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Hand osteoarthritis : natural course and determinants of outcome

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CLINICAL BURDEN OF EROSIVE HAND OSTEOARTHRITIS AND ITS RELATIONSHIP TO NODES

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ABSTRACT

Objective. To describe the clinical burden of erosive osteoarthritis (EOA) of the hand in terms of pain, functioning and health-related quality of life (HRQL), and its relationship to nodal osteoarthritis (OA).

Methods. Patients with EOA (n=42) and non-EOA (n=194) were compared. Pain was assessed with the Australian/Canadian Osteoarthritis Hand Index (AUSCAN), Michigan Hand Outcome Questionnaire (MHQ) and pain intensity upon palpation. Functioning was evaluated with AUSCAN, MHQ, grip strength, pinch grip and hand mobility tests. HRQL was measured with the Short Form-36. Patient satisfaction with hand function and aesthetics were evaluated. The presence of nodal OA as well as its extent reflected by the number of nodes was assessed. Mean differences between patient groups were estimated with linear mixed models. To determine whether differences were independent of the nodal character of disease, adjustments were made for the number of nodes.

Results. Patients with EOA experienced more pain, more functional limitations, less satisfaction with hand function and aesthetics and worse hand mobility than patients with non-EOA. HRQL was similar for the two groups. Patients with EOA had more nodes. A higher number of nodes was associated with worse outcome. After correction for the number of nodes, only hand mobility and patient satisfaction remained different between the groups.

Conclusion. Patients with EOA have a higher clinical burden than those with non-erosive disease. This higher burden is only partly attributed to erosive disease itself, but mainly to the nodal character of the disease.

INTRODUCTION

Hand osteoarthritis (OA) is a common musculoskeletal disorder characterised by degradation of cartilage and changes in subchondral bone.[1] Because of its heterogeneous character, different subsets have been proposed based on different risk factors, associations and outcomes, although evidence is limited.[2,3] Proposed subsets affecting the interphalangeal (IP) joints are erosive OA (EOA) and nodal OA.

The term EOA was first introduced by Peter et al.[4] in 1966, but its clinical and radiographic features had already been described.[5,6] EOA is a radiographic subset based on the presence of subchondral erosions which lead to deformities and sometimes to bony ankylosis.[7] Although it is assumed that EOA has a higher clinical burden and worse outcome than non-EOA, there are very few studies on this topic.[8,9] In addition, the relationship between EOA and the presence of nodes is unclear.

Whether EOA comprises a separate disease with specific risk factors and pathogenesis or a more severe subset of hand OA is unclear and therefore part of the research agenda of the EULAR OA Task Force.[2] A first step is to further characterise EOA. In addition, insight in the relationship between EOA and nodal OA can contribute to our knowledge on these subsets.

To obtain a clearer view of the clinical burden of EOA we compared patients with EOA and non-EOA with respect to pain, functioning and health-related quality of life (HRQL). In addition, we determined whether this clinical burden is attributable to the erosive character of the disease or to the presence of nodal OA.

PATIENTS AND METHODS

Study design and patient population

The Genetics ARthrosis and Progression (GARP) study population comprises 192 Caucasian sibling pairs with symptomatic OA at multiple sites in the hands or in two or more of the following joint sites: hand, knee, hip or spine. Details on recruitment and selection have been published elsewhere.[10] Patients from this population with hand OA evaluated after 6 years were included in the present study.

Diagnosis of hand OA

Hand OA was defined by the American College of Rheumatology (ACR) criteria for clinical hand OA[11] or the presence of bony swelling in ≥2 of the 10 selected joints from the ACR criteria and a Kellgren-Lawrence score ≥2 in any IP or first carpometacarpal (CMC-1) joint.

EOA was defined as the presence of erosive radiographic features according to the Verbruggen-Veys system in ≥2 IP joints.[12,13] Erosive features were assessed on standardised hand radiographs by consensus opinion of two experienced readers (JB, IW). Intrareader reproducibility for the presence of EOA was excellent (kappa=1.0). In addition, osteophytes were graded 0-3 using the Osteoarthritis Research Society International (OARSI) atlas.[14]

Nodal OA was defined as Heberden's or Bouchard's nodes assessed by palpation affecting ≥2 rays of either hand.[15] The number of nodes refers to the number of IP joints with nodes.

