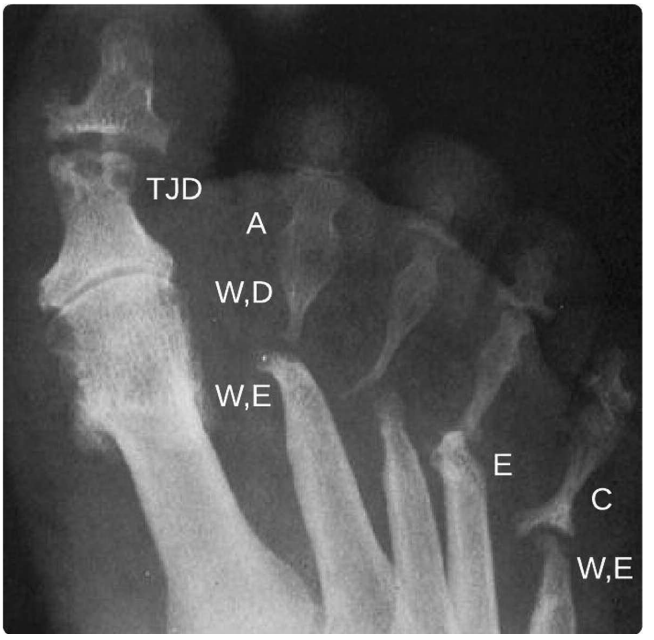

Figure 1. Illustration of radiographic features of PAM. Presence of total erosion at both sides of the joint (marked as TJD). Bone resorption involving of the epiphyseal head (marked as E). Bone resorption extending to the diaphysis (marked as D). Presence of bone whittling, resorption of bone causing pinpoint end (marked as W). Presence of pencil-in-cup change, resorption of bone causing cupping of distal or proximal end of the bone with whittling of the opposite side (marked as C). Presence of ankylosis (marked as A). PAM: psoriatic arthritis mutilans.

RESULTS

Literature search. There were 8570 citations identified (Figure 2). Citations were excluded if they were not related to the topic (n = 7375), reported patients with other rheumatic diseases (n = 47), did not report PAM as an outcome (n = 53), or were duplicate citations (n = 983). Of the 112 articles selected for full review, 58 were eligible for data abstraction[2,17–27,28–38,39–49,50–60,61–71,72,73]. These included 5 additional papers that were not identified in the computerized search[69,70,71,72,73]. The computerized search was limited to publications after 1946 (the inception date of the Medline database) and were found when the bibliography of the eligible studies was searched. Of the total 58 studies that were included for data abstraction, there were 17 review articles, 22 case studies, 14 cohort studies, 6 case series, 2 case-control studies, and 2 cross-sectional studies. We had a 95% agreement in inclusion of the papers and 90% agreement in data abstraction between 2 independent reviews, and all discrepancies were resolved by consensus. Because of the heterogeneity across studies and the descriptive nature of the findings, a metaanalysis was not performed.

Demographics and disease characteristics of subjects with PAM. Demographic and disease characteristics were reported in 45 studies (78%) that included a total of 283 subjects[17,18,20,21,22,23,24,26,27,28,29,30,33,34,36,37,39,40,42,44,45,47,48,49,50,51,52,53,54,56,59–69,70,71,72,73]. Based on reported data, 86/166

