

Original article:

To correlate MR imaging findings of radiographically diagnosed osteoarthritis of knee with its radiographic findings and clinical symptoms

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Abstract:

In India, osteoarthritis of knee is one of the most prevalent chronic conditions which lead to physical impairments. Radiographically, more advance stages of osteoarthritis tend to show more severe symptoms. However, the radiographic stage is often inconsistent with clinical symptoms. So, a whole organ evaluation which includes bone cartilage, soft tissue and synovium is required for better management. Sixty four patients formed the study group. MRI findings were correlated with radiographic findings and clinical symptoms. The conclusion is, although clinical findings and plain radiographs are still important in evaluating osteoarthritis of knee in Indian context, MRI plays an important role in imaging the bony and soft tissue detail of knee as a whole organ, thereby helping in better management and outcome of the disease. Also MRI plays an important role in depicting early changes of osteoarthritis.

INTRODUCTION

In India, osteoarthritis is one of the most prevalent chronic conditions which lead to physical impairment affecting older adults. It also leads to significant health problem among working age group adults.^{1,2} Radiographically, more advanced stages of osteoarthritis tend to show more severe symptoms. However, the radiographic stage is often inconsistent with clinical symptoms. Primary assessment of osteoarthritis is done by meticulous history taking and physical examination. Since long, radiography has been the primary imaging modality for evaluation of osteoarthritis. However, its limitations regarding severity of disease and clinical outcome are well established. At best, joint space narrowing determined by radiography is an indirect measure of

status of joint cartilage but only a small percentage of the total articular surface is included in the radiographic evaluation.³⁻⁶ As knee joint is complex three dimensional structure and radiographs are its two dimensional composite, so radiographs have limited sensitivity for observation of features such as osteophytes, subchondral sclerosis and bone eburnation. Lastly, in osteoarthritis of knee, abnormalities determined by radiographs often have imperfect correlation with clinical symptoms. For complete estimation of structural integrity in osteoarthritis of knee, a whole organ evaluation which includes bone cartilage, soft tissue and synovium is required. Magnetic resonance imaging is able to provide complete evaluation of all components of knee joint, its integrity and status.

AIMS AND OBJECTIVES

- Grading of different stages of osteoarthritis of knee radiographically on the basis of Kellgren-Lawrence Grading Scale.
- To evaluate correlation of magnetic resonance imaging findings of osteoarthritis of knee with radiographic findings and clinical symptoms.

MATERIAL AND METHODS

Study setting:- Department of Radiodiagnosis and imaging, National Institute of Medical Science, Shobha Nagar, Jaipur.

Study period:- Study was conducted between January 2015 to June 2016.

SELECTION OF PATIENTS

INCLUSION CRITERIA

- All patients referred to the department of radiodiagnosis and imaging for radiography and MRI for knee pain/ stiffness/ limitation of movement. Patient with knee osteoarthritis were diagnosed by Clinico-Radiological American Rheumatism Association Criteria, which is as follows

1. Osteophytosis
2. Knee pain
3. Age > 40 year
4. Joint stiffness <30 minutes
5. Crepitus

EXCLUSION CRITERIA

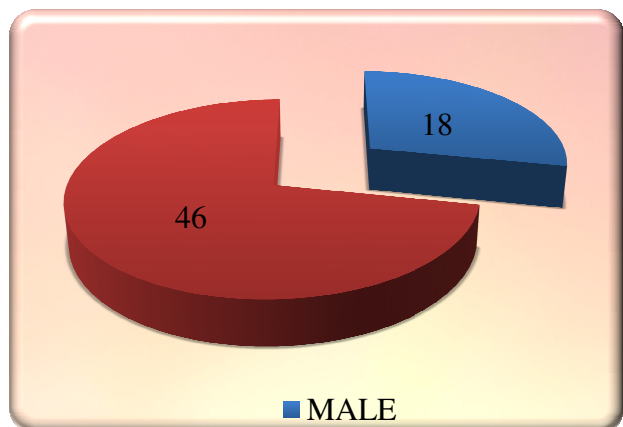
1. Claustrophobic or non-cooperative patient
2. Patients having obvious joint inflammation.
3. Operated knee or post traumatic knee joint.

4. Patients with ipsilateral hip joint pathology.
5. Patients with depression.
6. Patients with peripheral neuropathy or fibromyalgia.
7. Ulcer / wound around knee joint.
8. Patients with non-compatible MR implant.

