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Osteophytes and joint space narrowing are independently associated with pain in finger joints in hand osteoarthritis

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ABSTRACT

Objective

To study the associations between structural abnormalities on ultrasound (US) or conventional x-rays (CR) and pain in hand osteoarthritis (HOA).

Material and methods

In 55 consecutive patients with HOA (mean age 61 years, 86% women), fulfilling the American College of Rheumatology criteria, pain in 30 separate hand joints was assessed upon palpation; osteophytes were assessed by US and CR and joint space narrowing (JSN) by CR. Associations between structural abnormalities and pain per joint were analysed using generalized estimating equations to account for patient effects and adjusted for age, sex, body mass index, US inflammatory features and other remaining structural abnormalities.

Results

In 1649 joints, 69% and 46% had osteophytes on US and CR, respectively and 47% had JSN. Osteophytes and JSN showed independent associations with pain per joint adjusted: OR for osteophytes: 4.8 (95% CI 3.1 to 7.5) for US and 4.1 (95% CI 2.4 to 7.1) for CR; for JSN: 4.2 (95% CI 2.0 to 9.0)

Conclusions

Osteophytes and JSN are independently associated with pain in individual HOA joints taking in account patient effects.

INTRODUCTION

In hand osteoarthritis (HOA), the most predominant structural abnormalities -cartilage loss and marginal bony enlargements- have been studied mainly by conventional x-rays (CR) as osteophytes and joint space narrowing (JSN). Recently, ultrasound (US) studies have been performed[1,2,3] and suggest that US has a higher sensitivity for osteophytes than CR. However, US has difficulties detecting JSN when bony irregularities overlie the joint space,[1] and therefore seems less suitable as imaging modality for JSN.

HOA can cause considerable pain, and one could assume that structural abnormalities play a role in the aetiology of this clinical feature. However, in earlier CR studies limited associations were demonstrated.[4] An explanation for the limited associations could be that relationships were studied using global scores for pain and summated scores for structural abnormalities. Since all the signs of separate hand joints are combined into one score per patient, associations might be concealed. Second, since pain is a subjective experience influenced by genetic predisposition[5] and psychosocial factors such as the experience and expectations of patients,[6,7] it is important to take in account patient effects. In HOA this can be done by comparing affected with non-affected joints within the same patient using generalized estimating equation (GEE) analyses. This was not performed in previous studies.

We have investigated the association between structural abnormalities and pain in HOA. To prevent the above mentioned potential limitations, associations were studied at the patient level and at the individual joint level controlling for person confounding using both US and CR.

Methods

Patient population and osteoarthritis diagnosis

Consecutive patients fullfilling the American College of Rheumatology criteria for HOA[8] and at least 45 years of age were recruited from the rheumatology outpatient clinic of the Leiden University Medical Centre, The Netherlands, from May 2008 to February 2010. For HOA this is a secondary consultation centre for the region.

Local medical ethics committee approval and patients' informed consent were obtained.

Exclusion criteria were presence of rheumatoid factor, other inflammatory joint disease or disorders such as carpal tunnel syndrome, trauma or operation on the hands within 6 months, intra-articular injection within 3 months, or oral corticosteroids within 1 month prior to inclusion.

Clinical assessment

Hand pain over the last 48 h was assessed by a 100 mm visual analogue scale (VAS) and by the subscale of the Australian Canadian Osteoarthritis Hand Index (AUSCAN).[9] Function was assessed using AUSCAN subscale. AUSCAN responses are rated on a five-point Likert scale ranging from 0 (none) to 4 (extreme).

All 1st carpometacarpal (CMCJs), 1st interphalangeal (IPJs), metacarpalphalangeal (MCPJs), proximal interphalangeal (PIPJs) and distal interphalangeal (DIPJs) were examined for pain upon lateral pressure (0=none, 1=tender, 2= wincing, 3=withdrawal) using a validated Doyle Index for the hands.[10,11] No analgesics were allowed 72 h before the clinical and US assessment.

Ultrasound procedure

US and clinical assessment were performed on the same day by two ultrasonographers (MCK and WYK) in consensus, who were blinded to clinical findings and CR scores, using a Toshiba Applio scanner (Toshiba Medical systems, Tustin, California) with a 10-14 MHZ linear array transducer. Power Doppler Signal (PDS) was assessed with a pulse repetition frequency of 13.2 KHz and medium wall filter. Gain was adjusted until background signal was removed.

All joints were scanned from the dorsal side only in longitudinal and transverse planes, covering the dorsal and lateral sides of the joint, in accordance with a preliminary US scoring system for HOA.[12] Features had to be present in both planes.

Each joint was scored for osteophytes, PDS, effusion and synovial thickening on a 4-point scale as described previously.[13]

Intraobserver variability was tested by performing a second US in 10% randomly selected patients on the same day after at least 5 h, with at least one other US assessment in between. The intraobserver variability, taking in account the severity of the score, depicted by the intraclass coefficient (ICC) was 0.71 for osteophytes 0.73 for effusion, 0.73 for synovial thickening and 0.57 for PDS.

Radiographic assessment

Dorsal-volar hand x-rays were obtained within 16 weeks of the US assessment. The x-rays were scored for osteophytes (0-3) and JSN (0-3)[14] by one observer (MCK) blinded to patient characteristics and US outcomes. The intrareader variability, based on 10 randomly selected x-rays, depicted by the ICC was 0.73 for osteophytes, 0.67 for JSN.

Statistical analysis

With linear regression analysis the relationship between structural abnormality summated scores and AUSCAN pain, VAS pain and summated score of the Doyle Index was studied, adjusting for age, sex, body mass index and inflammatory US features.

With GEE the relationship of structural abnormalities and pain at joint level was studied taking into account patient effects. RRs were presented as OR (95%CI).

Data were analysed using SPSS for Windows, version 16.0 (SPSS, Chicago, Illinois, USA).

RESULTS

Study population

Sixty-four patients were recruited. Nine patients were excluded (one received an intra-articular injection after screening and in eight the time between US and CR exceeded 16 weeks). In the remaining 55 patients, one 5th MCPJ was excluded due to an operation in the past, hence 1649 joints were studied.

The demographic characteristics of the patients are shown in table 4.1. Excluded patients did not differ significantly from the included patients (data not shown).

Table 4.1 Demographic characteristics of 55 patients with hand osteoarthritis.

Variable	HOA patients (n=55)
Mean (SD) age (years)	61.4 (9.3)
Women, n (%)	47 (85.5)
Mean (SD) body mass index (kg/m^2)	27.7 (4.5)
Median (range) symptom duration (years)	5.0 (0-55)
Median (range) VAS pain (mm)	51.0 (0-99)
Mean (SD) AUSCAN pain (score:0-20)	9.1 (4.5)
Median (range) AUSCAN function (score: 0-36)	17.0 (0-33)

HOA, hand osteoarthritis; VAS, visual analogue scale; AUSCAN, Australian Canadian Osteoarthritis Hand Index

US and CR findings

Of the 1649 studied joints, 69% had osteophytes on US and 46% on CR; 47% of joints were narrowed. The distribution is shown in the supplement table S4.1.

The median number of osteophytes and the median summated osteophyte score per patient were higher on US than on CR (21 vs 11 and 44 vs 15, respectively).

Association of clinical outcomes with osteophytes and JSN on US and CR

Neither summated osteophytes score assessed by US or CR, nor summated JSN score showed an association with global pain scores (table 4.2).

Table 4.2 Association between structural abnormalities and pain in 55 patients with hand osteoarthritis.

	Osteophytes		JSN
	US	**CR**	**CR**
VAS pain	-0.2 (-3.0 to 0.8)	-0.2 (-0.5 to 0.2)	0.0 (-0.6 to0.5)
AUSCAN pain	-0.2 (-2.1 to 0.4)	-0.1 (-0.3 to 0.1)	0.0 (-0.7 to 0.4)
Doyle Index for the hands	0.0 (-2.2 to 1.6)	0.0 (-0.3 to 0.3)	0.0 (-0.6 to 0.5)

Linear regression analyses with summated osteophytes score by US or CR, and summated JSN score, as dependent variables. Beta coefficients (95% CI) adjusted for age, sex and body mass index and inflammatory ultrasound signs (effusion, power Doppler signal and synovial thickening).
JSN, joint space narrowing; US, ultrasound; CR, conventional x-ray; VAS, Visual analogue scale; AUSCAN, Australian Canadian Osteoarthritis Hand Index

Table 4.3 Association between structural abnormalities and pain upon palpation (presence vs absence) in separate small hand joints# using US and CR in 55 patients with hand osteoarthritis.

