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Erosive osteoarthritis: A systematic analysis of definitions used in the literature

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Abstract

Background: Erosive osteoarthritis (EOA) is a commonly invoked diagnosis representing an important variant of hand osteoarthritis (OA). There is increasing literature on the prevalence, risk factors, etiology, and management of EOA.

Methods: We systematically reviewed the literature to assess variability in the diagnostic definitions used to define EOA in these studies.

Results: We reviewed 336 articles and found 62 articles citing diagnostic definitions for EOA. Radiographic appearance was the most commonly used criterion, but there was little agreement on the details or extent of the radiographic changes. Overall, 56 of the 62 studies included clinical features in the diagnostic definitions, yet these features varied considerably. Exclusion criteria were mentioned in 43 of the studies.

Conclusion: Based on the widely disparate definitions of EOA, we urge caution in interpretation of this literature, and propose that further understanding of EOA will require consensus on its definition.

Keywords

Osteoarthritis; Erosive osteoarthritis; Inflammatory osteoarthritis

Introduction

The clinical syndrome known as erosive osteoarthritis (EOA) represents an important and clinically challenging type of hand osteoarthritis. The term erosive osteoarthritis (EOA) was first used in 1966 by Peter et al. [1]. Interestingly, many of this original cohort eventually developed rheumatoid arthritis. Synonyms at times used interchangeably in the literature include “inflammatory osteoarthritis” and “erosive osteoarthrosis.” Interest in this subset of OA has persisted and considerable literature on this topic exists. There is intriguing evidence that the epidemiology, clinical presentation, and even severity of symptoms differs from

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typical hand OA and yet management strategies are poorly defined and largely untested. Many unanswered questions have fostered a healthy debate about how EOA should be viewed by researchers and clinicians. In particular, controversy exists about whether it should be defined solely by radiographic findings or should include clinical criteria and, moreover, whether EOA should be considered a phase on a continuum of hand OA evolution.

In practice, EOA is often recognized by radiographic changes characterized by erosions and central cortical collapse. These may be accompanied by osteophytes, subchondral cyst formation, periarticular ossicles, and, less commonly, subluxations and ankyloses [2,3]. Clinical features attributed to EOA include an abrupt onset of severe hand pain with variable degrees of stiffness, erythema, joint swelling, esthetic concerns, and deformities [4,5]. Some authors suggest EOA patients may be younger than those with typical hand OA though a lack of an established EOA definition makes the epidemiology difficult to interpret [6].

Data from the Framingham Offspring and Community cohorts estimate the prevalence of EOA in the general population to be 3% among men and 10% among women though prevalence estimates are likely to vary significantly based on the specific population studied [7]. Other studies assessing progression of hand OA cite 40% of patients with classical osteoarthritis were “complicated by manifest erosive changes” [8]. Thus, EOA may comprise a significant number of patients with hand OA.

The diagnosis of EOA is currently challenging. Disease mimics include common inflammatory arthritides such as psoriatic arthritis and rheumatoid arthritis. Sjogren’s syndrome has been associated with a very destructive arthritis involving the PIP joints [9]. Crystal-induced arthropathies including gout, calcium pyrophosphate deposition disease, and basic calcium phosphate-induced periarthritis can also produce similar symptoms. It remains unclear how EOA relates to typical hand OA, it may be a subtype of hand OA rather than a unique disease entity.

In reviewing the EOA literature, we noted considerable variation in the disease definition. Inconsistent disease definition precludes a full understanding of many of the key aspects of EOA and complicates diagnostic strategies. In addition, interpretation of newly identified biomarkers, improved imaging technology including ultrasonography, and advanced genetic analyses requires a precise disease definition. Perhaps most importantly, the lack of diagnostic consensus on EOA seriously weakens the impact of clinical studies of therapies for this painful osteoarthritis.

We undertook a systematic review of the body of literature on EOA with an objective of assessing the variability of published definitions of EOA.

