

## Assessment of Cartilage Abnormalities on MRI in Patients with Osteoarthritis of Knee

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### ABSTRACT

**Background:** Osteoarthritis (OA) is a widely prevalent disease worldwide and, with an increasing ageing society, is a challenge for the field of physical and rehabilitation medicine. Hence; the present study was undertaken for assessing the cartilage abnormalities on MRI in OA patients.

**Materials & Methods:** A total of 20 OA of knee patients were enrolled in the present study. MRI was done in all the patients. Cartilage abnormalities were assigned grades as follows: grade 0, normal; grade I, internal signal intensity alteration only; grade IIA, defect of cartilage of less than 50%; grade IIB, defect of cartilage of 50%–99%; grade IIIA, 100% defect of cartilage with no bone ulceration; or grade IIIB, 100% defect of cartilage with subjacent bone ulceration.

**Results:** Out of 20 patients, grade 0 was found to be present in 2 patients, while grade 1 and Grade 2 were found to be present in 2 and 4 patients respectively. Grade 3 of cartilage abnormality was found to be present in 6 patients. Grade 4 of cartilage abnormality was found to be present in 6 patients.

**Conclusion:** MRI plays an important role in imaging the bony and soft tissues of knee as a whole organ.

**Key words:** MRI, Osteoarthritis.


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### INTRODUCTION

Osteoarthritis (OA) is a widely prevalent disease worldwide and, with an increasing ageing society, is a challenge for the field of physical and rehabilitation medicine.<sup>1</sup> Technologic advances and implementation of sophisticated post-processing instruments and analytic strategies have resulted in imaging playing a more and more important role in understanding the disease process of OA. Cost concerns, lack of clarity about diagnostic performance and little standardization regarding MRI interpretation has made it unclear whether this increased use of MRI in clinical practice is rational. In contrast to x-ray, MRI can visualize all tissues in the joint involved in OA: cartilage, menisci, bone, and soft tissue. In addition, MRI causes no ionizing radiation exposure.<sup>2-5</sup> The grade of cartilage abnormality was assessed using the Modified Outerbridge Classification.<sup>6</sup> Hence; under the light of above-mentioned data, the present study was undertaken for assessing the cartilage abnormalities on MRI in OA patients.

### MATERIALS & METHODS

The present study was conducted in the Department of Radiodiagnosis, PDU Medical College and Government Hospital, Rajkot, Gujarat (India) and it included assessment of cartilage abnormalities on MRI in OA patients.

Ethical approval was obtained from institutional ethical committee and written consent was obtained from all the patients after explaining in detail the entire research protocol.

A total of 20 OA of knee patients were enrolled in the present study. Complete demographic details and clinical data of all the patients were obtained. Clinical assessment was done in all the patients.

### Exclusion Criteria

- Patients with past history of trauma or knee surgery were excluded from the study

- Patients who couldn't undergo MR imaging such as patients with-
  - Cardiac pacemaker
  - Cochlear implants
  - Neurostimulators

After meeting the exclusion criteria, MRI was done in all the patients. The grade of cartilage abnormality was assessed using the Modified Outerbridge Classification.<sup>6</sup>

There are five grades of cartilage abnormalities. Grade 0 refers to normal cartilage; grade 1 is abnormal intrachondral signal (signal increase in T2 weighted images) but normal chondral surface cartilage; grade 2 is loss of less than 50% of cartilage but without exposure of subchondral bone defect; grade 3 is loss of more than 50% of cartilage thickness but without exposure of subchondral bone; grade 4 is complete loss of cartilage with subchondral bone exposure.

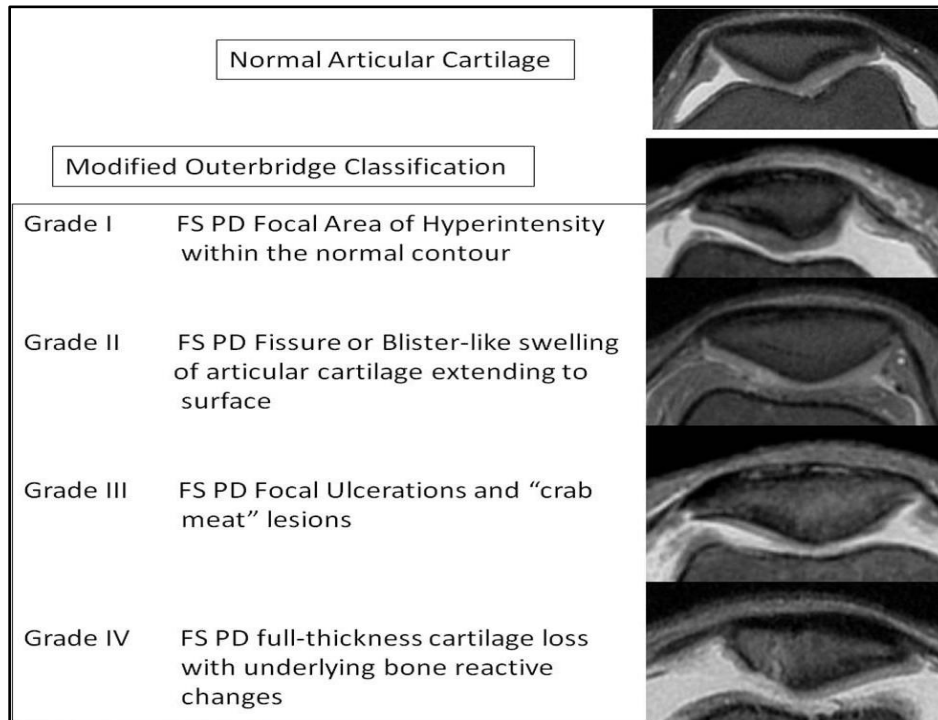


Fig 1: Modified Outerbridge Classification



Fig 2: Coronal PD FS image in 52-year-old female reveals a wide area of full-thickness cartilage loss involving the weight bearing surface of the femoral medial condyle. No evident subchondral bone reactive or sclerotic changes.



**Fig 3: Coronal PD FS and T1W images of knee joint in 60-year-old male show established osteoarthritis in medial-lateral compartment of the tibiofemoral articulation. There is a complete loss of articular cartilage covering weight bearing surfaces of femoral and tibial medial condyles exposing subchondral bone with reactive changes, associated with established marginal osteophytosis and subchondral bone sclerosis.**

**RESULTS**

In the present study, a total of 20 patients were analysed. Mean age of the patients of the present study was 59.85 years. Majority of the patients of the present study belonged to the age group of 51 to 70 years. 40 percent of the patients of the present study

were males while the remaining 60 percent were females. In the present study, out of 20 patients, grade 0 was found to be present in 2 patients, while grade I and Grade II were found to be present in 2 and 10 patients respectively. Grade III of cartilage abnormality was found to be present in 6 patients.

**Table 1: Age-wise distribution of patients**

Age group (years)	Number of patients	Percentage of patients
Less than 40	2	10
40 to 50	2	10
51 to 60	6	30
61 to 70	6	30
More than 70	4	20
<b>Total</b>	<b>20</b>	<b>100</b>
<b>Mean</b>	59.85	

**Table 2: Gender-wise distribution of patients**

Gender	Number of patients	Percentage of patients
Male	8	40
Females	12	60

**Table 3: Distribution of patients according to cartilage abnormality (On MRI)**

Grade (On MRI)	MRI Findings	Number of patients	Percentage of patients
Grade 0	Normal	2	10
Grade 1	Abnormal intrachondral signal (signal increase in T2 weighted images) but normal chondral surface cartilage	2	10
Grade 2	Loss of less than 50% of cartilage but without exposure of subchondral bone defect	4	20
Grade 3	Loss of more than 50% of cartilage thickness but without exposure of subchondral bone	6	30
Grade 4	Complete loss of cartilage with subchondral bone exposure	6	30
<b>Total</b>		<b>20</b>	<b>100</b>

## DISCUSSION

Osteoarthritis (OA) has become an enormous clinical burden as its impact upon the aging population has become increasingly apparent. OA, characterized as the slow progressive loss of joint function. Although OA was conventionally deemed to be a degenerative disease driven by articular cartilage “wear and tear,” recent evidence has led to a new view that OA pathophysiology should be perceived in the context of the entire joint with involvement of several tissues. OA is now understood to be the result of an imbalance between catabolic and anabolic activities in joint tissue, eventually leading to permanent tissue degradation, pain, physical disability and psychological distress.<sup>4,5,7,8</sup> Tissues of interest associated with OA, in the context of the knee joint, include the articular cartilage, synovium, menisci, ligaments, bone, muscles, and tendons. Because of the different characteristics of these tissues and their responses to OA, advanced imaging methods sensitive to various types of tissues are needed to properly evaluate OA.<sup>9</sup> Hence; under the light of above-mentioned data, the present study was undertaken for assessing the cartilage abnormalities on MRI in OA patients.

In the present study, a total of 20 patients were analysed. Mean age of the patients of the present study was 59.85 years. Majority of the patients of the present study belonged to the age group of 51 to 70 years. 40 percent of the patients of the present study were males while the remaining 60 percent were females. Saadat E et al evaluated the sensitivity, specificity and accuracy of sagittal in vivo 3-T intermediate-weighted fast spin-echo (iwFSE) sequences in the assessment of knee cartilage pathologies using histology as the reference standard in patients undergoing total knee replacement, and correlated MR imaging findings typically associated with osteoarthritis such as bone marrow edema pattern (BMPE) and cartilage swelling with histological findings. Tibial plateaus and femoral condyles of eight knees of seven patients were resected during surgery, and sagittal histological sections were prepared for histology. Preoperative MRI findings were compared to the corresponding region in histological sections for thickness, surface integrity and signal pattern of cartilage, and histological findings in areas of BMPE and swelling were documented. The overall sensitivity, specificity and accuracy were 72%, 69% and 70% for thickness, 69%, 74% and 73% for surface and 36%, 62% and 45% for intracartilaginous signal pattern. For all cases of BMPE on MRI subchondral ingrowth of fibrovascular tissue and increased bone remodelling were observed. MRI using fat-saturated iwFSE sequences showed good performance in assessing cartilage thickness and surface lesions, while signal changes of cartilage were not suited to characterize the severity of cartilage degeneration as validated by histology.<sup>9</sup>

In the present study, out of 20 patients, grade 0 was found to be present in 2 patients, while grade 1 and Grade 2 were found to be present in 2 and 4 patients respectively. Grade 3 of cartilage abnormality was found to be present in 6 patients. Grade 4 of cartilage abnormality was found to be present in 6 patients. Standard MRI techniques can be easily extended to assess the changes in cartilage thickness, surface area and volume before and during, or before and after, load. Such measures are sensitive enough to delineate changes in volume and surface area with early radiographic damage. MRI can visualize local cartilage changes that have yet to manifest as the global joint space narrowing that can be detected by radiograph, including swelling

that occurs with pre-radiographic damage and localized thinning and loss of cartilage. However, these measurements of thickness and volume change are nominal and may mask any depth-dependent changes in cartilage. Additionally, measurements of cartilage thickness and surface area are limited by the spatial resolution of imaging, the segmentation of regions of interest and the registration of images taken at different time points.<sup>5,7,8</sup>

In another study of 43 patients over 1–5 years (mean 1.8 years), among the cartilage lesions present at baseline, 12% were not detectable at follow up, 6% regressed to a lower grade, 32% remained the same grade and 50% progressed to a higher grade. There were 84 new lesions during the study period. In a study of 86 participants without knee OA, Wang and colleagues reported that over 2 years the cartilage defect score increased, and that the medial tibiofemoral, lateral tibiofemoral and patellar cartilage defect score increased in 63%, 65% and 36% of the subjects, remained unchanged in 32%, 30% and 46% of the subjects and decreased in 5%, 5% and 18% of the subjects, respectively. In a convenience midlife sample of 325 subjects, over 2.3 years, patellar cartilage defect score increased significantly, 12%, 13% and 22% of subjects had an increase in cartilage defect scores, whereas 13%, 12% and 13% of subjects had a decrease in cartilage defect scores at the medial, lateral and patellar sites, respectively. Overall, 33% of the subjects had a worsening ( $\geq 1$  point increase) and 37% of the subjects had an improvement ( $\geq 1$  point decrease) in cartilage defect score in any knee compartment during 2.3 years.<sup>10-13</sup> While medications can help slow the progression of RA and other inflammatory conditions, no proven disease-modifying agents for the treatment of knee osteoarthritis currently exist.<sup>14</sup>

## CONCLUSION

From the above results, the authors conclude 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.

## REFERENCES

1. Heidari B. Knee osteoarthritis prevalence, risk factors, pathogenesis and features: Part I. *Caspian J Intern Med.* 2011;2(2):205–12.
2. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee osteoarthritis in India and related factors. *Indian J Orthop.* 2016;50(5):518–22.
3. Kuyinu EL, Narayanan G, Nair LS, Laurencin CT. Animal models of osteoarthritis: Classification, update, and measurement of outcomes. *J Orthop Surg Res.* 2016 Feb 2;11:19.
4. Brown TD, Johnston RC, Saltzman CL, Marsh JL, Buckwalter JA. Posttraumatic osteoarthritis: A first estimate of incidence, prevalence, and burden of disease. *J Orthop Trauma.* 2006 Nov-Dec;20(10):739–44.
5. Loia MC, Vanni S, Rosso F, et al. High tibial osteotomy in varus knees: Indications and limits. *Joints.* 2016 Aug 18;4(2):98–110.
6. A. Goel and F. Gaillard, Modified Outerbridge Grading System, 2010, <http://radiopaedia.org/articles/chondromalacia-grading>.
7. Chan WP, Lang P, Stevens MP, Sack K, Majumdar S, Stoller DW, Basch C, