Original Research Article

Analysis of radiographic findings of osteoarthritis (OA) of knee joint using kellgren-lawrence scores in osteoarthritis of knee patients

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Abstract

Background: The aim of this study was to investigate the radiographic findings in patients with knee osteoarthritis (OA). **Methods:** The present study was conducted on 120 symptomatic knees fulfilling American College of Rheumatology criteria for OA were included in the study. Patients with trauma, inflammatory, and infective conditions of the knee and with a history of intra-articular interventions and surgery were excluded. Demographic data, body mass index (BMI), visual analog scale (VAS) were obtained. Kellgren–Lawrence (K-L) score was obtained on radiography. **Results:** A total of 120 consecutive symptomatic knees were examined. The participants with a mean age of 50.66 ± 7.28 years, mean duration of disease of 4.20 ± 4.16 months, mean BMI of 28.20 ± 5.40 kg/m2, and mean score of VAS scale of 6.30 ± 1.50. K-L grading of 1, 2, 3, and 4 was reported in 25%, 33.33%, 29.16%, and 12.5% of the knees, respectively. The mean VAS score showed statistically significant correlation with KL grading ($P < 0.05$). **Conclusion**: Our study found that K-L grading and few ultrasonographic criteria showed a significant positive correlation with pain scores, while few other ultrasonographic criteria did not. Both imaging modalities are complementary to each other, rather than one being superior to the other.

Keywords: Osteoarthritis, Kellgren–Lawrence grading, ultrasonography, visual analog scale score.

Introduction

Pain is the major clinical symptom in osteoarthritis of the knee and a key determinant for seeking medical care. Despite the importance of pain in knee osteoarthritis, little is understood about its causes. Knee osteoarthritis (OA) is one of the most common degenerative joint diseases with a prevalence of 28.7% in India[1]. Osteoarthritis (OA) is the most common degenerative joint disorder and a major public health problem throughout the world. It affects any joint containing hyaline cartilage[2,3] and the knees are the most commonly affected joints[4]. Knee osteoarthritis (OA), characterized by pathological features including joint space narrowing (JSN) and osteophytosis, is a major public health issue causing chronic pain and disability of the elderly in most developed countries[5,6].

Conventional radiography is the initial imaging investigation in knee OA. It detects bony structural abnormality, but its findings did not show much correlation with the severity of pain in knee OA. This could possibly be because of the fact that soft-tissue structures cannot be viewed on radiographs, thus providing only an indirect evidence of cartilage and other soft-tissue damage. Joint space narrowing seen on radiography is considered an indirect indicator of femoro-tibial cartilage loss, however the assessment of actual joint space depends on both cartilage thickness and meniscal integrity, both of which cannot be directly evaluated with the help of radiography[7,8].

Till date, magnetic resonance imaging (MRI) is considered the most accurate imaging method for quantifying degenerative changes in knee OA. It can evaluate osseous abnormalities as well as soft-tissue changes with high sensitivity and specificity, but it cannot be used as a routine investigation because of its high cost and relatively low availability[9]. Many studies have been performed to establish the possible correlations between ultrasonographic findings and knee OA symptoms. Recent studies have indicated that ultrasonography is a useful and reliable method for identifying knee osteophytes, medial meniscal protrusion, and morphological changes in the cartilage in the medial femoral condyle, but no clear conclusions were drawn. Various treatment strategies are recommended, which are aimed to reduce symptoms and prevent further functional deterioration[10,11]. While planning rehabilitation or making arthroplasty decision many physicians take into consideration the radiographic features. It is important that we have a clear understanding about the relationship between function and radiographic features. This study was undertaken to find out the possible correlation between knee pain scores and radiographic as well as ultrasonographic findings in knee OA and to further explore, if ultrasonographic findings presented better association with knee pain scores than conventional radiography.

Material and methods

120 adult patients fulfilling American College of Rheumatology criteria for OA, referred to radiology department for radiographic study, were recruited[12]. Exclusion criteria were inflammatory knee disorders, other arthropathies, metabolic bone disease, serious systemic diseases, depression, neoplasms, history of knee trauma or knee surgery, and previous intra-articular injections. Patients not giving informed consent and having inflammatory and infective conditions of the knee were also excluded. Informed consent of all the participants was obtained after explaining the procedure.

