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OSTEOARTHRITIS OF KNEE- COMPARISON OF RADIOGRAPHY AND MAGNETIC RESONANCE IMAGING

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ABSTRACT

Diagnosis of knee OA is based on symptoms of pain and stiffness, and the presence of OA changes on a knee radiograph. Radiographs are also used to monitor change and for treatment planning. Grading scales are applied to knee radiographs to rate the severity of OA. The study population consisted of patients with clinical picture of knee osteoarthritis such as pain that worsens during activity and improves with rest, joint stiffness and knee joint instability attending Orthopaedic and Rheumatology clinics during the study period. Kellgren – Lawrence Grading System will be used to diagnose and grade the severity of disease.MR imaging evaluation of both knee will be done in 'Axial, Coronal and Sagittal T1-weighted spin-echo and Sagittal T2 weighted fat suppression techniques'.MR imaging based diagnosis and grading will be done based on 'Whole Organ Magnetic Resonance Imaging Score. K-L score among 100 knees of osteoarthritis on radiography, revealed that 40% of knees had grade 3, 27% of knees had grade1, 21% of knees had grade 2, 9% of knees had grade 4 and only 3% of knees had grade 0. On MRI, 87% of knees had ligament score of 0, 6% of knees had ligament score of 1, 7% of knees had ligament score of 2. There is a statistically significant relation was found between MRI findings and X ray findings in relation to compartment specific findings.

INTRODUCTION

Worldwide, osteoarthritis is the most common form of arthritis. The disease commonly affects weight-bearing joints, such as the knee. Radiologically osteoarthritis is estimated to be prevalent in 30% of people over 65 years of age.

Osteoarthritis (OA) is a progressive joint disease hallmarked by cartilage and bone breakdown. It is a significant cause of pain and disability in our aging population [1]. In knee OA, excessive or prolonged force or instability leads to fibrillation and thinning of the articular cartilage [2]. Associated with cartilage changes, the periarticular bone remodels, causing osteophytes.

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While osteophytes are often thought of as contributing to the progression of OA, they may actually help to stabilize the joint. Erosion of the subchondral bone occurs as the cartilage continues to wear. Deeper into the bone structure, areas of sclerosis and cysts form. It has been acknowledged recently that other tissues are also affected in knee OA. Ligaments and menisci degenerate, sometimes even before cartilage damage can be appreciated on a radiograph. This can lead to increased cartilage wear and joint instability, creating a cycle of destruction. The synovium becomes mildly inflamed and the joint capsule thickens. These whole joint changes ultimately cause pain, deformity and disability in many people. The main risk factors for knee OA are increasing age, obesity and prior knee injury, Knee OA incidence increases significantly with age [3,4].

For example, the odds ratio (OR) for having knee OA at age 65 and older, compared to individuals less than

35 years old, is 28.4 [5]. Obesity is also a well-documented risk factor for knee OA. Men and women with a body mass index (BMI) in the obese range (30 kg/m^3 to 35 kg/m^3) have ORs of 4.0 and 3.5 respectively compared to individuals with a BMI in the normal range (18.5 kg/m^3 to 25 kg/m^3). Traumatic knee injury is a considerable risk factor, especially anterior cruciate ligament tears, meniscal damage and tibial plateau fractures. Even surgical repair does not fully mitigate the risk of developing subsequent knee OA [6].

Diagnosis of knee OA is based on symptoms of pain and stiffness, and the presence of OA changes on a knee radiograph. Radiographs are also used to monitor change and for treatment planning. Grading scales are applied to knee radiographs to rate the severity of OA. Current scales vary from poor to excellent in their reliability [7], poor to moderate in their sensitivity to change and negligible to moderate in their relationship to other knee OA features (pain, alignment, function) . Many scales emphasize a single feature of knee OA, which may limit their usefulness for different presentations of the disease [8].

Radiographs can show osteoarthritic changes of the bone, however, soft tissue involvement may not be appreciated. MR imaging has direct multiplanar imaging capability and provides a higher soft tissue contrast. MR imaging is established as a noninvasive tool for evaluating pathological changes in the articular cartilage, menisci and ligaments of the Knee.

METHODOLOGY:

The study population consisted of patients with clinical picture of knee osteoarthritis such as pain that worsens during activity and improves with rest, joint stiffness and knee joint instability attending Orthopaedic and Rheumatology clinics during the study period

Inclusion criteria:-

- Patients with clinical picture of knee osteoarthritis such as pain that worsens during activity and improves with rest, joint stiffness and knee joint instability
- Clinically diagnosed knee osteoarthritis with Knee pain, Age > 40 years, Joint stiffness > 30 min., and crepitus

Exclusion criteria:-

- Claustrophobia,
- non co-operative patients,
- patients with obvious inflammation,
- secondary osteoarthritis e.g. trauma,
- operated knee joint,
- Inflammatory arthritis eg. rheumatoid arthritis ,
- morning stiffness >1 hr in hand joints

Sample size is based on level of precision; precision consists of significance level and allowable error. In this study 5% significance and 20% allowable error is considered.