Patients and methods

Literature search

We performed an electronic literature search of PubMed and Ovid/Medline using search terms “erosive osteoarthritis” and “erosive OA” for articles published between 1962 and August 2015.

Inclusion and exclusion criteria

Studies were included for analysis if they met the following criteria: English language, human subjects, greater than or equal to 3 patients studied, a stated definition of EOA, and focus on hand OA. All identified review articles, case reports, letters to the editor, and opinion pieces were excluded.

Results

The Figure represents a flow sheet of the study selection process. Search term “erosive osteoarthritis” (search 1) identified 329 articles while use of “erosive OA” (search 2) identified 109 articles. Only 7 of the 109 articles found with search 2 were not found with search 1. Therefore, after reviewing 336 studies, 62 met our inclusion criteria and are represented in the Table.

The sizes of the studies varied among the 62 studies included for analysis with patient numbers ranging from 3 to 355. Defining clinical definition as information obtainable by history or physical exam, 55 of the 62 studies used a definition that included some combination of both clinical and radiographic parameters. Overall, 37 studies used the 1990 ACR criteria for hand OA as a clinical criterion [10]. One study used the EULAR task force evidence-based recommendations for hand OA diagnosis published in 2008 [11]. Six studies used no clinical inclusion. In all, 18 of the 62 studies employed unique clinical criteria based on features such as the number of involved joints, pain levels on VAS, presence of visible or palpable nodes, duration and frequency of joint pain, swelling, and stiffness.

Radiological definitions were included in all studies except one and remain the major parameter for the definition of EOA. The single study not including a radiographic criterion was a magnetic resonance imaging study (54). In all, 17 of the 62 studies used a named OA grading or scoring system such as Kellgren and Lawrence [2], Verbruggen and Veys [12], or Kallman [3].The majority of studies (64%) outlining individual radiographic definitions for EOA often included common terms such as central articular erosions, subchondral erosions, ankyloses, or “gull wing” or “saw tooth” deformities. Five studies refer to “typical” EOA radiographic findings as a radiologic definition. Sixteen studies included images of radiographs depicting examples of EOA. Radiographic definitions included a threshold for the number of involved joints in 37 of the 62 studies identified. Of those 37 articles, 19 required ≥ 1 involved joint, 12 required ≥ 2 involved joints, and 6 required ≥ 3 involved joints. Four studies included the presence of MCP erosions as an exclusion criterion.

Overall, 40 of the 62 studies included an alternative diagnosis as an exclusion criterion. The presence of psoriasis, rheumatoid arthritis, a spondyloarthropathy, crystal arthropathy, a

metabolic condition, and trauma are all sporadically mentioned as exclusion criteria. Twelve studies included the presence of a positive rheumatoid factor as an exclusion criterion. Four studies also included the presence of a positive ANA or elevated inflammatory markers as exclusion criteria. Interestingly, the presence of a family history of psoriasis was also infrequently mentioned as an exclusion criterion.

Discussion

It is not clear whether EOA is a subset of HOA to be placed on a spectrum of degenerative joint diseases or whether it represents a separate disease entity with a pathophysiology similar to arthropathies traditionally felt to represent inflammatory disease such as crystal arthritis, rheumatoid arthritis, or spondyloarthropathy. However, defining EOA remains critical in order to study the disease further with hopes of improved understanding of the pathogenesis and, ultimately improve accuracy of diagnosis and efficacy of treatment. The goal of this work was not to establish a set of diagnostic criteria but rather to carefully review the available literature and determine disparities and trends across studies regarding the definition of EOA.

This systematic review found remarkably little uniformity among studies regarding a definition of EOA. While the majority of studies (60%) used the 1990 ACR hand OA definition (which includes patient experiencing pain, aching, or stiffness along with hard tissue enlargement of 2 or more selected joints and fewer than 3 swollen MCP joints along with hard tissue enlargement of 2 or more DIP joints or deformity of 2 or more of 10 selected joints), some included no clinical definitions and 30% of studies included no exclusion criteria to limit inclusion of common EOA mimics. Nearly all studies used some form of a radiographic definition. However, radiographic definitions varied widely and the majority of authors used their own unique radiographic definitions of EOA. Approximately, 1/3 of studies required patients to only meet radiographic criteria at a single joint often without any consideration of prior joint trauma or other local processes. Masking even more lack of uniformity when it comes to defining EOA in the literature is the observation that several authorship groups are cited multiple times in the Table. For example, the Italian group of authors including Dr. Punzi is responsible for 7 out of the 62 publications.

There are many potential reasons for this lack of consistency in the EOA literature. Central to the problem, undoubtedly, is it is unknown whether EOA is a unique entity or whether it represents a true subtype of HOA. As a result, there are no established diagnostic or classification criteria for EOA accepted by musculoskeletal medicine groups or societies. Proposed diagnostic criteria have been outlined which includes a combination of clinical criteria, exclusion criteria, limited radiographic criteria, and normal (or near normal) markers of inflammation but these are not validated and do not seem widely used [13]. In addition, the pathogenesis of EOA remains unclear with an evolving literature regarding biomarkers and imaging advancements with potential to continuously redefine the disease. Finally, diagnostic criteria are particularly important for recruitment for therapeutic studies which are, in general, limited in HOA literature. Radiographic definitions for defining EOA are very important. However, there currently is not a clear consensus regarding a preferred method for an HOA grading scale and, moreover, correlation between pain, disability, and

radiographic findings is known to be poor. Several scoring systems have been created in an effort to grade osteoarthritis severity. Among them, the initial Kellgren and Lawrence system has been criticized for an excessive dependence on the presence of osteophytes and a modified score has been created to combat this potential shortcoming [14]. Large image collections, including the OARSI atlases, are widely available and provide a standardized semi-quantitative methodology to assess for presence and severity of OA at many anatomical sites including the hand [15]. Another scoring system from Verbruggen and Veys based on a paradigm involving successive and radiographically recognizable phases of hand OA now includes an updated Ghent University Scoring System (GUSS) to adjust for pathological changes and phase overlap felt to be unique to EOA [16].

Future diagnostic definitions will need to consider demographics (including age and gender), description and duration of symptoms, longitudinal data regarding number of joints involved over time, and exam findings. In addition, major components of any future diagnostic definition of EOA should include well-defined radiographic findings as well as important “negatives” such as serology results and presence of co-morbidities such as psoriasis, inflammatory bowel disease, gout, and calcium pyrophosphate deposition disease. Most importantly, identifying efficacious treatments, that are rigorously tested, for patients suffering from EOA, will require an established disease definition.

Conclusion

In our review, we observed a lack of uniform diagnostic definitions in the EOA literature. In the future, it will be necessary to define EOA so as to establish clear classification and diagnostic criteria.

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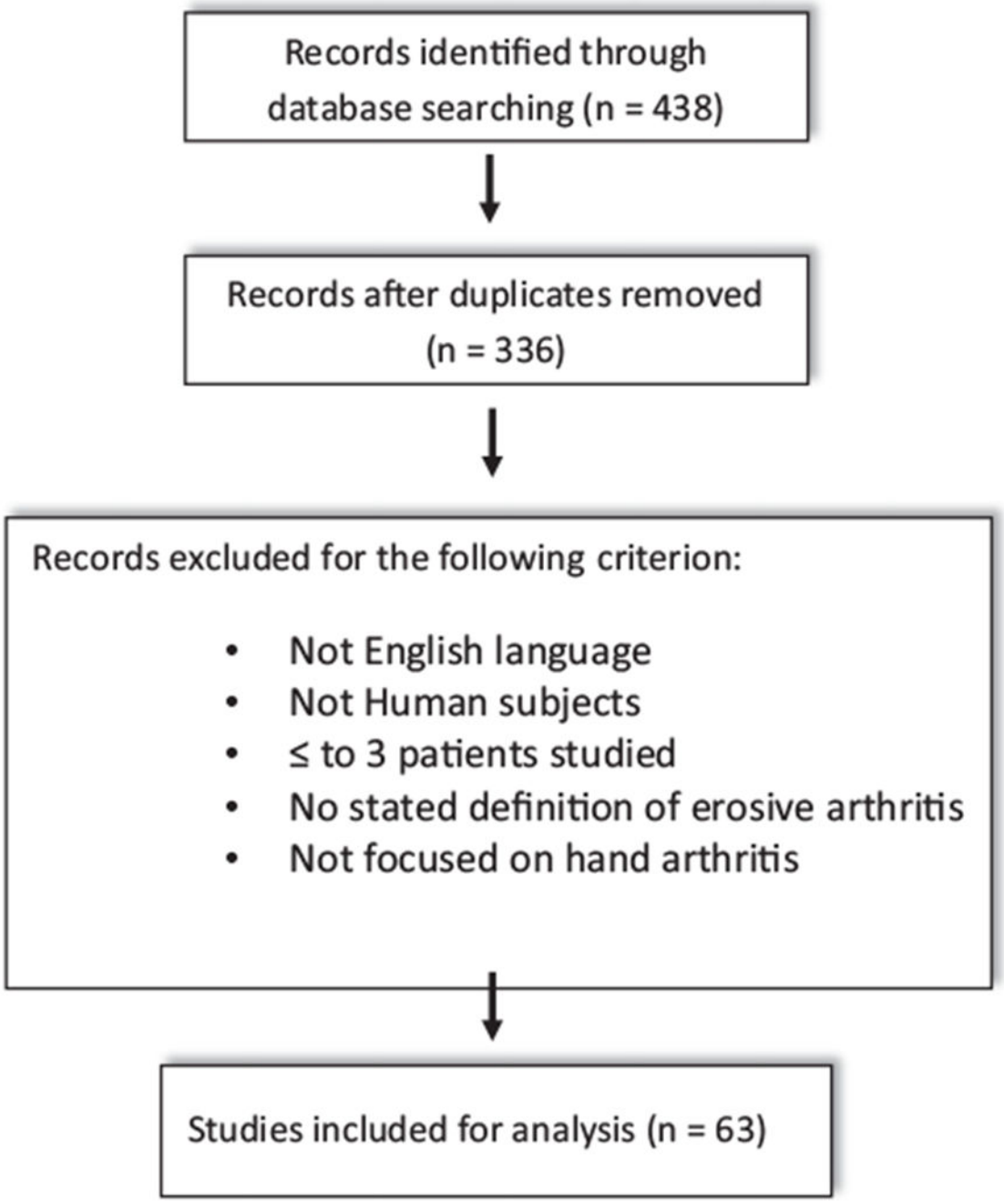

Fig.
Flow diagram of study selection process.

