

## Correlation Between the Severity of Pain and Radiographic Findings in Hip Osteoarthritis

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### ABSTRACT

**AIM:** To analyze the association between the severity of pain and individual radiographic features and global radiographic indexes in hip osteoarthritis (OA).

**MATERIALS AND METHODS:** Forty-five consecutive patients who attended to our outpatient clinic with hip pain diagnosed as hip OA according to American College of Rheumatology (ACR) criteria were recruited for the study. Anteroposterior pelvic radiographs were obtained in all patients. Radiographs were read blindly and evaluated using Croft index, Lane index, individual radiographic features (IRF) of Lane index and Croft's measurement of the "minimal joint space" (MJS) and Kellgren-Lawrence grading by a radiologist. After radiographic evaluation Kellgren Lawrence grade 1 patients were excluded from the study and 38 patients with Kellgren Lawrence grade 2-4 hip OA patients were statistically analyzed. Correlation between the severity of pain evaluated by visual analog scale (VAS) and radiographic findings were statistically analyzed with Spearman correlation test. Linear regression analyses (stepwise method) were used to investigate associations between severity of pain and radiographic findings. JSN and osteophyte grading according to Lane index, MJS, MJS<2.5 mm and global indexes (KL,Croft,Lane) were chosen as independent variables in linear regression analyses.

**RESULTS:** Mean age of patients was 60.76±13 years. 38 patients had Kellgren Lawrence grade 2-4 hip osteoarthritis. Joint space narrowing (JSN) grading according to Lane index ( $r = 0.32$  and  $p = 0.05$ ) and minimal joint space measurement <2.5 mm according to Croft index ( $r = -0.33$  and  $p = 0.04$ ) showed correlation with severity of pain. No correlation was observed between osteophyte grading, sclerosis, cyst, deformity and global indexes and severity of pain ( $p > 0.05$ ). Applying logistic regression analyses, only reduced minimum joint space (MJS) (cut off value set at 2.5 mm) was found to be significantly associated to the severity of pain ( $p = 0.002$ ).

**CONCLUSION:** Quantitative measurement and grading of joint space narrowing showed correlation with severity of pain in hip osteoarthritis patients. It is observed that the radiographic finding that is related to the severity of pain in hip OA was MJS< 2.5 mm. This finding should be confirmed with further studies of larger sample size of patients with different radiographic severity.

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**Key words:** Osteoarthritis; Hip; Radiology; Validity

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### INTRODUCTION

There is no consensus in definition of hip osteoarthritis (OA) for epidemiologic and clinical studies<sup>[1]</sup>. Most studies have used radiological changes to define hip OA<sup>[2,3]</sup>. Although there are various definitions of hip OA, cross-sectional association with symptoms which represent construct validity of these definitions has rarely been studied in hip OA and the results are conflicting<sup>[4-7]</sup>.

Radiographic variables, particularly minimal joint space width measurement (JSW), are considered the most appropriate structural

outcome measure in hip OA<sup>[8]</sup>. However, the clinical relevance of this outcome measures remain doubtful, since there is a debate on whether an association with clinical symptoms exists. To assess a potential outcome measure, it is necessary to assess its validity and reliability, as defined by the Outcome Measures in Rheumatology Clinical Trials (OMERACT) filter<sup>[9]</sup>.

Hip pain is the main symptom for the hip OA as it impacts on key functions such as walking. Therefore in this study we aimed to determine whether the severity of pain in hip OA correlates with individual radiographic features (IRF's) and global radiographic indexes and thus study the construct validity of different definitions of radiological hip OA including Croft index, Lane index, IRF's of Lane index and Kellgren-Lawrence (KL) grading<sup>[4,10-13]</sup>.

## MATERIALS AND METHODS

In our study, patients between 34-82 years of age who attended to our outpatient clinic with hip pain in one or both hips who were diagnosed as hip OA according to ACR criteria were included consecutively. American College of Rheumatology (ACR) combined clinical (history, physical examination, laboratory) and radiographic classification criteria for OA of the hip, classification tree format was used to diagnose hip OA<sup>[14]</sup>. This classification criteria combines pain with at least 2 of the following 3 criteria: osteophytes (femoral or acetabular), joint space narrowing (superior, axial, and/or medial), and ESR less than 20 mm/hour.

Exclusion criteria were previous hip or knee joint replacement surgery, hip OA due to hip fracture or infection, history of inflammatory joint disease like rheumatoid arthritis or other systemic inflammatory disease, other conditions than hip OA appearing to be the cause of the patient's symptoms, local knee pain originating from the knee on the same side as the hip OA, low back pain dominating over the hip symptoms.

Routine laboratory investigations including sedimentation rate, C-reactive protein, complete blood count were done to exclude other pathologies. All study participants underwent radiographic evaluation.

### Radiographic evaluation

Anteroposterior pelvic radiographs of all patients were performed from a 1 meter distance focusing symphysis pubis in supine position. Radiographs were read blindly by the radiologist without knowledge of the clinical data. Radiographs were graded according to Croft index, Lane index and individual radiographic features (IRF's) of Lane index and Kellgren-Lawrence grading<sup>[10-13]</sup>. IRF scores of Lane index were osteophytes, joint space narrowing (JSN), sclerosis, cyst and deformity. IRF's were graded as 0=normal, 1=mild, 2=moderate, 3=severe.

Croft *et al* graded OA into 5 categories: grade 1, osteophytosis only; grade 2, joint space narrowing only; grade 3, two of osteophytosis, joint space narrowing, subchondral sclerosis, and cyst formation; grade 4, three of the same features as above; and grade 5, as in grade 4 but with deformity of the femoral head. Croft's measurement of the "minimal joint space" (lateral, superior, axial, medial) was measured by a ruler as the shortest distance on the radiograph between the femoral head margin and the acetabular edge<sup>[10]</sup>.

Pain was evaluated with 100 mm VAS. In patients with bilateral pain, the hip which is more painful was included. Only one hip; the symptomatic or the most symptomatic hip per individual was analyzed. Descriptive analysis of demographic findings of patients was performed. Association between the severity of pain and radiographic findings and global indexes were statistically analyzed

with Spearman correlation test. Linear regression analyses (stepwise method) were used to investigate associations between severity of pain and radiographic findings. JSN and osteophyte grading according to Lane index, MJS, MJS  $\leq 2.5$  mm and global indexes (KL,Croft,Lane) were chosen as independent variables in linear regression analyses. Power analysis was performed to determine the minimum sample size required. Significance level was set at  $p < 0.05$ . All statistical analyses were performed with the SPSS 15 statistical software.

Of 45 patients 38 had radiographic findings of KL Grade 2-4. In most studies, radiographs were evaluated using KL grading (with grade  $\geq 2$  indicating radiological hip OA). KL grade 1 represents doubtful narrowing of joint space and possible osteophytes. Therefore we excluded Kellgren Lawrence grade 1 hip OA patients and all statistical analysis were performed in 38 patients with KL grade 2-4 hip OA.

All patients were given detailed information concerning the purpose of the study and gave informed consent to participate in the study. The study protocol was approved by the Medical Ethics Committee of the Katip Celebi University Medical Center.

## RESULTS

A total of 45 patients diagnosed as hip OA according to ACR criteria were included in this study. The number and percentage of patients according to Kellgren-Lawrence (KL) grade I-IV were 7(15.6 %), 29(64.4%), 1(2.2%), and 8 (17.8 %) respectively. 38 patients with Kellgren Lawrence grade 2-4 hip osteoarthritis were further studied. Twenty-seven patients were women while 11 were men. Pain was bilateral in 15(39.5%), on the left in 12 (31.6%) and on the right hip in 11 (28.9%) patients. Demographic and clinical findings of the study group are shown in table 1.

In 38 patients with KL grade 2-4 radiographic findings, pain in hip OA evaluated by VAS showed correlation with joint space narrowing (JSN) grading according to Lane index (JSN) ( $r = 0.32$ ,  $p = 0.05$ ) and MJS  $\leq 2.5$  mm ( $r = -0.33$ ,  $p = 0.04$ ). Osteophyte grading, presence of sclerosis, cyst, and deformity and global indexes (KL,Croft, Lane) did not show any correlation with the severity of pain defined as VAS  $p > 0.05$ . Correlation coefficients and p values are shown in table 2.

Mean MJS was  $1.8 \pm 0.9$  mm (min- max; 0-5 mm) in 38 patients with KL grade 2-4 hip OA radiographic findings. MJS was  $\leq 2.5$  mm in 31 (81.6%) patients. VAS values increased with the increase in JSN.

Applying logistic regression analyses, only reduced minimum joint space (MJS) (cut off value set at 2.5 mm) was found to be significantly associated to the severity of pain ( $p = 0.002$ ) Regression results are shown in table 3. Excluded variables in the stepwise analysis are shown in table 4. Power analysis revealed that the minimum sample size required was thirty-four.

## DISCUSSION

In this study we aimed to investigate whether the severity of pain in hip OA correlates with individual radiographic features and global indexes. Our results suggested that the severity of pain in hip osteoarthritis was related to JSN. Minimal joint space (MJS)  $\leq 2.5$  mm measured quantitatively by a ruler by Croft's method and joint space narrowing (JSN) grading according to Lane index showed correlation with the severity of pain. No correlation was observed between pain and other individual radiographic findings and global indexes.

**Table 1** Demographic and clinical findings of the patients.

N=38	Mean ± SD	min-max
Age (years)	60.7+13	34-82
Pain duration (months)	26.6+28.5	1 -96
VAS (mm)	73.2+25.5	5-100

**Table 2** Correlation coefficients between pain and individual radiographic features and global radiographic indexes.

N=38	r (Spearman's correlation coefficient)	P
JSN	0.27	0.10
JSN grade (Lane)	0.32	0.05*
MJS ( Croft )	-0.28	0.08
MJS< 2.5 mm	0.33	0.04*
Osteophyte grade (Lane)	-0.07	0.64
Sclerosis	-0.01	0.92
Cyst	0.08	0.61
Deformity	0.06	0.71
Kellgren & Lawrence	0.07	0.64
Croft index	0.15	0.34
Lane index	0.03	0.83

\* $p < 0.05$  Statistically significant; JSN: Joint space narrowing; MJS: Minimal joint space.

**Table 4** Excluded variables in the linear regression stepwise analyses.

	Beta In	t	Sig
JSN grade	0.122	0.542	0.591
MJS	-0.096	-0.471	0.640
OSTEOPHYTE	-0.108	-0.737	0.346
KELLGREN grade	-0.069	-0.452	0.871
CROFT grade	-0.094	-0.461	0.892
LANE grade	-0.320	-1.817	0.628

Predictors in the Model: (Constant), MJS  $\leq 2.5$ ; Dependent variable: VAS; JSN: Joint space narrowing; MJS: Minimum joint space.

Our results are consistent with previous studies which reported that MJS had the highest relationship among other radiographic findings with the hip pain in hip OA patients<sup>[4,5,15]</sup>. The validity of radiographic joint space width metric measurement in hip OA was investigated in a systematic review. The results suggested that there is evidence of association between JSW and symptoms in hip OA<sup>[15]</sup>. In a systematic review by Reijman et al, validity, reliability, and applicability of seven definitions of hip OA were studied<sup>[4]</sup>. MJS had the highest relationship with the hip pain in a male population. The reliability and validity according to the Croft grade were inferior to the MJS, the KL grade, and the index according to Lane. In another study by the same author KL grade and MJS showed the strongest associations with clinical symptoms of hip OA, especially with hip pain and lower limb disability for both moderate and severe hip OA. The Croft grade had the weakest associations with clinical symptoms of hip OA<sup>[5]</sup>.

Construct validity was assessed between the pain and function and X-ray stages in hip OA patients by Gossec et al. They concluded that KL, OARSI stages and categorization of JSW all have similar predictive and construct validity, it appears that categorical JSW is more reproducible and more sensitive to change and may be the preferred method to evaluate structural severity in hip OA clinical trials<sup>[7]</sup>.

As a conclusion the measurement of minimal joint space width (JSW) was generally acknowledged as the cardinal individual feature in assessment of radiological hip OA and for monitoring of progression of degeneration over time and correlate with clinical status of hip OA patients<sup>[16,17]</sup>. JSW is a reliable measurement and easy to perform in clinical practice<sup>[18]</sup>.

There was no statistically significant association between pain in hip OA and global indexes (KL grade, Croft and Lane index) in our

**Table 3** Linear regression analyses (stepwise method) results.

N=38	Unstandardized		Standardized		95% Confidence Interval for B		
	Coefficients B	Std. Error	Coefficients Beta	t	Sig.	Lower Bound	Upper Bound
(Constant)	47.571	8.590		5.538	0.000	30.151	64.992
MJS< 2.5	31461	9.510	0.483	3.308	0.002	12.174	50.748

Dependent variable: VAS; MJS  $\leq 2.5$ : Minimum joint space  $\leq 2.5$  mm.

study. Birrell et al reported that mild/ moderate radiographic changes of OA was very frequent and not related to pain, whereas severe change was rare but strongly related to pain in a population with and without hip pain. They concluded that there was a limited relationship between the presence of hip pain and the degree of radiographic change<sup>[19]</sup>. In our study most patients were graded as KL grade 2 (mild OA). This could be the reason why we couldn't observe an association between pain and global indexes. There is also another study which reported that global visual assessment can be used if only in patients with severe grades of hip OA were included<sup>[18]</sup>.

Another reason could be the poor association between hip pain and osteophytes and the importance of osteophytosis in KL grading<sup>[10,20]</sup>. Osteophytosis is quite common in the absence of symptoms or any other features of OA. We couldn't also find any association between hip pain and osteophytes in our study.

In our study bilateral hip OA patients were also included. VAS is a subjective value of pain and affected at bilateral hip OA patients. The effect of bilateral involvement should be evaluated in further studies with adequate sample study size.

Our study is of importance in pointing out the clinical association of pain and quantitative evaluation of joint space width which is an easy method to perform in clinical practice. It is observed that the radiographic finding that is related to the severity of pain in hip OA was MJS  $\leq 2.5$  mm. This finding should be confirmed with further studies of larger sample size of patients with different radiographic severity. Surprisingly, the relationship between radiographic findings and symptoms has rarely been evaluated in hip OA patients and the results of cross-sectional correlations were heterogeneous<sup>[15]</sup>.

In conclusion, the severity of pain in hip osteoarthritis showed association with quantitative measurement of minimum joint space width. Our results suggested that measurement of joint space width maybe the preferable radiological method rather than global scales in mild hip OA cases.

## CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

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