Totally 50 study subjects were included in the study as this number of patients attended hospital during the study period. No sampling method adopted as all the study subject fitting to inclusion criteria were considered. Data was collected using Pre tested semi structured

Questionnaire which was filed by the investigator. Radiography of knee in posteroanterior weight-bearing, true lateral non-weight bearing and sunrise patellar projections will be done. Kellgren – Lawrence Grading System will be used to diagnose and grade the severity of disease. MR imaging evaluation of both knees will be done in 'Axial, Coronal and Sagittal T1-weighted spin-echo and Sagittal T2 weighted fat suppression techniques'.

MR imaging based diagnosis and grading will be done based on 'Whole Organ Magnetic Resonance Imaging Score'.

RESULTS

Table 1. Distribution of study subjects based on age

Age group	Frequency	Percentage
<60 years	17	34.0%
61 – 65 years	12	24.0%
66 – 70 years	16	32.0%
>70 years	05	10.0%
Total	50	100%

Among total study subjects, highest proportion of subjects were in the age group of less than 60 years (34%) followed by 66 – 70 years (32%), 61 – 65 years (24%) and more than 70 years (10%)

Table 2. Distribution of study subjects based on K-L score

Grades	Frequency	Percentage
Grade 0	03	03%
Grade 1	27	27%
Grade 2	21	21%
Grade 3	40	40%
Grade 4	09	09%
Total	100	100%

Note: 50 patients and 100 Knees

The above table depicts the K-L score among 100 knees of osteoarthritis on radiography. It was observed that 40% of knees had grade 3, 27% of knees had grade1, 21% of knees had grade 2, 9% of knees had grade 4 and only 3% of knees had grade 0

Table 3. Comparison of PF joint involvement

Radiography	MRI		Total
	Involved	Not involved	
Positive	64 (100%)	00	64 (100%)
Negative	19 (52.7%)	17 (47.3%)	36 (100%)
Total	83	17	100

On radiography, among 100 knees examined, 64% of PF joints were affected and 36% of PF joints were not affected

On MRI, among 100 knees examined, 83% of PF joints were affected and 17% of them were not affected

All the PF joints positive in radiography were also found to be positive in MRI but among 36 knees shown as negative in radiography, MRI found positive in 19 knees

The sensitivity of radiography is 77%

The specificity of radiography is 100%

The positive predictive value is 100%

The negative predictive value is 47%

Table 4. Relation between K-L score and Lig.Score

Grades	Lig.score				Total
	Score 0	Score 1	Score 2	Score 3	
Grade 0	03 (100%)	00	00	00	03 (100%)
Grade 1	27 (100%)	00	00	00	27 (100%)
Grade 2	20 (95.2%)	01 (04.8%)	00	00	21 (100%)
Grade 3	32 (80.0%)	02 (05.0%)	06 (15.0%)	00	40 (100%)
Grade 4	05 (55.5%)	03 (33.3%)	01 (11.1%)	00	09 (100%)
Total	87	06	07	00	100

P VALUE – 0.001

On radiography, K-L score of 0 was found in 3 patients and all these 3 patients (100%) had lig.score of 0

K-L score of 1 was found in 27 patients and among these 27 patients (100%) had lig.score of 1

K-L score of 2 was found in 21 patients and among these 20 patients (95.2%) had lig.score of 0, 1 patient (4.8%) had lig.score of 1

K-L score of 3 was found in 40 patients and among these 32 patients (80%) had lig.score of 0, 2 patients (5%) had score of 1, 6 patients (15%) had score of 2

K-L score of 4 was found in 9 patients and among these 5 patients (55.5%) had lig.score of 0, 3 patients (33.3%) had score of 1, 1 patient (11.1%) had score of 2

Table 5. Relation between K-L score and meniscus score

Grades	Meniscus score		Total
	Normal findings	Abnormal findings	
Grade 0	03 (100%)	00	03 (100%)
Grade 1	26 (96.2%)	01 (03.8%)	27 (100%)
Grade 2	20 (95.2%)	01 (04.8%)	21 (100%)
Grade 3	28 (70.0%)	12 (30.0%)	40 (100%)
Grade 4	04 (44.4%)	05 (55.6%)	09 (100%)
Total	81	19	100

P VALUE – 0.001

On radiography, K – L score of 0 was found in 3 patients and among them all the three (100%) patients had normal meniscus score

K – L score of 1 was found in 27 patients and among them 26 (96.2%) patients had normal meniscus score