Self-reported pain, functioning and HRQL

Hand pain and functional limitations were assessed with the pain (5 items) and function (9 items) subscales of the Australian/Canadian Osteoarthritis Hand Index (AUSCAN), on a five-point Likert scale (0=none to 4=extreme).[16]

In addition, the Michigan Hand Outcome Questionnaire (MHQ) was used.[17,18] This hand-specific questionnaire includes 6 subscales: overall hand function, activities of daily living (ADL), pain, work performance and patient satisfaction with hand function and aesthetics. Subscale scores are calculated by summing the five-point Likert scale responses and normalizing them to 0-100.[17] Higher scores indicate better hand function, except for the pain subscale on which higher scores correspond to more pain.

The number of self-reported painful joints was assessed on a standard diagram including 30 hand joints (distal interphalangeal (DIP), proximal interphalangeal (PIP), first interphalangeal (IP-1), metacarpophalangeal (MCP) and CMC-1 joints).

HRQL was assessed with the Physical Component Summary scale (PCS) and Mental Component Summary scale (MCS) of the Medical Outcomes Study Short Form-36 (SF-36) derived using norm based data from the Dutch population.[19,20] Higher scores indicate better HRQL.

Physician-obtained measures

Pain upon joint pressure was graded 0-3 in the 30 hand joints mentioned above (0=no pain, 1=complaining of pain, 2=complaining of pain and wincing, 3=complaining of pain and withdrawal of the joint). This pain intensity score ranges from 0 to 90.

Performance

Grip strength and pinch grip were measured with a hydraulic hand dynamometer and hydraulic pinch gauge (Saehan corporation, Masan, South-Korea), respectively.

Hand mobility was assessed with the Hand Mobility in Scleroderma test (HAMIS) and fingertip to palm distance during maximal finger flexion.[21,22] Using the HAMIS the nine movements included in the range of motion of the hand are graded 0 (normal) to 3 (unable to do) for each hand and summed. The total score is the mean of two hands. Fingertip to palm distance in millimeters was measured from the finger pulp to the distal palmar crease for each finger and summed.

Statistical analysis

Data were analysed using SPSS, version 16.0 (SPSS, Chicago, Illinois, USA). Demographic and disease characteristics were compared between EOA and non-EOA patients using t-test and chi-squared test. Mean differences between these groups in measures of pain, functioning and HRQL, as well as the number of nodes, were estimated with a linear mixed model correcting for age, sex, body mass index (BMI) and with a random intercept to adjust for family effects within sibling pairs. Estimates are reported with 95% confidence intervals (95%CI).

To determine whether differences between the groups can be attributed to the erosive or nodal component of the disease, the number of nodes was taken into account. By

doing so, its influence on differences in outcome can be assessed as well as the effect of erosiveness, independent of the nodal aspect. First, the association between outcome measures and the number of nodes was determined using linear mixed models, adjusting for age, sex, BMI and family effects. Estimates indicate the change that is accompanied by the presence of one additional node. Secondly, mean differences with 95%CI for measures of pain, functioning and HRQL between EOA and non-EOA groups were estimated using linear mixed models adjusting for the number of nodes in addition to age, sex, BMI and family effects. These estimates reflect the influence of erosiveness on clinical measures independent of the nodal disease character.

We evaluated the radiographic appearance of nodes by assessing the presence and severity of osteophytes in IP joints with nodes. In addition, the above mentioned analysis was performed with correction for osteophytes instead of nodes.

RESULTS

Population description

Of the 236 patients with hand OA included, 42 (18%) were classified as having EOA. Nodal OA was present in 215 (91%) patients. All patients with EOA were also classified as having nodal OA, compared to 89% of the patients with non-EOA (p=0.031). The mean number of nodes in patients with EOA and non-EOA was 15.0 (range 6-18) and 10.6 (range 2-18), respectively (p<0 001).