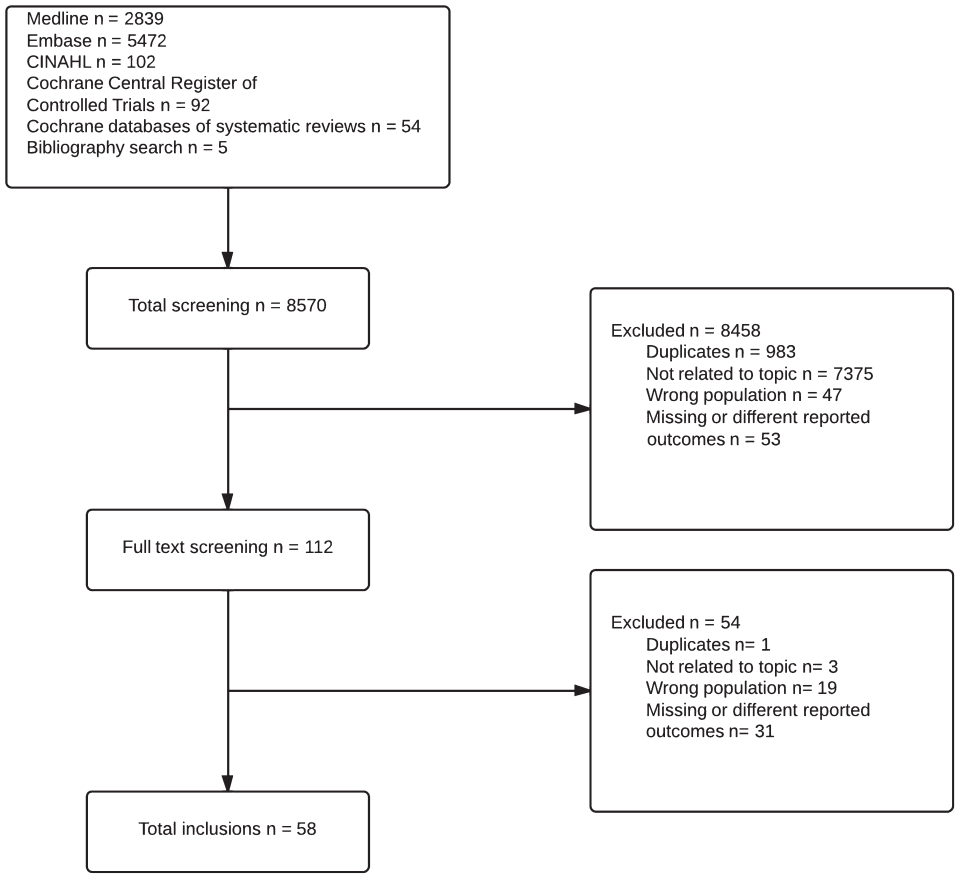

Figure 2. Flow diagram of search results. CINAHL: Cumulative Index to Nursing and Allied Health Literature, 1984–2013.

(51.6%) of the study subjects were men (sex was reported in 59% of the study population) and had a mean age (SD) of 54.1 years (7.3; reported in 52% of cases). Most of the patients had psoriasis before the diagnosis of PsA, with a mean age at diagnosis of psoriasis of 28.7 years (7.4; reported on 49% of cases) and PsA of 33.9 years (8.2; reported on 57% of cases). Dactylitis was present in 29–64% of the cases, whereas enthesitis was reported to occur in 29–32%[21,22]. Axial disease was present in 14–27% of patients with PAM[20,21]. The presence of nail lesions was reported in 47% of patients with PAM in 1 case series[21]. Patients with PAM had 1[33,37] or more[22,24,25,28,34,40,45,47,52,56,60,63,67,69] affected joints involving any of the interphalangeal, metacarpophalangeal, or metatarsophalangeal joints. PAM was reported to occur within a few months[25,37] and up to several years[33,45] after PsA onset.

Definitions of PAM. Eight definitions for PAM have been proposed in the literature and are summarized in Table 1. Prior to 1973, there were case reports or case series on patients with arthritis mutilans in the presence[69,70,71,72,73] or absence[75,76] of psoriasis. All patients had articular manifestations with severe joint destruction and either digital tapering (opera glass hands) or joint ankylosis. The most commonly cited definition for PAM reported in 50% of the studies (n = 29) was the definition by Moll and Wright, which described "patients with arthritis mutilans often complicated with digital telescoping or the *doigt en lorgnette* deformity resulting from severe osteolysis; these patients often have sacroiliitis"[2]. Twenty-one percent of the studies (n = 12) did not provide a definition.

The clinical and radiographic features of PAM. The clinical features that were used in the definitions are summarized in Table 2. They included the presence of digital telescoping (n = 20, 34%), presence of digital shortening (n = 19, 33%), and flail joints (n = 13, 22%). Only 17% of the articles (n = 10) specified the type of joints affected with no consensus because some investigators generalized the definition for the small joints of hands or feet[19,23,30,31,43,48,52,55,60] and others specified only the interphalangeal joints[18,45]. Other studies included the metacarpophalangeal and metatarsophalangeal joints[52,55,60]. A few papers commented on the number of joint affected[17,21,30,31]. Helliwell, *et al*[17] suggested that a presence of at least 1 affected joint is required, but PAM was characterized as a polyarticular disease in other studies[21,30]. Four studies commented on the time to joint destruction,

Table 1. Definitions for PAM proposed in the literature.