K – L score of 2 was found in 21 patients and among them 20 (95.2%) patients had normal meniscus score

K – L score of 3 was found in 40 patients and among them 28 (70%) patients had normal meniscus score

K – L score of 4 was found in 09 patients and among them 04 (44.4%) patients had normal meniscus score

Table 6. Comparison of loose bodies on radiography and on MRI

Grades	MRI				Total
	Score 0	Score 1	Score 2	Score 3	
0	90 (100%)	0	0	0	90 (100%)
1	0	06 (100%)	0	0	06 (100%)
2	0	0	02 (100%)	0	02 (100%)
3	0	0	0	02 (100%)	02 (100%)
Total	90	06	02	02	100

P VALUE – 0.001

On radiography, loose bodies of grade 0 was found in 90 patients and among them all the 90 patients (100%) had score 0 on MRI

On radiography, loose bodies of grade 1 was found in 06 patients and among them all the 06 patients (100%) had score 1 on MRI

On radiography, loose bodies of grade 2 was found in 02 patients and among them all the 02 patients (100%) had score 2 on MRI

On radiography, loose bodies of grade 3 was found in 02 patients and among them all the 02 patients (100%) had score 3 on MRI

Table 7. Relation between K-L score and S.Thick and effusion

Grades	S.Thick and effusion				Total
	Score 0	Score 1	Score 2	Score 3	
Grade 0	02 (66.7%)	01 (33.3%)	00	00	03 (100%)
Grade 1	20 (74.0%)	06 (22.2%)	00	01 (03.7%)	27 (100%)
Grade 2	14 (66.6%)	07 (33.4%)	00	00	21 (100%)
Grade 3	08 (20.0%)	22 (55.0%)	10 (25.0%)	00	40 (100%)
Grade 4	00	03 (33.3%)	06 (66.7%)	00	09 (100%)
Total	44	39	16	01	100

P value – 0.003

On radiography, K-L score of 0 was found in 3 patients and among these 2 patients (66.7%) had s.thick and effusion score of 0, 1 patient (33.3%) had score of 1

K-L score of 1 was found in 27 patients and among these, 20 patients (74%) had s.thick and effusion score of 0, 6 patients (22.2%) had score of 1, 1 patient (3.7%) had score of 3

K-L score of 2 was found in 21 patients and among these, 14 patients (66.6%) had s.thick and effusion score of 0, 7 patients (33.4%) had score of 1

K-L score of 3 was found in 40 patients and among these, 08 patients (20%) had s.thick and effusion score of 0, 22 patients (55%) had score of 1, 10 patients (25%) had score of 2

K-L score of 4 was found in 9 patients and among these, 3 patients (33.3%) had s.thick and effusion score of 1, 6 patients (66.7%) had score of 2

Table 8. Relation between K-L score and S.cysta and bursa

Grades	S.cysta and bursa				Total
	Score 0	Score 1	Score 2	Score 3	
Grade 0	03 (100%)	00	00	00	03 (100%)
Grade 1	27 (100%)	00	00	00	27 (100%)
Grade 2	20 (95.2%)	00	01 (04.8%)	00	21 (100%)
Grade 3	38 (95.0%)	02 (05.0%)	00	00	40 (100%)
Grade 4	08 (88.8%)	00	01 (11.2%)	00	09 (100%)
Total	96	02	02	00	100

P value – 0.48

On radiography, K-L score of 0 was found in 3 patients and among these all 3 patients (100%) had S.cysta and bursa score of 0

K-L score of 1 was found in 27 patients and among these, all 27 patients (100%) had S.cysta and bursa score of 0

K-L score of 2 was found in 21 patients and among these, 20 patients (95.2%) had S.cysta and bursa score of 0, 1 patient (4.8%) had score of 2

K-L score of 3 was found in 40 patients and among these, 38 patients (95%) had S.cysta and bursa score of 0, 2 patients (5%) had score of 1

K-L score of 4 was found in 9 patients and among these, 8 patients (88.8%) had S.cysta and bursa score of 0, 1 patient (11.2%) had score of 2

Table 9. Comparison of MRI compartment specific findings with K-L score

Site	Highest grade	Association of K-L score with highest grade			P value*
		Grade 2	Grade 3	Grade 4	
MFTJ	30 (30%)	00	15 (15%)	15 (15%)	0.001
LFTJ	30 (30%)	00	20 (20%)	12 (12%)	0.01
FTJ	05 (05%)	00	04 (4%)	00	0.003
PFJ	06 (06%)	00	06 (6%)	00	0.001

The above table depicts that there is a statistically significant relation was found between MRI findings and X ray findings in relation to compartment specific findings

DISCUSSION

Our results confirm that there are increasingly more frequent, as well as more severe, abnormalities at MR imaging in multiple tissues as the Kellgren- Lawrence grade of OA of the knee at radiography increases. Second, MR imaging– defined abnormalities were more frequent in the patella-femoral compartment than they were in the medial and lateral femorotibial compartments.