Convenient sampling method was used, and data were collected on a preformed structured interviewer-administered questionnaire. All patients were informed about the aims of the study and the study protocol, and their informed consents were obtained prior to the study.Demographic data included age, sex, height, weight, and body mass index (BMI). Patients were then asked to score their average knee pain during the past month on a 100-mm visual analog scale (VAS) from 0 to 100 mm, where 0 mm represented no pain, while 100 mm represented extreme pain. The radiographs were interpreted for severity of knee OA using Kellgren–Lawrence (K-L) score by a radiologist (blinded to the clinical and ultrasonographic findings)[13].

Radiographic assessment

All participants had bilateral weight bearing, fixed flexion postero-anterior and lateral radiographic evaluation of the knee, as described elsewhere[14]. Radiographs were scored by a musculoskeletal radiologist and a rheumatologist blinded to pain status, both experienced in reading study films. Each knee joint was scored for

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Kellgren and Lawrence grade (0- 4).Ultrasonographic examination was performed by a radiologist having 10 years of experience in doing musculoskeletal ultrasonography (blinded to clinical and radiographic findings). Ultrasound examination was performed with the patient lying in supine position and knee flexed to 20°–30° with a pillow under the knee for comfort. After applying abundant gel over the supra-patellar region, scanning was commenced in longitudinal and transverse planes applying minimal pressure over the area so as to avoid displacing the effusion sideward.Presence of effusion and synovial hypertrophy was noted. Quadriceps/patellar tendons and prepatellar/infrapatellar bursa were also evaluated. Patients were then asked to flex the joint completely, and a probe was placed over trochlear notch for evaluation of the femorotrochlear articular cartilage degeneration. The degeneration was graded as: "Grade 0 – normal, Grade1 – loss of the normal sharpness of cartilage interfaces and/or increased echogenicity of the cartilage, Grade 2A – Grade 1 with clear local thinning (<50%) of the cartilage, Grade 2B – local thinning of the cartilage of more than 50% but < 100%, and Grade 3 – 100% focal loss of cartilage thickness"[15]. Patients were then asked to lie prone, and the posterior aspect of the knee joint was scanned in longitudinal and transverse planes. The distension of semimembranosus-medial head of gastrocnemius bursa was evaluated. After demographic information and disease duration were recorded, detailed physical examination including anthropometric measures for determination of body mass index (BMI) was performed.

Results

Table 1: Demographic features, clinical, and radiological characteristics of the patients

Age (years) (mean ± SD)	50.66± 7.28
BMI (kg/m2) (mean ± SD)	28.20 ± 5.40
Gender	
Females	80 (66.66%)
Males	40 (33.33%)
Disease duration (years) (mean ± SD)	4.20 ± 4.16
Kellgren-Lawrence scale, *n* (%)	
Grade I	30 (25%)
Grade II	40 (33.33%)
Grade III	35 (29.16%)
Grade IV	15 (12.5%)

One hundred and twenty patients with knee OA were included in this study. The ages of the OA patients were between 40 and 65 years (mean 50.66 ± 7.28) and the majority of the OA patients were females. The disease duration of knee OA patients was between 1 and 20 (mean 4.20 ± 4.16) years. The mean BMI score was 28.20 ± 5.40 kg/m2.

On the radiographic assessment, 30 patients (25%) were grade 1 on the Kellgren-Lawrence Index, 40 (33.3%) were grade 2, 35 (29.16%) were grade 3, and 15 (12.5%) had grade 4, showing that the subjects were mostly categorized as mild to moderate for radiographic features. The demographic, clinical, and radiological data of the patients are presented in Table 1.

Table 2: Correlation of Kellgren-Lawrence grading with visual analog scale

KL Grading	Distribution, *n* (%)	VAS, mean±SD
Grade I	30 (25%)	5.30±0.76
Grade II	40 (33.33%)	5.59±1.20
Grade III	35 (29.16%)	5.70±1.25
Grade IV	15 (12.5%)	6.26±1.09
ANOVA Test		5.75
p		<0.05

K-L grading of 1, 2, 3, and 4 was reported in 25%, 33.3%, 29.16%, and 12.5% of the knees, respectively. The mean VAS score increased with increase in K-L grading with statistically significant correlation ($P < 0.05$)The mean BMI and VAS scores were 28.91 ± 3.69 kg/m^2 and 6.30 ± 1.50respectively. K-L grading of 1, 2, 3, and 4 was reported in 25%, 33.3%, 29.16%, and 12.5% of the knees, respectively. The mean VAS score increased with increase in K-L grading with statistically significant correlation ($P < 0.05$).On applying Pearson's correlation, positive and statistically significant correlation was found between K-L grading and pain scores. Similar positive and statistically significant correlation was reported for medial sided osteophytes, medial meniscal extrusion, medial femorotrochlear cartilage grading, medial collateral ligament degeneration, and effusion in relation to VAS score.

Discussion

In this present study, we investigated if there was any association between pain, disability, and radiographic features in patients with knee OA. Our results demonstrated that age and disease duration were found to be positively associated with Kellgren-Lawrence grading scale. Our study included 120 patients with OA-affected knee joints, examined clinically, radiographically, and ultrasonographically.

The mean VAS scores in our study were 6.30 ± 1.50. Serban et al[16]. reported similar mean score of VAS (6.58 ± 2.08). Knee OA is particularly important in view of its high prevalence and association with severe pain and disability[17]. Pain is the main complaint among patients with knee OA, a leading cause of physical disability[18]. The risk of disability increases with the presence of knee pain in the community[19].

As far as K-L grading is considered, 40% of the knees were in Grade IV, which differed from that of previous published literature. This difference in K-L grading might be due to the fact that demography of the patients in surrounding area is rural and they involved in agricultural and strenuous work who seeks medical attention late in the disease course. The mean pain scores increased with increase in K-L grading. A positive and significant correlation was found between K-L grading and VAS scores. Therefore, it can be said that with increase in K-L grading, pain also increases, which is in line with a recent systematic review that higher Grade of OA (K-L 3 or above) is a stronger predictor of pain than lower Grades (K-L 2 or less). Serban et al.also revealed significantly higher VAS scores as the K-L score increased.

A positive and significant correlation was reported for effusion in relation to VAS scale. Similarly, Hill et al[20]. reported a strong association between effusion and pain in knee OA. Naredo et al[21]. found a strong association between effusion and pain in knee on motion as well as rest, and this finding was independent of radiographic OA severity, age, disease duration, and BMI.

In contrast to such studies, by taking advantage of nature we compared two knees within a person in whom the two knees had different levels of pain.

When all person level factors influencing pain would contribute equally to both knees, we are asking why in an individual person one knee has pain (or more pain) whereas the other does not (or has less pain). This novel approach eliminates between person confounding, allowing us to obtain valid effect estimates of radiographic osteoarthritis or specific radiographic features on knee pain, even in mild osteoarthritis. as a substantial proportion of people with knee osteoarthritis have intermittent pain[22], this temporal variability further complicates observational studies of knee pain.

In addition to the widely held belief that only a modest association exists between radiographic severity and pain symptoms, another difference compared with previous studies is that we found joint space narrowing to be more strongly associated than osteophytes with knee pain[23]. This suggests that joint space narrowing grades adequately reflect the underlying pathological changes occurring in advanced stages of osteoarthritis. The lack of co-occurrence of knee pain and radiographic knee osteoarthritis may suggest that radiographic osteoarthritis has limited discriminating potential for knee pain. It does not imply, however, that the association between those two factors is weak. Understanding the pathophysiology of pain in osteoarthritis will ultimately lead to rational therapeutic targets for this disease, which has minimal treatment options. Newer ultrasonographic techniques such as elastography and

three-dimensional/four-dimensional ultrasound and use of ultrasound contrast agents will also help in understanding the pathophysiology of OA in a better way.

Conclusion

The present study revealed that findings of conventional radiography (K-L grading) and few ultrasonographic criteria showed a significant positive correlation with pain scores of the knees. Hence, it can be said that although conventional radiography and musculoskeletal ultrasound measure different structural tissues of the osteoarthritic knee, both imaging modalities are complementary to each other, rather one being superior to other. Thus, radiographic severity, as determined by Kellgren and Lawrence grades and individual radiographic features, particularly joint space narrowing, is a strong risk factor for the presence, consistency, and severity of knee pain and accurately reflect the presence of painful pathology.

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