Study	Definition	Citation Index
Moll and Wright[2]	Digital telescoping (*doigt en lorgnette*) or opera glass finger resulting from severe osteolysis.	768
McGonagle, *et al*[19]	Diffuse bone destruction of the small joints of hands, especially the DIP joints, with bone changes that are reminiscent of enthesopathy-associated bone lesions.	169
Helliwell, *et al*[17]	Severe destructive changes in small joints of hands and feet with telescoping of at least 1 digit.	132
Marsal, *et al*[18]	Complete erosion of the metacarpal or metatarsal head and the corresponding epiphysis of the phalanx or both epiphyses of an interphalangeal joint of a finger or a toe.	75
Tan, *et al*[20]	Pencil-in-cup deformities or bone lysis causing 30–50% resorption of proximal and middle phalanges manifesting clinically as digital shortening or radiographically as complete erosion of bone at both sides of the joints.	11
Helliwell[21]	Patients with PAM are more likely to have polyarticular, symmetrical disease for a long duration and positive CCP in the context of bone osteolysis, ankylosis, entheseal abnormalities, and spinal abnormalities.	4
Gudbjornsson, *et al*[22]	Presence of clinical arthritis of type PAM that is also radiographically confirmed.	1
Chandran, *et al*[74]	≥ 5 joints with grade IV damage using the modified Steinbrocker scoring method.	0

DIP: distal interphalangeal; PAM: psoriatic arthritis mutilans; CCP: cyclic citrullinated peptide antibodies.

Table 2. Clinical and radiographic features in the definition of PAM.

Criteria	Description	Studies Reporting Items, n (%)	References
Clinical	Presence of digital shortening	19 (33)	2,25,26,31,34,37,38,41,45,46, 48,51,52,54,55,57,58,59,60
	Presence of digital telescoping	20 (34)	2,17,26,30,34,37,38,41,45,46, 48,51,52,54,55,58,59,60,66
	Presence of flail joints	13 (22)	2,26,30,37,38,41,48,51,52,54,55,58,60
Radiographic	Bone resorption	24 (41)	2,18,19,21,22,25,26,30,31,34,37,38,41,43, 45,46,48,52,54,55,56,58,60,66,68
	Presence of joint ankylosis	12 (21)	2,21,30,31,45,52,55,56,58,60
	Presence of pencil-in-cup change	9 (16)	22,25,31,45,52,55,58,60,66
	Presence of total joint erosion	8 (14)	18,20,34,55,58,60,66
	Presence of joint subluxation	4 (7)	31,52,55,58

PAM: psoriatic arthritis mutilans.

describing it as a rapid process[28,31] in patients with long disease duration[21,26].

The radiographic items for PAM included the presence of bone resorption (41%, n = 24), joint ankylosis (21%, n = 12), pencil-in-cup change (16%, n = 9), total joint erosions (14%, n = 8), and subluxation (7%, n = 4) as shown in Table 2.

DISCUSSION

Arthritis mutilans is recognized as the most severe destructive form of PsA. However, criteria for the classification of PAM have not yet been formulated. Patients with PAM experience severe joint destruction and functional disability. It is, therefore, crucial that we identify clinical predictors and biomarkers for PAM so that patients at risk are identified early and appropriate therapeutic intervention instituted. Criteria for the classification of PAM will facilitate clinical and biomarker research on this severe form of PsA. Classification criteria for PAM will identify more homogeneous groups of patients for inclusion into research studies, and facilitate comparisons across studies[16]. Similarly, it may decrease misclassification. We, therefore, conducted a systematic search of the literature to review definitions of PAM reported previously, and synthesized the clinical and radiographic domains used to describe this extreme phenotype. Synthesis of the literature is a necessary prerequisite for modern classification criteria development[16].