METHODS

- Study included patients who were diagnosed with osteoarthritis of knee on plain radiographs and were then referred to the department of radiodiagnosis for MRI of knee for further evaluation.
- The patients were interviewed about their clinical symptoms and osteoarthritis was graded by WOMAC score.⁷
- Anteroposterior radiographs of the knee were assigned grades by using Kellgren-Lawrence (KL) scoring system.⁸
- MR imaging of the knee was performed in each patient. Each knee was assessed globally and according to compartment for 13 MRI defined parameters: defects of cartilage, subchondral cysts, sclerosis, meniscal abnormalities, ligamentous (ACL, PCL, and lateral collateral ligament) abnormalities, joint effusions, synovial cysts, and synovitis.
- Sixty four patients formed the study group. MRI findings were correlated with KL score and also with Western Ontario and McMaster Universities (WOMAC) score.

RESULTS



GRAPH 1: SEX WISE DISTRIBUTION

In our study female population was having much higher incidence of osteoarthritis

TABLE 1
DISTRIBUTION ACCORDING TO BMI

BMI SCORE	NO.OF CASES
16-20	4
21-25	20
26-30	24
31-35	16
TOTAL	64

In our study population 24 patients (37.5%) had mass index less than 25 and 40 patients (62.5%) had body mass index more than 25. Thus we can say that osteoarthritis is more common in patients with a high body mass index.

TABLE 2
INCIDENCE OSTEOPHYTES AT DIFEERENT SITES

SITES	NO. OF PATIENTS	PERCENTAGE
MEDIAL FEMORAL CONDYLE	64	100%
LATERAL FEMORAL CONDYLE	44	68.75%
MEDIAL TIBIAL CONDYLE	58	90.62%
LATERAL TIBIAL CONDYLE	46	71.87%
PATELLA MEDIAL FACET	52	81.25%

PATELLA LATERAL FACET	26	40.62%
FEMUR TROCHLEA	20	31.25%

Medial femoral condyle was the most common site of the osteophytosis and medial tibial condyle was the second most frequent site of osteophytes.

TABLE 3

INCIDENCE OF SUBCHONDRAL CYST AT DIFEERENT SITES

SITES	NO. OF PATIENTS	PERCENTAGE
MEDIAL FEMORAL CONDYLE	40	62.5%
LATERAL FEMORAL CONDYLE	30	46.87%
MEDIAL TIBIAL CONDYLE	34	53.12%
LATERAL TIBIAL CONDYLE	18	28.12%
PATELLA MEDIAL FACET	18	28.12%
PATELLA LATERAL FACET	10	15.62%
FEMUR TROCHLEA	18	28.12%

Medial femoral condyle was the most frequent site of subchondral cysts and second most common site was medial tibial condyle

TABLE 4

KL SCORES IN OSTEOPHYTES

SITE	GRADE	KL SCORE 2	KL SCORE 3	KL SCORE 4
MF	0	0	0	0
	1	24	22	0
	2	0	8	10
MT	0	6	0	0
	1	16	12	0
	2	2	18	10
LF	0	6	10	2
	1	18	8	2
	2	0	12	6
LT	0	14	6	0
	1	10	18	4
	2	0	6	6
FT	0	20	18	6
	1	4	10	4
	2	0	2	0
PTMF	0	4	8	0
	1	20	18	10
	2	0	4	0
PTLF	0	16	18	4
	1	8	6	6
	2	0	6	0

In tibiofemoral compartment KL score is showing high correlation with severity of osteophytes in MRI. As the MRI severity of osteophytes increases, the KL score also increases (p value = 0.000 and 0.098 for medial and lateral condyles of femur respectively and p= 0.000 and 0.001 for medial and lateral condyles of tibia respectively). The correlation coefficients between KL score and MRI detected osteophytes in patellofemoral were not significant (p>0.05).

TABLE 5

KL SCORING IN BONE MARROW EDEMA

SITE	GRADE	KL SCORE	KL SCORE	KL SCORE
		2	3	4
MF	0	8	6	0
	1	2	10	8
	2	10	12	8
MT	0	12	6	2
	1	8	10	4
	2	0	12	10
LF	0	12	12	6
	1	0	10	4
	2	8	6	6
LT	0	12	14	8
	1	6	14	2
	2	2	0	6
FT	0	14	16	6
	1	2	10	8
	2	4	2	2
PTMF	0	14	20	4
	1	4	8	10
	2	2	0	2
PTLF	0	12	18	10
	1	6	8	6
	2	2	2	0

Bone marrow edema in the medial and lateral condyles of tibia, lateral condyle of femur correlate well with radiographic osteoarthritis (p=0.001, 0.029 and 0.017 respectively).

TABLE 6
MEAN WOMAC INDEX IN OSTEOPHYTES AT DIFFERENT SITES

		MF	MT	LF	LT	FT	PTMF	PTLF
WOMAC PAIN (max.=20)	MEAN	5.64	5.137	5.423	5.46	5.79	5.267	5.4933
	%	28.20	25.69	27.12	27.30	28.95	26.34	27.47
WOMAC STIFFNESS (max.=08)	MEAN	1.73	1.337	1.483	1.6	1.947	1.703	1.67
	%	21.63	16.71	18.54	20.00	24.34	21.29	20.88
WOMAC DISABILITY (max.68)	MEAN	21.35	20.86	20.74	20.94	19.29	19.12	20.88
	%	31.40	30.68	30.50	30.79	28.37	28.12	30.71
WOMAC TOTAL (max.=96)	MEAN	28.72	27.33	27.66	28.01	27.04	26.29	28.05
	%	29.92	28.47	28.81	29.18	28.17	27.39	29.22

Considering the mean total WOMAC score in different compartments of knee, we got highest mean WOMAC score in osteophytes in medial articulating surface of femur.

A positive correlation was seen between osteophytes in medial compartment of femur and knee stiffness (P value=0.0093).

TABLE 7
MEAN WOMAC INDEX IN JOINT EFFUSION

	0	1	2
WOMAC PAIN (max.=20)	4.6	5.66	5.71
WOMAC STIFFNESS (max.=08)	1.4	1.44	1.57
WOMAC DISABILITY (max.68)	19	20.33	24
WOMAC TOTAL (max.=96)	25	27.44	31.28

No significant statistical association was seen between joint effusions and pain, stiffness or physical disability in knee joint (p>0.05). However the patients in our study had higher WOMAC pain, stiffness, physical disability and total scores with increasing severity of joint effusions

TABLE 8

MEAN WOMAC INDEX IN CARTILAGE DEFECTS AT DIFFERENT SITES

			MF	MT	LF	LT	FT	PTMF	PTLF
WOMAC PAIN (max.=20)	MEAN		5.23	5.40	5.30	4.62	6	5	6.75
	%		26.17	27.02	26.52	23.13	30.00	25.00	33.79
WOMAC STIFFNESS (max.=08)	MEAN		1.47	1.45	1.46	1	1	1	1.48
	%		18.38	18.18	18.34	12.50	12.50	12.50	18.54
WOMAC DISABILITY (max.68)	MEAN		19.71	20.90	19.35	19.63	21	21	22.24
	%		28.99	30.74	28.46	28.87	30.88	30.88	32.72
WOMAC TOTAL (max.=96)	MEAN		26.42	27.77	26.11	25.25	28	28	30.49
	%		27.53	28.93	27.20	26.30	29.17	29.17	31.77

Considering the mean total WOMAC score in different compartments of knee, we got highest mean WOMAC score in cartilage defect at femur trochlea and patella medial facet (mean total WOMAC score 28 at both sites).



Fig. 1: KL Grade IV with lateral subluxation
Of tibia

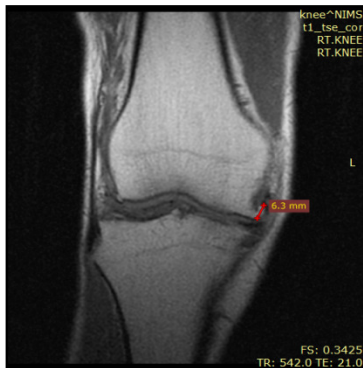


Fig. 2: Grade II osteophyte at lateral articulating
surface of femur

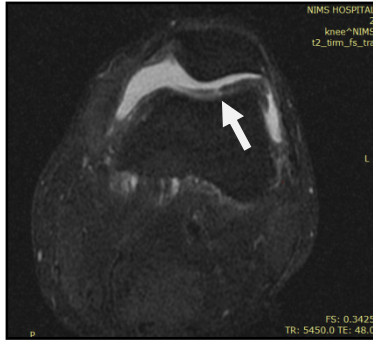


Fig. 3: Articular cartilage defect in articulating surface of femur



Fig. 4: Synovitis with joint effusion

DISCUSSION

- Mary I. O' Connor in 2007 also shown that Women experience earlier and more severe osteoarthritis as compared to males.⁹
- In the longitudinal study by Framingham, high body mass index predicted the disease development in later life¹⁰
- In our study medial compartment of the joint was most commonly involved. Curtis W. Hayes; et al in 2005 observed that most common site of osteophytosis, bone marrow edema and cartilage defect was patellofemoral compartment followed by medial and lateral compartment.¹¹
- In our study, no significant association was seen between joint effusions and pain, stiffness or physical disability in knee joint. However the patients in our study had higher WOMAC scores with increasing joint effusion severity. Hill; et al found in their study that moderate to severe joint effusions were more frequent in the patients came with joint pain.¹² But Link; et al found no significant association between these features, however they found an inclination towards higher scores of pain in patient came with joint effusion.¹³ Capsular distention is the cause of knee pain in joint effusion as stated by different studies.^{12, 13}
- Peter R Kornaat et al; in 2006 reported association between joint effusion (of grade II and III) and joint pain.¹⁴

- A correlation was seen between cartilage defects in tibiofemoral compartment in both lateral and medial aspect and KL score (P=0.058, 0.058, 0.080 and 0.002 in medial femoral condyle, medial tibial condyle, lateral femoral condyle and lateral tibial condyle respectively).