Score	**US**		**CR**	
	OR (95% CI)*	**OR (95% CI)****	**OR (95% CI)***	**OR (95% CI)****
Osteophytes				
0	1	1	1	1
1	1.6 (1.2-2.3)	1.6 (1.2-2.3)	2.2 (1.7-2.9)	2.0 (1.5-2.7)
2	2.8 (1.8-4.4)	2.7 (1.8-4.1)	3.9 (2.6-5.9)	3.2 (2.1-4.8)
3	6.2 (4.0-9.4)	4.8 (3.1-7.5)	4.8 (2.7-8.4)	4.1 (2.4-7.1)
JSN				
0			1	1
1			2.0 (1.4-2.8)	1.8 (1.3-2.4)
2			5.3 (3.1-9.1)	4.3 (2.6-7.2)
3			6.4 (2.7-14.8)	4.2 (2.0-9.0)

Small hand joints: DIPJs, PIPJs, 1st IPJs, MCPJs and 1st CMCJs.
* General estimating equations analyses adjusted for age, sex and body mass index.
** General estimating equations analyses adjusted for age, sex, body mass index and synovial thickening, effusion and power Doppler signal as assessed by ultrasound and osteophytes or JSN.
US, ultrasound; CR, conventional x-rays; JSN, joint space narrowing

Association of pain in individual joints with osteophytes and JSN on US and CR
A strong dose-dependent relationship was found between pain in individual joints, taking into account patient effects and osteophytes, on both US and CR (table 4.3). Associations were still significant after adjustment for inflammatory US features and JSN.

JSN assessed by CR showed a strong dose-dependent association with pain in individual joints taking in account patient effects, which remained significant after adjustment for inflammatory US features and osteophytes. This means that both osteophytes and JSN are independently related to pain in HOA.

DISCUSSION

The study reveals a strong dose-dependent association between pain and structural abnormalities assessed on joint level with US or CR, taking into account patient effects in patients with symptomatic HOA. Associations were absent when summated scores of structural abnormalities and global pain scores were analysed. Both osteophytes and JSN are independently associated with pain. To the best of our knowledge, this is the first report to demonstrate this association for JSN. These findings are important for our understanding of HOA and for elucidating the aetiology of pain.

This study supports the hypothesis that analyses on joint level, taking into account patient effects, such as genetic and psychosocial factors, are important for identifying associations between structural abnormalities and pain in HOA. This is in line with an earlier study in knee osteoarthritis (OA), which investigated subjects with knees discordant for pain status, and showed that radiographic OA was strongly associated with pain when controlling for person confounding.[15] Also, in an earlier study assessing inflammatory signs and pain in HOA, associations were found when analyses were performed on the joint level and corrected for patient effects, but not when summated scores of inflammatory signs and global pain scores were used.[13]

JSN was found to be associated with pain upon palpation. This was not just another way to find OA as detected by osteophytes, since the association was independently of osteophytes. In earlier studies using CR, JSN has not been studied as separate feature in the association with pain. One US study showed only a trend for an association between JSN and painful versus painless joints, possibly because patient effects were not taken into account in the analyses.[1] The fact that JSN is independently associated with pain is especially interesting since, in a recent article, JSN was shown to be an important predictor for the development of erosive HOA.[16]

This study shows that US detects more osteophytes than CR. This could be explained by detection of osteophytes located on the dorsal or palmar sides of the joints rather then the lateral sides. The osteophytes located at the palmar and dorsal sides can easily be missed by CR. Whether US reflects the true number of osteophytes is difficult to say, since it is not clear what the gold standard is. Cross-validation with MRI or CT scanning could be helpful.

There are several potential limitations to this study. First, joints were only studied with US on the dorsal and lateral sides, thereby potentially underestimating the amount of osteophytes. Also, a linear array transducer was used instead of a hockey stick transducer, which is more difficult to handle when joints are deformed. A drawback of hockey stick transducers is, however, the lower resolution of these transducers.

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Supplement table S4.1 Distribution of joints with osteophytes in 55 patients with hand osteoarthritis assessed by ultrasound (US) and conventional radiographs (CR).

Right hand				Osteophytes		Left hand				
5	**4**	**3**	**2**	**1**		**1**	**2**	**3**	**4**	**5**
				52	CMC US	52				
				27	CMC CR	38				
4	8	6	16	35	MCP US	27	14	5	2	4
2	2	12	13	25	MCP CR	21	8	6	1	3
47	50	49	51	49	PIP US	48	47	49	51	50
30	20	26	26	37	PIP CR	42	27	33	19	28
51	51	51	55		DIP US		54	54	54	52
39	33	40	46		DIP CR		42	39	28	43

CMC=Carpometacarpal, MCP=metacarpal, PIP=proximal interphalangeal, DIP= distal interphalangeal.