Our systematic review reveals 8 definitions of PAM used by investigators to date. The definition of PAM by Moll and

Wright was most commonly cited by 50% of studies, though there was variability in the clinical and radiological features used in describing the condition. Moreover, in about 21% of the studies, no definition was provided. The studies reported a wide clinical spectrum of manifestations of PAM. Clinically, at the level of the digit, the reported features most commonly included the presence of digital shortening, telescoping, and flail joints. Severe osteolysis and bone resorption were the most common radiographic characteristics used to characterize PAM. A fifth of the manuscripts included concomitant presence of joint ankylosis as a manifestation of PAM. However, joint subluxation was included as a feature in less than 10% of the articles. With regard to the number of joints involved, although PAM is generally described as polyarticular, few manuscripts have specifically mentioned the number of joints or specific joints in the definition. Thus, severe osteolysis leading to destruction of joint surfaces and proximal epiphysis manifesting as shortened, flail, or digital telescoping seems to be the most common feature used to characterize PAM. Features such as ankylosis and subluxation may be associated with PAM, but these may not be defining features. Interestingly, axial disease was reported to be present in 9 studies with varying prevalence estimates, with the highest reported prevalence being 27%[20,21,34,36,37,39,45,49,64].

Based on our findings, we have developed a conceptual framework for PAM and its associated clinical features as shown in Figure 3[77]. The framework emphasizes severe bone resorption (osteolysis) as the defining feature of PAM. There may be associated subluxation or ankylosis. Bone resorption leads to joint instability, resulting in the formation of flail joints. Greater degree or severity of osteolysis would lead to digital shortening and telescoping. Many of these features may be seen in the same individual, but may vary across individuals. This conceptual framework is not meant to be static, but rather to lay the groundwork for further debate and revision.

A potential limitation of this work is the influence of the definition of Moll and Wright. This phenotype relies on an older classification of PsA that was proposed in a different setting than we have today. Given this older, dominant concept of PsA, there is the threat of bias because of circularity of reasoning in the papers included in the review. Many of them reply on the initial Moll and Wright phenotype that, according to modern standards, were poorly validated in the first place. Further, we have included studies from a variety of treatment eras that may introduce confounding and calendar bias. It may be that these candidate criteria reflect established, late disease, and are insufficient in the modern treatment era. The next step may be to elicit beliefs from international PsA experts to understand what is the true "gestalt" of PAM today[78,79]. It may be that additional candidate criteria for the various elements of the disease are needed. Indeed, we found that other potential important variables [e.g., body mass index, smoking habits, type of skin disease, HLA-B27