Curtis W. Hayes reported strong association between K L score and cartilage defect. Their data showed as the K L score increased the frequency and severity of the abnormalities detected in MRI also increased.¹¹

CONCLUSION

- The incidence of the disease was more common in females as compared to males.
- Medial tibiofemoral compartment was the most common site of osteophytes, BME subchondral cysts and cartilage defects.
- No association was seen between cartilage defects, bone marrow edema, sub chondral cysts, subchondral sclerosis, Baker's cysts with clinical features.
- A positive correlation was seen between osteophytes in medial articular surface of femur and knee stiffness (P value = 0.0093).
- A statistically significant association was seen between functional disability and stiffness in knee joint (considering WOMAC functional disability and stiffness scores) and the presence of osteochondral bodies (P =0.01).
- In tibiofemoral compartment MRI detected osteophytes and radiographically diagnoses osteophytes showed a high correlation and as the MRI severity at osteophytes increased, the K L score also increased.
- In summary, although clinical findings and plain radiographs are still important in evaluating osteoarthritis of knee in Indian context, MRI plays an important role in imaging the bony and soft tissues of knee as a whole organ, thereby helping in better management and outcome of the disease. Also MRI plays an important role in depicting early changes of osteoarthritis.

REFERENCES

1. From the Centers for Disease Control and Prevention. Prevalence and impact of arthritis among women- United States, 1989-1991. *JAMA* 1995; 273; 1820-1821.
2. Praemer A, Furner S, Rice DP. Musculoskeletal conditions in the United States. Park Ridge, Ill: *American Academy of Orthopedic Surgeons*, 1992.
3. Spector TD, Hart DJ, Huskisson EC. The use of radiographs in assessing the severity of knee osteoarthritis. *J Rheumatol Suppl* 1991;27:38-39.
4. Altman RD. Criteria for classification of clinical osteoarthritis. *J Rheumatol Suppl* 1991;27:10-12.
5. Brandt KD, Fife RS, Braunstein EM, Katz B. Radiographic grading of the severity of knee osteoarthritis: relation of the Kellgren and Lawrence grade to a grade based on joint space narrowing, and correlation with arthroscopic evidence of articular cartilage degeneration. *Arthritis Rheum* 1991;34:1381-1386.
6. Hunnan MT, Felson DT, Pincus T. Analysis of the discordance between radiographic changes and knee pain in osteoarthritis of the knee. *J Rheumatol* 2000;27:1513-1517.

7. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988;15:1833–40.
8. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis.* 1957 Dec;16(4):494–502.
9. Mary I. O' Connor Sex Differences in Osteoarthritis of the Hip and knee, *MD J Am Acad Orthop Surg*, Vol 15, No Suppl_1, September 2007, S22-S25.
10. Felson DT, Anderson JJ, Naimark A, Walker AM, Meenan RF. Obesity and knee osteoarthritis. The Framingham Study. *Ann Intern Med* 1988; 109: 1824.
11. Curtis W. Hayes, MD, Dacid A. Jamadar, MB, BS, Gavin W. Welch, PhD, Mary L. Jannausch, MS, Laurie L. Lachance, PhD, PhD, Diana C. Capul, BA and MaryFran R Sowers, PhD; et al Osteoarthritis of the knee: Comparison of MR Imaging Findings with Radiographic Severity Measurements and pain in Middle-aged Women *Radiology* 2005;237:998-1007.
12. Catherine I, Hill Daniel G, Gale. Christine E. Chaisson, Katherine Skinner, Lawis Kazis, M. Elon Gale, and David T. Felson; et al Knee Effusions, Popliteal Cysts, and synovial Thickening: Association with Knee Pain in Osteoarthritis *J Rheumatol* 2001;28:1330-7.
13. Link TM, Steinbach LS, Ghosh S, et al. Osteoarthritis: MR imaging findings in different stages of disease and correlation with clinical findings. *Radiology* 2003;226:373-381.
14. Peter R Kornaat Johan L Bloem Ruth YT Ceulemans Naghmeh Riyazi Frits R Rosendaal Rob G Nelissen Wayne O Carter Marie-Pierre Helio Le Graverand Margreet Kloppenburg Magnetic resonance imaging in knees of patients with osteoarthritis at multiple sites: association with clinical findings *Radiology June* 2006.