The disparity in sensitivity between MR imaging and standard radiography for detection of abnormalities, especially in the patella-femoral compartment, may partly explain the observation that clinically symptomatic OA of the knee can long precede radiographic evidence of OA of the knee.

Our data show that there were more frequent and more severe abnormalities detected at MR imaging as the radiographically determined grades of OA of the knee increased. Increasing Kellgren-Lawrence scores were associated with more frequent and more severe defects ofcartilage, BME, osteophytes, sub chondralsclerosis, effusion, synovitis, and meniscal tears. This finding reinforces the evolving concept that OA of the knee is a whole-organ disease and that MR imaging is capable of showing the bone and soft-tissue evidence of OA of the knee.

MR imaging–depicted synovitis was strongly correlated with the Kellgren-Lawrence grade. The capability of MR imaging to depict evidence of synovitis with abnormal signal intensity in the Hoffa fat pad was suggested by Schweitzer et al [9] and confirmed by Fernandez-Madridet al [10]. Although OA of the knee is not considered an inflammatory arthritis perse, it clearly may have associated synovitis that may be depicted by using MR imaging. In support of this idea, we previously reported that C-reactive protein, a well-established measurement of chronic inflammation, is elevated among those with OA of the knee [11].

It is not surprising that there was a strong correlation between MR imaging–depicted osteophytes and radiographically determined OA of the knee, since the Kellgren-Lawrence system is driven primarily by radiographically determined osteophyte size. Interestingly, some knees with Kellgren-Lawrence scores of grade 2were classified as having no osteophytes with MR imaging. This discrepancy suggests that radiography may be more sensitive for the detection of tiny osteophytesthan are some MR imaging sequences, particularly those with robust fat saturation. Future protocols may benefit from a sequence more specifically targeted for osteophyte detection.

In our study, It was observed that 40% of knees had grade 3, 27% of knees had grade1, 21% of knees had grade 2, 9% of knees had grade 4 and only 3% of knees had grade 0

All the PF joints positive in radiography were also found to be positive in MRI but among 36 knees shown as negative in radiography, MRI found positive in 19 knees.

K-L score of 3 was found in 40 patients and among these 32 patients (80%) had lig.score of 0, 2 patients (5%) had score of 1, 6 patients (15%) had score of 2

K-L score of 4 was found in 9 patients and among these 5 patients (55.5%) had lig.score of 0, 3 patients (33.3%) had score of 1, 1 patient (11.1%) had score of 2

K – L score of 3 was found in 40 patients and among them 28 (70%) patients had normal meniscus score

K – L score of 4 was found in 09 patients and among them 04 (44.4%) patients had normal meniscus score

In our report, there are findings that are parallel with findings of other investigators.Fernandez-Madrid et al [12] published a study of 97 knees in 52 subjects with OA of the knee in which MR imaging findings and radiographic evidence of OA of the knee were compared. They found a significant correlation between the MR imaging parameters of synovial proliferation, meniscal abnormalities, defects of cartilage, effusion, sub chondral lesions, and osteophytes and the radiographically determined Kellgren-Lawrence score. Only effusion, however, showed a positive correlation with pain. Link et al [13] assessed knees in 50 subjects and compared MR imaging findings with results of radiographic and clinical assessment for OA of the knee. Of the parameters examined, defects of cartilage, BME, cysts, effusion, and ligamentous abnormalities showed a positive association with radiographic severity of OA of the knee.

Felson et al [14] and Bhattacharyya et al [15] also described the association between several MR imaging–

defined parameters and radiographic severity of OA of the knee, as well as pain, in men and women.

These authors reported that they found a statistically significant association between pain and BME lesions, especially larger lesions, just as we did. Synovial or Baker cysts were common in our population and occurred in more than one-third of knees evaluated, but there was no correlation with radiographic severity of OA or pain status.

Joint effusion, however, showed a strong correlation with both radiographic severity of OA and pain, a finding that was consistent with the findings of Felson etal.

Several additional points and differences between the results of this study and those in prior reports reflect some strengths and limitations of our study.

Our participants were younger than those included in the study of Felson et al or in that of Link et al, and they had less severe OA of the knee as a group.

By design, we included a younger population in the hope of authenticating MR imaging–defined parameters for detection of early OA of the knee. As opposed to older patients with advanced OA of the knee, younger persons with early OA of the knee may benefit most from the development of structure-modifying therapies.

CONCLUSION

MR is a sensitive tool for detecting early osteoarthritic changes. MR appears to be particularly useful for noninvasive longitudinal monitoring of osteoarthritis in studies that assess the efficacy of treatments for osteoarthritis.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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