Table

Studies included in the systematic review

				Exclusion criteria		
	Clinical criteria	**Radiologic criteria**	**No. of EOA patients**	**Labs**	**Patient characteristics**	**Family history of psoriasis**
1 [17]	"… onset abrupt and painful"	Radiographic evidence of osteoarthritis	170		History of psoriasis	
	Nodal enlargement of small joints of hands				History or laboratory evidence of other rheumatic diseases	
2 [18]		Osseous production or osteophytes of the PIP or DIP joints	15			
		Erosions of the PIP and DIP joints				
		Absence of erosions at the inferior radioulnar or carpal articulations				
3 [19]	Symptomatic polyarticular IP hand OA affecting more than three rays of each hand— Heberden's node formation	Subchondral erosions in three or more rays of each hand	10		Unrelated to obvious trauma	
4 [20]	Symptomatic polyarticular IP hand OA affecting more than three rays of each hand	Subchondral erosions in three or more rays of each hand	10		History of clinical, radiographic, or serological evidence of additional arthropathy	
	Heberden's node formation					
5 [21]	"Presence of pain or stiffness in the fingers"	K/L grade III or IV OA in at least one joint with erosion of subchondral bone	19			
6 [22]		Bony erosions, collapse of subchondral plate or joint ankyloses of DIPs, PIPs, thumb IP joint, or MCPs	33		History of serologic or radiologic evidence of rheumatoid arthritis, psoriatic arthritis, SLE, or CPPD	
7 [23]	"…frank painful arthritis of PIP, DIP, and TMC joints."	Joint-space narrowing and central joint erosions of PIP, DIP, and TMC joints	24		History of psoriasis, diabetes, spondyloarthritis, rheumatoid arthritis, gout, and tenosynovitis	Yes
					Juxta-articular osteoporosis	
					Marginal erosions "Laboratory abnormalities"	
8 [24]	"Inflammatory arthritis of PIP and DIP ...."	Evidence of OA and also bone erosions, collapse of subchondral plates, or joint ankylosis	15		History of other rheumatologic disorders known to cause articular changes	
9 [25]	ACR criteria for hand OA	Subchondral erosions and ankylosis of IP joints	20		History of rheumatoid arthritis, psoriatic arthritis, spondyloarthritis, and hyperparathyroidism	
10 [26]	"… acute, with pain, swelling, and tenderness of the joints."	Presence of ≥3 subchondral erosions in DIPs, PIPs, 1st CMC, and trapezioscaphoid joints	28	RF+		

				Exclusion criteria		
	Clinical criteria	**Radiologic criteria**	**No. of EOA patients**	**Labs**	**Patient characteristics**	**Family history of psoriasis**
11 [27]	"… phlogistic involvement of the DIP and PIP joints of each hand …"	"Typical" central erosions in IP joints	56	RF+ ANA+	History of psoriatic arthritis or psoriasis, RA, gout, pseudogout, Raynaud's phenomenon, or undifferentiated spondyloarthropathies	
12 [28]		≥ 1 Central erosion in DIP and/or PIP	24		History of other erosive inflammatory and "dysmetabolic" conditions	
13 [29]	ACR criteria for hand OA	Central erosions	21		Post-menopausal Disease duration > 5 years	
14 [30]	"Inflammatory involvement of the DIP and/or PIP joints of each hand."	"Typical EOA radiographic findings"	56			
15 [31]	ACR criteria for hand OA	≥ 1 Joint erosions in thumb IP, DIPs, PIPs, and CMC-1	101			
16 [32]	ACR criteria for hand OA	Radiographic central erosions and/or ankyloses in the IP joints of the hands in at least three digits	26		History of inflammatory arthritis, psoriasis, or CPPD.	
		Absence of erosions in the MCPs, carpal joints, or radio-carpal joint				
17 [33]	ACR criteria for hand OA	≥ 1 Central erosion in DIP or PIP	24		History of other erosive inflammatory and "dysmetabolic" conditions	
18 [34]	ACR criteria for hand OA	Central erosions and/or ankylosis in IP joints in at least three digits	30		Personal history of psoriasis	Yes
					History of other rheumatic or skeletal degenerative diseases	
19 [35]	ACR criteria for hand OA	At least 2 erosions in IP joints	84			
		No erosions in MCPs				
20 [36]		"… typical EOA radiologic findings."	32		History of psoriatic arthritis, rheumatoid arthritis, undifferentiated spondyloarthropathies, gout, and pseudogout	
21 [37]	ACR criteria for hand OA	≥ 2 Erosions in DIP or PIP joints	67	RF+	History of other known arthropathies	
		No erosions in MCPs				
22 [38]	"Swelling, pain, and tenderness of DIP and PIP joints"	"Typical central erosions, subchondral plate collapse and bone ankyloses in combination with classical OA changes"	22	ESR > 20 mm/h CRP > 0.5 mg/dl	Radiographic signs of rheumatoid arthritis, psoriatic arthritis, chondrocalcinosis, and gout	
	Heberden's and Bouchard's nodes			RF+ ANA+		