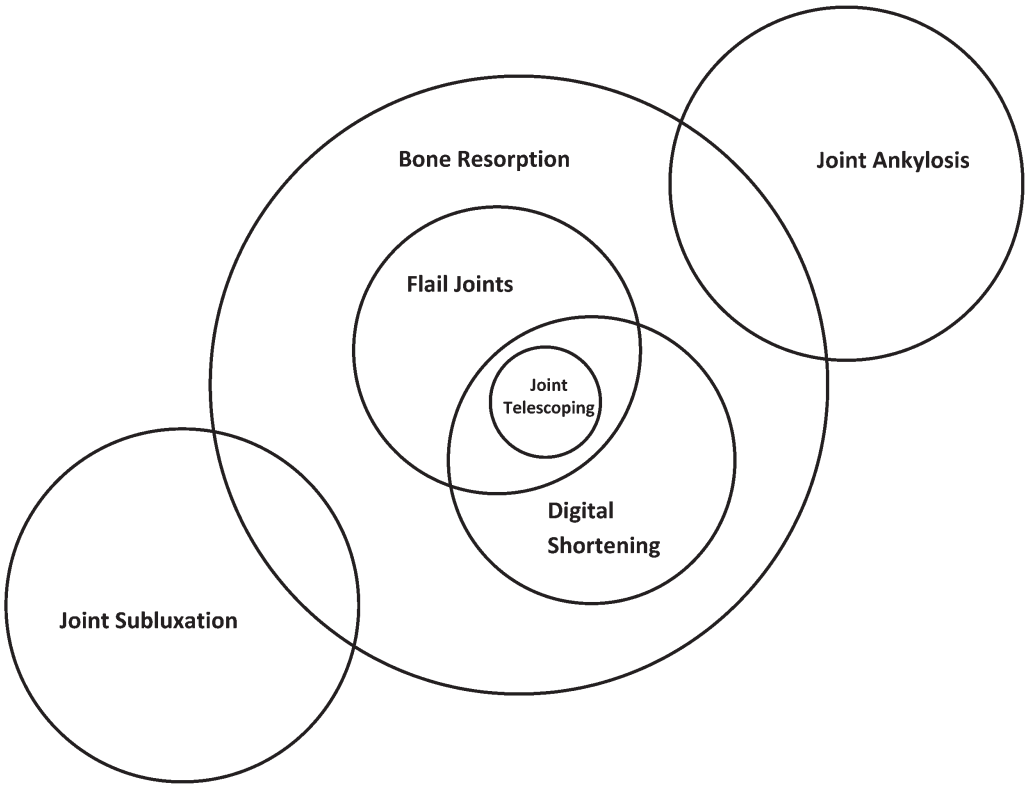

Figure 3. A conceptual framework suggesting the relationship between the clinical and radiological items of PAM, with bone resorption being a fundamental feature. PAM: psoriatic arthritis mutilans.

positivity, and autoantibodies (rheumatoid factor and anticyclic citrullinated peptide antibodies positivity)] were not well reported in the literature. Future studies should incorporate and evaluate the effect of these factors.

To our knowledge, our study is the first to systematically review the definitions used to describe PAM. We have identified key features that define this severe form of PsA, as well as features associated with the condition that, however, may not be "defining." We have synthesized candidate criteria for consideration, and proposed a conceptual framework for debate and revision in the next phase of classification criteria development[5]. Classification criteria for PAM would facilitate research studies on identifying clinical predictors and biomarkers for PAM so that patients likely to develop PAM are identified early and longterm disability is prevented.

ACKNOWLEDGMENT

The study was presented at the annual meeting of the Group for Research and Assessment of Psoriatic Arthritis in 2013 and briefly reported in the meeting report[80].

ONLINE SUPPLEMENT

Supplementary data for this article are available at jrheum.org.

REFERENCES

1. Taylor W, Gladman D, Helliwell P, Marchesoni A, Mease P, Mielants H, et al. Classification criteria for psoriatic arthritis: development of new criteria from a large international study. Arthritis Rheum 2006;54:2665-73.
2. Moll JM, Wright V. Psoriatic arthritis. Semin Arthritis Rheum 1973;3:55-78.
3. Haddad A, Chandran V. Arthritis mutilans. Curr Rheumatol Rep 2013;15:321.
4. Gladman DD, Antoni C, Mease P, Clegg DO, Nash P. Psoriatic arthritis: epidemiology, clinical features, course, and outcome. Ann Rheum Dis 2005;64 Suppl 2:ii14-7.
5. Chandran V, Gladman DD, Helliwell PS, Gudbjörnsson B. Arthritis mutilans: a report from the GRAPPA 2012 annual meeting. J Rheumatol 2013;40:1419-22.
6. Felson DT, Anderson JJ. Methodological and statistical approaches to criteria development in rheumatic diseases. Baillieres Clin Rheumatol 1995;9:253-66.
7. Singh JA, Solomon DH, Dougados M, Felson D, Hawker G, Katz P, et al; Classification and Response Criteria Subcommittee of the Committee on Quality Measures, American College of Rheumatology. Development of classification and response criteria for rheumatic diseases. Arthritis Rheum 2006;55:348-52.
8. Fransen J, Johnson SR, van den Hoogen F, Baron M, Allanore Y, Carreira PE, et al. Items for developing revised classification criteria in systemic sclerosis: results of a consensus exercise. Arthritis Care Res 2012;64:351-7.
9. Johnson SR, Fransen J, Khanna D, Baron M, van den Hoogen F, Medsger TA Jr, et al. Validation of potential classification criteria for systemic sclerosis. Arthritis Care Res 2012;64:358-67.
10. Neogi T, Aletaha D, Silman AJ, Naden RL, Felson DT, Aggarwal R, et al; American College of Rheumatology; European League Against Rheumatism. The 2010 American College of Rheumatology/European League Against Rheumatism classification criteria for rheumatoid arthritis: Phase 2 methodological report. Arthritis Rheum 2010;62:2582-91.
11. Johnson SR, Naden RP, Fransen J, van den Hoogen F, Pope JE, Baron M, et al. Multicriteria decision analysis methods with 1000Minds for developing systemic sclerosis classification criteria. J Clin Epidemiol 2014;67:706-14.
12. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO 3rd, et al. 2010 Rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis Rheum 2010; 62:2569-81.
13. van den Hoogen F, Khanna D, Fransen J, Johnson SR, Baron M, Tyndall A, et al. 2013 classification criteria for systemic sclerosis: an American College of Rheumatology/European League against Rheumatism collaborative initiative. Arthritis Rheum 2013; 65:2737-47.
14. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Int J Surg 2010;8:336-41.
15. Johnson SR, Feldman BM, Hawker GA. Classification criteria for systemic sclerosis subsets. J Rheumatol 2007;34:1855-63.
16. Johnson SR, Goek ON, Singh-Grewal D, Vlad SC, Feldman BM, Felson DT, et al. Classification criteria in rheumatic diseases: a review of methodologic properties. Arthritis Rheum 2007; 57:1119-33.
17. Helliwell P, Marchesoni A, Peters M, Barker M, Wright V. A re-evaluation of the osteoarticular manifestations of psoriasis. Br J Rheumatol 1991;30:339-45.
18. Marsal S, Armadans-Gil L, Martínez M, Gallardo D, Ribera A, Lience E. Clinical, radiographic and HLA associations as markers for different patterns of psoriatic arthritis. Rheumatology 1999;38:332-7.
19. McGonagle D, Conaghan PG, Emery P. Psoriatic arthritis: a unified concept twenty years on. Arthritis Rheum 1999;42:1080-6.
20. Tan YM, Østergaard M, Doyle A, Dalbeth N, Lobo M, Reeves Q, et al. MRI bone oedema scores are higher in the arthritis mutilans form of psoriatic arthritis and correlate with high radiographic scores for joint damage. Arthritis Res Ther 2009;11:R2.
21. Helliwell PS. Established psoriatic arthritis: clinical aspects. J Rheumatol Suppl. 2009 Aug;83:21-3.
22. Gudbjornsson B, Ejstrup L, Gran JT, Iversen L, Lindqvist U, Paimela L, et al. Psoriatic arthritis mutilans (PAM) in the Nordic countries: demographics and disease status. The Nordic PAM study. Scand J Rheumatol 2013;42:373-8.
23. Torre Alonso JC, Rodriguez Perez A, Arribas Castrillo JM, Ballina Garcia J, Riestra Noriega JL, Lopez Larrea C. Psoriatic arthritis (PA): a clinical, immunological and radiological study of 180 patients. Br J Rheumatol 1991;30:245-50.
24. Appel da Silva F, Appel da Silva MC, Romagna ES. Clinical images: Psoriatic arthritis mutilans. Arthritis Rheum 2010;62:2159.
25. Bell L, Murphy CL, Wynne B, Cunnane G. Acute presentation of arthritis mutilans. J Rheumatol 2011;38:174-5.
26. Cantini F, Niccoli L, Nannini C, Kaloudi O, Bertoni M, Cassarà E. Psoriatic arthritis: a systematic review. Int J Rheum Dis 2010;13:300-17.
27. Gladman DD, Shuckett R, Russell ML, Thorne JC, Schachter RK. Psoriatic arthritis (PSA)—an analysis of 220 patients. Q J Med 1987;62:127-41.
28. Clarke O. Arthritis mutilans associated with psoriasis. Lancet 1950;1:249-51.
29. Reich K, Krüger K, Mössner R, Augustin M. Epidemiology and clinical pattern of psoriatic arthritis in Germany: a prospective interdisciplinary epidemiological study of 1511 patients with plaque-type psoriasis. Br J Dermatol 2009;160:1040-7.
30. Golding DN, Baker H, Thompson M. Arthritis mutilans and psoriasis. Ann Phys Med 1963;7:133-9.

31. Golding DN. Arthritis mutilans. Rheumatism 1965;21:86-90.
32. Gladman DD, Brockbank J. Psoriatic arthritis. Expert Opin Investig Drugs 2000;9:1511-22.
33. Di Vittorio S. [Psoriatic mutilating osteoarthropathy. Clinical case]. [Article in Italian] Reumatismo 1963;15:36-8.
34. Ly J, Pinto C, Doyle A, Dalbeth N, McQueen FM. Axial bone proliferation causing cervical myelopathy in the mutilans form of psoriatic arthritis despite peripheral bone erosion. Ann Rheum Dis 2009;68:443-4.
35. Helliwell PS, Porter G, Taylor WJ; CASPAR Study Group. Polyarticular psoriatic arthritis is more like oligoarticular psoriatic arthritis, than rheumatoid arthritis. Ann Rheum Dis 2007;66:113-7.
36. Iannello S, Camuto M, Cavaleri A, Fagone S, Belfiore F. [Psoriasis complicated with severe mutilating psoriatic osteoarthropathy. Clinical case and review of the literature]. [Article in Italian] Minerva Med 2000;91:191-226.
37. Juozevicius JL, Parhami N. Psoriatic arthritis rapidly progressing to arthritis mutilans. J Rheumatol 1986;13:654-6.
38. Laurent MR. Psoriatic arthritis. Clin Rheum Dis 1985;11:61-85.
39. Kammer GM, Soter NA, Gibson DJ, Schur PH. Psoriatic arthritis: a clinical, immunologic and HLA study of 100 patients. Semin Arthritis Rheum 1979;9:75-97.
40. Jones SM, Armas JB, Cohen MG, Lovell CR, Evison G, McHugh NJ. Psoriatic arthritis: outcome of disease subsets and relationship of joint disease to nail and skin disease. Br J Rheumatol 1994;33:834-9.
41. Moll JM. The clinical spectrum of psoriatic arthritis. Clin Orthop Relat Res 1979;143:66-75.
42. Moghaddassi M, Shahram F, Chams-Davatchi C, Najafizadeh SR, Davatchi F. Different aspects of psoriasis: analysis of 150 Iranian patients. Arch Iran Med 2009;12:279-83.
43. Mchugh NJ. Other seronegative spondyloarthropathies. Medicine 2002;30:61-3.
44. Scarpa R, Oriente P, Pucino A, Torella M, Vignone L, Riccio A, et al. Psoriatic arthritis in psoriatic patients. Br J Rheumatol 1984;23:246-50.
45. O'Neill TW, Evison G, Bhalla AK. 'Pseudoarthroplastic' hand in arthritis mutilans. Br J Rheumatol 1992;31:559-60.
46. Pavlica L, Perić-Hajzler Z, Jovelić A, Sekler B, Damjanović M. Psoriatic arthritis: a retrospective study of 162 patients. Vojnosanit Pregl 2005;62:613-20.
47. Radke H. [Arteriographic studies on arthritis mutilans]. [Article in German] Fortschr Geb Rontgenstr Nuklearmed 1956;84:480-2.
48. Perdices Acero C, García Méndez P, Delgado Lacosta A, De la Gala Sánchez F. Radiological evolution of the crippling form of psoriatic arthritis. Mapfre Medicina 2001;12:54-8.
49. Pomerantz RG, Mody E, Husni ME, Qureshi AA. Follow-up of psoriatic arthritis mutilans patients treated with anti-TNF-alpha therapy. J Drugs Dermatol 2009;8:406-12.
50. Calzavara PG, Cattaneo R, Franceschini F, Tosoni C, Martinelli M, Carlino A. Antinuclear antibodies in psoriatic arthritis and its subgroups. Acta Derm Venereol Suppl 1989;146:31-2.
51. Eroschenko K, Cleaveland KW, Gunter K. Psoriatic arthritis: a review. J Pharm Pract 2009;22:86-103.
52. Gaffar M. Arthritis mutilans in a patient with psoriasis. Hosp Physician 2002;38:46-50.
53. Gu NY, Liu B, Gu F, Ding C. Clinical analysis of 29 patients with psoriatic arthritis. J Clin Dermatol 2007;36:688-90.
54. Ribeiro A, Costa J, Bogas M, Costa L, Araújo D. [Mutilans psoriatic arthritis]. [Article in Portuguese] Acta Reumatol Port 2009; 34:290-1.
55. Rose JH, Belsky MR. Psoriatic arthritis in the hand. Hand Clin 1989;5:137-44.
56. Swezey RL, Bjarnason DM, Alexander SJ, Forrester DB. Resorptive arthropathy and the opera-glass hand syndrome. Semin Arthritis Rheum 1972-1973;2:191-244.
57. Tam LS, Leung YY, Li EK. Psoriatic arthritis in Asia. Rheumatology 2009;48:1473-7.
58. Tan AL, McGonagle D. Psoriatic arthritis: correlation between imaging and pathology. Joint Bone Spine 2010;77:206-11.
59. Veale D, Rogers S, FitzGerald O. Classification of clinical subsets in psoriatic arthritis. Br J Rheumatol 1994;33:133-8.
60. Walton RL, Brown RE, Giansiracusa DF. Psoriatic arthritis mutilans: digital distraction lengthening: pathophysiologic and current therapeutic review. J Hand Surg Am 1988;13:510-5.
61. Yamamoto T, Yokozeki H, Nishioka K. Clinical analysis of 21 patients with psoriasis arthropathy. J Dermatol 2005;32:84-90.
62. Leonard DG, O'Duffy JD, Rogers RS. Prospective analysis of psoriatic arthritis in patients hospitalized for psoriasis. Mayo Clin Proc 1978;53:511-8.
63. Wright V. Psoriatic arthritis. A comparative radiographic study of rheumatoid arthritis and arthritis associated with psoriasis. Ann Rheum Dis 1961;20:123-32.
64. Rodriguez-Moreno J, Bonet M, Del Blanco-Barnusell J, Castaño C, Clavaguera T, Mateo-Soria L, et al. Mutilating/resorptive arthritis. A study of 24 patients in a series of 360 patients with psoriatic arthritis. Reumatol Clin 2013;9:38-41.
65. Nossent JC, Gran JT. Epidemiological and clinical characteristics of psoriatic arthritis in northern Norway. Scand J Rheumatol 2009;38:251-5.
66. Candia L, Cuellar ML, Marlowe SM, Marquez J, Iglesias A, Espinoza LR. Charcot-like arthropathy: a newly-recognized subset of psoriatic arthritis. Clin Exp Rheumatol 2006;24:172-5.
67. Bruzzese V, Marrese C, Ridola L, Zullo A. Psoriatic arthritis mutilans: case series and literature review. J Rheumatol 2013;40:1233-6.
68. González-Nieto JA, López-Montes L, Gallego-García F, Tugues-Roure JM. [Psoriatic arthritis mutilans]. [Article in Spanish] Rev Clin Esp 2012;212:e87.
69. Avila R, Pugh DG, Slocumb CH, Winkelmann RK. Psoriatic arthritis: a roentgenologic study. Radiology 1960;75:691-702.
70. Fawicitt J. Bone and joint changes associated with psoriasis. Br J Radiol 1950;23:440-53.
71. Jungmann H, Stern VS. An unusual case of joint disease. (A possible example of arthritis psoriatica). Br J Radiol 1944;17:383-5.
72. Storm S. A case of arthropatica psoriatica. Acta Radiol 1921;1:21.
73. Shlionsky H, Blake FG. Arthritis psoriatica; report of a case. Ann Int Med 1936;10:537-46.
74. Chandran V, Thavaneswaran A, Pellett F, Gladman DD. The association between human leukocyte antigen and killer-cell immunoglobulin-like receptor gene variants and the development of arthritis mutilans in patients with psoriatic arthritis. Arthritis Rheum 2011;63 Suppl 10:1362.
75. Marie P, Leri A. [A rare variety of chronic rheumatism: opera glass hand]. [Article in French] Bull Soc Med Hop Paris 1913;36:104.
76. Nielsen B, Snorrason E. [Arthritis mutilans: Hand and finger telescope.] [Article in French] Acta radiol 1946;27:607-16.
77. Johnson SR, Swiston JR, Granton JT. Prognostic factors for survival in scleroderma associated pulmonary arterial hypertension. J Rheumatol 2008;35:1584-90.
78. Johnson SR, Tomlinson GA, Hawker GA, Granton JT, Feldman BM. Methods to elicit beliefs for Bayesian priors: a systematic review. J Clin Epidemiol 2010;63:355-69.
79. Johnson SR, Tomlinson GA, Hawker GA, Granton JT, Grosbein HA, Feldman BM. A valid and reliable belief elicitation method for Bayesian priors. J Clin Epidemiol 2010;63:370-83.
80. FitzGerald O, Mease PJ, Helliwell PS, Chandran V. GRAPPA 2013 Annual Meeting, rheumatology updates: psoriatic arthritis (PsA) biomarker project, arthritis mutilans, PsA-peripheral spondyloarthritis epidemiology project. J Rheumatol 2014; 41:1244-8.