Original Investigation

Correlation Between Functional Status and Thickness of Articular Cartilage in Ultrasonography in Patients with Knee Osteoarthritis

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ABSTRACT

Objective: To evaluate the correlation between functional status using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and severity of osteoarthritis (OA) based on radiological findings (articular cartilage thickness using ultrasonography and X-ray) in patients with knee OA.

Methods: Thirty patients with unilaterally symptomatic knee OA, based on American College of Rheumatology (ACR) guidelines, were enrolled in the study. The asymptomatic but radiographically osteoarthritic knee of the patients was used as the control knee. The severity of knee pain, stiffness, and disability were determined with the WOMAC index. The severity of OA in plain X-ray was graded using Kellgren-Lawrence (K-L) scale. We also measured the mean articular cartilage thickness with ultrasonography in medial and lateral tibiofemoral joint.

Results: The results showed no correlation between WOMAC scores and the severity of OA on K-L scale ($P > 0.05$). The results also failed to show any statistically significant correlation between WOMAC scores and articular cartilage thickness in ultrasonography ($P > 0.05$). On the other hand, in comparing symptomatic and control knees, articular cartilage thickness in the control knees was more than symptomatic knee and the severity of OA based on K-L scale in the symptomatic knee was higher than control knee ($P < 0.05$).

Conclusion: Although this study did not show any correlation between WOMAC score and articular cartilage thickness or K-L scale, the severity of knee OA based on K-L scale was significantly higher and articular cartilage thickness was significantly lesser in symptomatic knee when compared with control knee.

Keywords: Knee Osteoarthritis, ultrasonography, WOMAC questionnaires, X-Ray film

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Introduction

Osteoarthritis (OA) is the most common joint disorder which occurs in 60 to 90 % of people older than 65 years and is the most common cause of chronic disability (1). Knee OA is very common and causes severe pain and disability. Pain is the most important problem in patients suffering from OA (2). While planning rehabilitation or making arthroplasty decision, many physicians take into consideration the radiographic features. It is important to have a clear understanding about the relationship between function and radiographic features. Plain radiographic findings of OA include articular space narrowing, osteophyte formation, subchondral sclerosis and subchondral cyst formation. After 40 years of age, many people show radiographic changes of OA without clinical findings of OA (3,4). Studies have found that, there is not always direct relationship between radiographic changes and clinical findings (5, 6). A previous study found the lack of significant correlation between

MRI findings and clinical findings based on WOMAC questionnaire (7). One study evaluated the association between clinical features and structural abnormalities at MRI and indicated that only moderate and massive joint effusion and the presence of a patellofemoral osteophyte and the presence of more than four osteophytes in the entire knee were associated with clinical findings while in another study only cartilage lesions were significantly associated with clinical findings (8-9).

In recent years, ultrasonography has been one of diagnostic tools for evaluating soft tissues in osteoarthritic joints. Its advantages include low price and non-invasiveness. Ultrasonography provides valuable information about articular cartilage and synovial membrane (10). In 2011, Ajay et al. evaluated validity and reliability of ultrasonography in diagnosing OA in 18 patients with OA. Moderate to strong correlation was found for osteophyte and joint effusion in patients evaluated with ultrasonography. Moderate to strong relationship was also found for femur cartilage thickness (11).

Although correlations between clinical findings and plain radiographic and MRI findings have been evaluated previously but there were no study to evaluate correlations between clinical findings and ultrasonographic measurement of articular cartilage thickness.

Therefore, this study was performed to evaluate the correlation between radiologic findings (mean articular cartilage thickness based on ultrasonographic findings and severity of OA based on plain radiographic findings) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) in patients with knee OA.

Materials and Methods

Thirty patients with unilaterally symptomatic knee OA, based on American College of Rheumatology (ACR) guidelines, referring to outpatient rehabilitation clinics were selected and enrolled in the study. The asymptomatic but radiographically osteoarthritic knee of the patients was used as the control knee. The severity of knee pain, stiffness, and disability were determined with the WOMAC index.

Inclusion criteria: Patients diagnosed as knee OA complaining of unilateral symptoms since 3 months ago and took no drug affecting cartilage such as glucosamine.

Exclusion criteria: History of knee trauma, rheumatologic disorder, knee surgery for any cause, systemic disorders, and patients with congenital bone disorder.

In this study, patients meeting inclusion criteria were asked to fill out the Persian version of WOMAC questionnaire to determine severity of pain and disability. The Persian version of WOMAC demonstrated acceptable validity and reliability (12, 13). This questionnaire has 26 items under 3 subgroups of pain, joint stiffness and physical function. The scores of pain vary between 0 to 28, joint stiffness between 0 to 8 and physical function between 0 to 68. If patient takes higher score, more severe OA should be expected.

In this study we used ultrasonographic unit GF LOGIO 7 with 7.5 MHZ high resolution linear probe. Maximum articular cartilage thickness in both medial and lateral compartment (distal femur) was measured and also was compared with control (asymptomatic) side.

The severity of OA was determined with plain radiography using Kellgren and Lawrence (K-L) Grading Scale :(14,15)

GRADE 0 : No radiographic findings of osteoarthritis.

GRADE 1: Minute osteophytes of doubtful clinical significance

GRADE 2: Definite osteophytes with unimpaired joint space

GRADE3: Definite osteophytes with moderate joint space narrowing

GRADE 4: Definite osteophytes with severe joint space narrowing and subchondral sclerosis

To evaluate correlation between radiologic findings of OA and clinical function based on WOMAC index, we used Pearson correlation coefficient and Kendall correlation coefficient. Also, to compare severity of OA based on radiographic findings on symptomatic and control knee, we used Wilcoxon signed ranks test. Paired sample T-test was used to compare articular cartilage thickness in symptomatic and control knee. Values were presented as mean ±SD (standard deviation). All the analyses were carried out using SPSS software version 15.0. A P-value of <0.05 was statistically considered significant.

Results

There were 12 men and 18 women in this study. The ages of patients were between 50 and 60 years. The mean WOMAC score was 38.13 ± 17.03. Patients had a K-L radiographic severity grade 0 or 1 in 76.6%, grade 2 in 20% and grade 3 in 3.4% in lateral aspect and grade 0 or 1 in 53.3%, grade 2 in 40% and grade 3 in 6.7% in medial aspect of knee.

Table 1. Comparison between thickness of knee cartilage in symptomatic and control sides.

Thickness of knee cartilage	Knee	Mean+SD*	p-value
Lateral aspect	Symptomatic (N=30)	1.88±0.37	0.002
	Control (N=30)	2.02±0.31	
Medial aspect	Symptomatic (N=30)	1.92±0.28	0.003
	Control (N=30)	2.08±0.32	

***SD:** Standard deviation*

The Kendall correlation coefficient was used to assess correlations between severity of knee OA and WOMAC scores in medial and lateral aspect of symptomatic knees. There was no statistically significant correlation between WOMAC scores and K-L score of lateral (Kendall correlation coefficient=0.236, P=0.111) and also medial aspect of symptomatic knees (Kendall correlation coefficient = 0.216, P=0.155).

The correlation between WOMAC scores and thickness of cartilage was assessed using Pearson correlation coefficients. The WOMAC scores did not correlate with thickness of cartilage in lateral (Pearson correlation coefficient: 0.109, P=0.567) and also medial aspect of knees (Pearson correlation coefficient: 0.218, P=0.248).

The mean articular cartilage thickness in medial and lateral aspect of symptomatic knee was significantly less than control knee. (Table 1). Severity of knee OA in symptomatic sides were compared with control sides using Wilcoxon signed ranks test. The K-L score in lateral (P= 0.001) and also medial aspect of symptomatic knees (P=0.013) was significantly higher than control knees

Discussion

In this cross-sectional study we investigated if there was any association between functional status, and radiographic and ultrasonographic features in patients with knee OA. We used WOMAC questionnaire that is a reliable scale for assessment of functional status of patients with knee OA in comparison with radiographic findings (articular cartilage thickness using ultrasonography and severity of OA knee using plain X-ray) to determine correlation between them. To the best of our knowledge there was no similar study to compare thickness of cartilage using ultrasonography with disability status of patients with knee OA. Based on our study there is no statistical correlation between WOMAC index and severity of knee OA using plain X-ray or thickness of articular cartilage using ultrasonography. On the other hand, with comparing control and symptomatic knee, articular cartilage thickness in the control knee was more than symptomatic knee and the severity of OA based on K-L scale in the symptomatic knee was higher than control side.

In 2003, Link et al. evaluated correlation between knee pain, morning stiffness and restriction of motion with severity of disease in MRI and plain X-ray. They found significant correlations between K-L score and extent of cartilage damage (8). Also, another study that was done by Phan et al. to assess the rate of cartilage loss based on MRI in patients with knee OA and to assess these findings with clinical status, showed no direct relationship between WOMAC scores and severity of articular cartilage damage(7). Same as our results, a study that was done to determine relationship between radiographic findings (K-L scale) and clinical symptoms of patients with knee OA, showed that the WOMAC sub scores were not related with K-L grading scale(6). A systematic review determined that much discordance remains between pain and X- ray findings (16).

Therefore, this study determined that clinical findings of patients suffering from knee OA are the mainstay of assessment. Moreover, the results of knee X- ray and ultrasonography should not be used in isolation when assessing patients with knee pain.

Potential limitations of this study are its cross-sectional design rather than longitudinal follow-up and relatively small number of participants. Further studies are recommended with larger number of patients across a wide range of age. We also suggested to compare two knees within a person in whom the bilateral knees had different levels of pain and also similar study on hip OA.

Clinical findings expressed by WOMAC index showed no significant correlations with severity of knee OA using radiographic K-L scores or articular cartilage thickness using ultrasonography. However, this study found that

severity of knee OA based on K-L scale was significantly higher and articular cartilage thickness was also significantly lesser in symptomatic knee when compared with control knee. Therefore, X-ray and ultrasonography seem to be useful to assess patients with knee pain but treatment should be planned according to clinical features and functional status instead of radiological findings alone.

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