				Exclusion criteria		
	Clinical criteria	**Radiologic criteria**	**No. of EOA patients**	**Labs**	**Patient characteristics**	**Family history of psoriasis**
23 [39]	ACR criteria for hand OA	Central erosions, and/or ankylosis in the IP joints in at least 3 digits, associated with joint-space narrowing, subchondral sclerosis and/or osteophytes	15		History of psoriasis	Yes
24 [40]	ACR criteria for hand OA	≥ 1 Articular surface erosion at the DIP and/or PIP	12		History of SLE, psoriasis	
25 [41]	ACR criteria for hand OA	K/L scoring	30		History of fracture, inflammatory disease (RA) or Paget's disease.	
26 [42]	High pain level on VAS	"Important radiographic erosions"	3	RF+ CCP+ ESR > 10 mm/h		
27 [43]	ACR criteria for hand OA	Single erosion of PIP or DIP joint Kallman grading scale	55			
28 [44]	ACR criteria for hand OA	Erosions on articular surface	22			
29 [45]	ACR criteria for hand OA	Central articular erosions in at least 1 PIP or DIP joints	10	RF+ CCP+ ANA + ESR/CRP in normal range	History of concomitant rheumatic disease	
30 [46]		Erosive OA PIP and DIP joints (excludes thumb)	18		History of other rheumatologic conditions	
31 [47]	ACR criteria for hand OA	Erosions in the central joint area of the IP joints	18	RF+		
32 [48]	ACR criteria for hand OA	"Typical erosive changes in two or more digits"	197		History of other inflammatory arthritides or psoriasis	Yes
33 [49]	ACR criteria for hand OA	Erosive features according to the V/V system in ≥ 2 IP joints	12			
34 [50]	ACR criteria for hand OA	Classic central erosions in at least 2 joints	13	RF+	History of psoriasis, connective tissue disease, other inflammatory arthritides, inflammatory bowel diseases, gout, or chondrocalcinosis	Yes
35 [51]	ACR criteria for hand OA	Presence of erosions in at least 1 joint	31			
36 [52]	ACR criteria for hand OA	Presence of central subchondral bone erosions in ≥ 2 IP joints of the hands	94	RF+ CCP+	History of other known arthropathies, radiographic chondrocalcinosis, or sacroillitis	Yes
37 [53]	ACR criteria for hand OA	EULAR recommendations for EOA	32		History of infections, cancer, renal, and liver diseases, cryoglobulinemia, scleroderma, sjogren syndrome, autoimmune thyroiditis, psoriatic arthritis	

	Clinical criteria	Radiologic criteria	No. of EOA patients	Exclusion criteria		Family history of psoriasis
				Labs	Patient characteristics	
					undifferentiated spondyloarthropathies, gout, and pseudogout.	
38 [54]	EULAR recommendations for the diagnosis of hand OA		9			
39 [55]	ACR criteria for hand OA	≥ 1 Erosive IP finger joint	9			
40 [56]	Self-reported hand pain	≥ 1 IP joint with erosions according to the V/V system	96			
41] [57]	ACR criteria of hand OA	"Erosive pattern" K/L and Kallman scoring systems	233		History of clinical and laboratory features of chronic inflammatory rheumatic diseases (including microcrystal diseases)	Yes
42 [58]	ACR criteria of hand OA	Kallman grading scale	31			
43 [59]	ACR criteria for hand OA	≥ 1 IP finger joint in erosive phase of V/V system	60	RF+ CCP+	History of chronic inflammatory rheumatic disease	
44 [60]	ACR criteria for hand OA	Presence of erosive features in ≥ 2 IP joints according to V/V system	167		History of other rheumatic diseases or disorders that can impair the functionality of the hand	
45 [61]	Painful phase VAS score > 4/10 of two or more PIPs or DIPs	≥ 2 PIP or DIP with sharp marginal defects, central crumbling erosions	38		History of rheumatologic diseases	
46 [62]	ACR criteria of hand OA	≥ 2 IP joints with central erosions	233	RF+	History of chronic inflammatory diseases including rheumatoid arthritis, inflammatory bowel disease, uveitis, connective tissue diseases, or psoriasis. History or evidence of microcrystalline arthritis.	Yes
47 [63]	ACR criteria for hand OA	≥ 2 Joints with erosive features according to V/V system	68			
48 [64]		≥ 1 DIP/PIP joint with K/L grade > 2 and erosion in same joint	355			
49 [65]	ACR criteria for hand OA	≥ 1 Central bone erosion in IP joints No erosions in MCP and/or thumb base joint	57		History of known arthropathies or psoriasis	Yes
50 [66]	Hand pain, aching, or stiffness > 1 day in last 1 month	≥ 1 "E or R" phase DIP, PIP, or 1st IP joints according to V/V system	80			
51 [67]	Hand pain, aching, or stiffness > 1 day in last 1 month	Presence of erosions in IP joints according to V/V system	52		History of rheumatoid arthritis or psoriatic arthritis	
52 [68]	ACR criteria for hand OA	≥ 1 Erosion in IP joint	13			
53 [69]	Self-reported symptoms Presence of HN and/or BN	Central erosion in at least 2 IP joints	146			
54 [70]	ACR criteria for hand OA	≥ 1 Erosive IP joint	9		History of rheumatoid arthritis, psoriatic arthritis, or gout	

				Exclusion criteria		
	Clinical criteria	**Radiologic criteria**	**No. of EOA patients**	**Labs**	**Patient characteristics**	**Family history of psoriasis**
55 [71]	ACR criteria for hand OA	> 1 “E or R” phase joint according to V/V	28	RF+	History of other inflammatory joint disease or disorders such as carpel tunnel syndrome History of trauma or operation on the hands < 6 months ago	
56 [72]	Hand pain on a few days or more in previous month	≥ 1 “E or R” phase IP joints according to V/V system	80		History of rheumatoid arthritis or psoriatic arthritis	
57 [73]	ACR criteria for hand OA	IP joint central erosions	24			
58 [74]	Hand pain ≥ 1 day in last 1 month	≥ “E or R” phase in CMC, DIP, PIP, or 1st IP joints according to V/V system			History of systemic inflammatory rheumatic disease History of inflammatory changes on radiographs	
59 [75]	ACR criteria for hand OA	≥ 1 Erosion in DIP or PIP joint	14		History of any autoimmune disease including psoriasis	
60 [76]	ACR criteria for hand OA	≥ 1 Joints with central erosions joints with grade ≥ 2 according to K/L	131		History of inflammatory joint diseases	
61 [77]	ACR criteria for hand OA	Central erosions in IP joints Erosions in MCP joints	55		History of trauma or other arthropathies including rheumatoid arthritis, psoriatic arthritis, gout, or chondrocalcinosis	
62 [78]	ACR criteria for hand OA	“Gull-wing” configuration at DIP and/or PIP joints	17		History of arthritis/arthralgia involving the hand, such as rheumatoid arthritis, peripheral spondyloarthritis, hemochromatosis, traumatic arthritis, crystalline arthritis, and fibromyalgia.	

ACR = American College of Rheumatology, EULAR = European League Against Rheumatism, EOA = erosive osteoarthritis, OA = osteoarthritis, K/L = Kellgren and Lawrence, V/V = Verbruggen and Veys, DIP = distal interphalangeal, PIP = proximal interphalangeal, MCP = metacarpalphalangeal, IP = interphalangeal, CMC = carpometacarpal, VAS = visual analog scale, HN = Heberden’s nodes, BN = Bouchard’s nodes, “E or R” = erosive or remodeled.