The mean age was 64.8 years and 83% were women (table 1). All patients with EOA fulfilled the ACR criteria for clinical hand OA. Demographic characteristics did not differ between patient groups (data not shown).

Pain

Patients with EOA reported more pain and a higher number of painful joints than patients with non-EOA (table 2). There was a trend towards a higher pain intensity score in patients with EOA.

Table 1. Patient characteristics of 236 patients with hand osteoarthritis (OA).

Age, mean (SD) years	64.8 (6.9)
Women, no (%)	195 (83)
Postmenopausal women, no (%)	185 (95)
Body mass index, mean (SD) kg/m^2	28.3 (5.8)
ACR criteria hand OA, no (%)	206 (87)
Right handed, no (%)	187 (79)
Symptom duration, mean (SD) years	17.0 (8.2)
Additional OA sites, no (%)	
Knee	94 (40)
Hip	69 (29)
Spine	174 (74)

ACR: American College of Rheumatology

Table 2. Mean (SD) values and mean differences (95%CI) in measures of pain, functioning and health related quality of life for patients with erosive OA (EOA, n=42) and patients with non-erosive OA (non-EOA, n=194).

	EOA	Non-EOA	P-value (t-test)	Mean difference*	Mean difference taking nodes into account**
Pain					
AUSCAN pain (0-20)	9.0 (4.8)	7.0 (4.8)	0.016	2.0 (0.4 to 3.7)	1.0 (-0.7 to 2.7)
MHQ pain (0-100)	47.1 (18.1)	37.9 (22.8)	0.016	9.5 (2.0 to 17.0)	3.9 (-3.9 to 11.7)
Number of painful joints (0-30)	11.3 (6.8)	7.9 (7.8)	0.009	3.4 (0.9 to 6.0)	1.5 (-1.2 to 4.2)
Pain intensity (0-90)	8.7 (7.2)	6.6 (7.0)	0.082	2.1 (-0.2 to 4.4)	1.0 (-1.5 to 3.5)
Functioning					
AUSCAN function (0-36)	17.3 (8.7)	13.2 (8.7)	0.006	4.1 (1.2 to 6.9)	3.0 (-0.1 to 6.1)
MHQ overall function (0-100)	53.5 (14.8)	61.2 (15.6)	0.004	-7.5 (-12.7 to -2.4)	-4.8 (-10.2 to 0.6)
MHQ ADL (0-100)	73.2 (19.4)	79.3 (17.8)	0.049	-6.3 (-12.2 to -0.3)	-4.4 (-10.8 to 1.9)
MHQ work performance (0-100)	65.2 (24.5)	71.1 (25.9)	0.182	-6.2 (-14.9 to 2.5)	-5.5 (-14.9 to 3.9)
Grip strength, kg	19.7 (8.4)	21.7 (10.7)	0.241	-1.6 (-4.2 to 1.0)	-1.0 (-3.8 to 1.8)
Pinch grip, kg	3.2 (1.8)	3.2 (1.5)	0.872	0.1 (-0.3 to 0.6)	0.1 (-0.4 to 0.6)
HAMIS (0-27)	5.7 (4.0)	3.7 (2.6)	<0.001	2.1 (1.2 to 3.0)	1.2 (0.3 to 2.1)
Fingertip to palm distance, mm	54.0 (52.1)	15.1 (27.3)	<0.001	39.1 (28.0 to 50.2)	26.6 (15.4 to 37.8)
Health related quality of life					
SF-36 PCS	44.1 (9.0)	44.9 (9.1)	0.559	-1.2 (-4.2 to 1.8)	-1.2 (-4.5 to 2.1)
SF-36 MCS	50.2 (9.4)	50.6 (10.5)	0.800	-0.1 (-3.5 to 3.4)	-0.4 (-4.1 to 3.3)
MHQ function satisfaction (0-100)	45.5 (19.6)	61.6 (25.6)	<0.001	-16.1 (-24.4 to -7.7)	-11.0 (-19.8 to -2.1)
MHQ aesthetic satisfaction (0-100)	74.6 (15.2)	85.4 (16.3)	<0.001	-10.9 (-16.3 to -5.5)	-8.6 (-14.3 to -2.8)
Number of IP joint nodes (0-18)	15.0 (3.0)	10.6 (4.6)	<0.001	4.4 (3.0 to 5.8)	NA

*Adjusted for age, sex, BMI and family effects. Non-EOA was reference group.
**Adjusted for the number of nodes, age, sex, BMI and family effects. Non-EOA was reference group.
Abbreviations: AUSCAN: Australian/Canadian Osteoarthritis Hand Index, MHQ: Michigan Hand Outcome Questionnaire, HAMIS: Hand Mobility in Scleroderma, SF-36: Short Form-36, PCS: Physical Component Summary scale, MCS: Mental Component Summary Scale, IP: interphalangeal, NA: not applicable.

Functioning

Self-reported hand function measured with the AUSCAN and MHQ subscales overall function, ADL and work performance was worse in patients with EOA (table 2). Grip strength and pinch grip did not differ between the groups. Hand mobility measured with the HAMIS and finger-palm distance was worse in patients with EOA.

Health related quality of life

Although no difference in PCS between the patient groups was found, a score below 50 indicates that physical health was lower than the general population. The MCS was also similar for the groups, but not different from the general population. Patient satisfaction with hand function and aesthetics was lower in those with EOA (table 2).

Association between outcome measures and number of nodes

A higher number of nodes was related to more pain and self-reported functional limitations (table 3). Grip strength and pinch grip were not related to the number of nodes, whereas worse hand mobility was related to the number of nodes; for each additional node, the fingertip to palm distance increased 3.7 mm and the HAMIS increased 0.24 points. No relationship between the SF-36 and the number of nodes was found. Lower patient satisfaction with hand function and aesthetics was associated with the presence of more nodes.

Table 3. Association between outcome measures and the number of nodes for total population expressed as β-coefficient (95%CI).

	Association with number of nodes*
Pain	
AUSCAN pain	0.26 (0.12 to 0.39)
MHQ pain	1.37 (0.77 to 1.98)
Number of painful joints	0.50 (0.29 to 0.71)
Pain intensity	0.29 (0.09 to 0.48)
Functioning	
AUSCAN function	0.33 (0.09 to 0.58)
MHQ overall function	-0.77 (-1.20 to -0.35)
MHQ ADL	-0.56 (-1.06 to -0.06)
MHQ work performance	-0.34 (-1.07 to 0.39)
Grip strength, kg	-0.17 (-0.39 to 0.05)
Pinch grip, kg	0.02 (-0.02 to 0.06)
HAMIS	0.24 (0.17 to 0.31)
Fingertip to palm distance, mm	3.71 (2.79 to 4.64)
Health related quality of life	
SF-36 PCS	-0.04 (-0.29 to 0.21)
SF-36 MCS	0.06 (-0.23 to 0.35)
MHQ function satisfaction	-1.51 (-2.20 to -0.81)
MHQ aesthetic satisfaction	-0.79 (-1.24 to -0.33)

*Adjusted for age, sex, BMI and family effects.
Abbreviations see table 2.

Pain, functioning and HRQL adjusted for number of nodes

Mean differences in pain, functioning and HRQL were estimated with additional adjustment for the number of nodes (table 2). The estimated mean difference for all outcome measures was lower after this adjustment. Only hand mobility and patient satisfaction with hand function and aesthetics remained significantly different between patients with EOA and non-EOA. Adjustment for osteophytes instead of nodes did not change the results.

Structural abnormalities in IP joints with nodes

In the total population 13% (340/2682) of the IP joints with nodes had osteophytes grade 2-3 reflecting severe structural changes (table 4). For patients with EOA and non-EOA these proportions were 40% (255/628) and 4% (85/2054), respectively.

DISCUSSION

This study was one of the first to investigate the clinical burden of EOA by comparing pain, functioning and HRQL between patients with EOA and non-EOA. It was found that patients with EOA experience more pain, report more functional limitations, have worse hand mobility and are less satisfied with hand function and aesthetics than those with non-EOA. HRQL was comparable for the patient groups. Patients with EOA had more nodes, which was also found to be a determinant of clinical outcome. Taking into account the number of nodes, only hand mobility and patient satisfaction remained different between the groups. These findings demonstrate that the clinical burden of EOA is higher compared to its non-erosive counterpart. However, it seems that this higher burden cannot exclusively be attributed to the erosive character but also to the nodal character of the disease.

Our results are in line with a study showing that patients with EOA reported more pain during ADL tasks than patients with non-EOA, but that grip strength did not differ between the groups.[9] Maheu, et al. showed that patients with EOA reported more functional limitations, more aesthetic damage, similar HRQL and similar pain levels compared to those with non-EOA.[8] This last finding is in contrast with our results, which may be due to difference in outcome measures.

Hand mobility was assessed with the HAMIS and fingertip to palm distance. The HAMIS was developed for scleroderma patients. However, it can be regarded as a

Table 4. Osteophyte grades for interphalangeal (IP) joints with and without nodes for the total population as well as erosive OA (EOA) and non-erosive OA (non-EOA) patient groups.

	Total population Number of IP joints		EOA Number of IP joints		Non-EOA Number of IP joints	
	with nodes	without nodes	with nodes	without nodes	with nodes	without nodes
Osteophytes grade 0	1237	1215	143	95	1094	1120
Osteophytes grade 1	1105	336	230	31	875	305
Osteophytes grade 2-3	340	4	255	1	85	3
Total	2682	1555	628	127	2054	1428

generic test since it evaluates all movements included in the range of motion of the hand, which was supported by a study showing that the HAMIS was valid for patients with rheumatoid arthritis.[21,23] HAMIS and fingertip to palm distance showed the same results, indicating construct validity of both measures.

For both groups it was found that physical health was lower compared to the general population, which is in line with a study by Slatkowsky-Christensen, et al.[24]

Patient satisfaction with hand function and aesthetics in hand OA comprises a domain not studied before. Although aesthetic damage is considered of potential importance in the evaluation of hand OA[3], a recognised outcome measure is lacking. We have shown that the MHQ could serve this purpose.

There are a number of potential limitations to address. First, the GARP study was not designed to investigate differences between EOA and non-EOA. As a consequence the number of patients with EOA is relatively small, although it is the largest group of patients with EOA studied to date. This may reflect clinical practice in which, in our experience, EOA is not very prevalent. Data on the prevalence of EOA in a hospital population are unavailable. Cavasin, et al. showed that 8.5% of the general population of the Venetian area in Italy with signs or symptoms of hand OA had EOA.[25] Second, patients in the present study had familial OA at multiple sites. Whether this specific phenotype affects our findings is unclear, and therefore similar studies in other OA phenotypes are warranted.

We found that a higher number of nodes was associated with more pain, more functional limitations and less patient satisfaction. This is in line with a study reporting that Heberden's nodes were positively related to hand pain.[26] Only part of the nodes had high-grade osteophytes and this proportion was higher in patients with EOA than in those with non-EOA. This suggests that nodes do not only reflect severe structural abnormalities. The pathogenesis and role of nodes in IP joint OA is not fully understood. Nodes develop from mesenchymal stem cells from the periosteum or synovium by chondrogenesis and endochondral ossification induced by growth factors from the transforming growth factor β (TGF-β) family.[27] Erosions are the product of increased osteoclast activity induced by inflammatory cytokines.[28] Hence, processes involved in node and erosion formation seem to be different.

After taking the number of nodes into account, pain and self-reported functional limitations between the patient groups were no longer different. This implies that the higher levels of these outcomes in patients with EOA cannot exclusively be attributed to erosiveness. Differences in hand mobility and patient satisfaction, however, remained significant after correction for the number of nodes meaning that they can also be attributed to erosiveness. A possible explanation is that hand mobility is a mechanical feature with structural underlying pathology, as seen in EOA.[7]

This study showed that the clinical burden in patients with EOA is higher than in those with non-EOA. This higher burden seems to be due to the nodal character and only partly to the erosive character of the disease. Further research on disease characteristics, risk factors and the pathogenesis of EOA is needed to determine whether it comprises a separate disease and, more importantly, to enable the development of new treatment strategies.

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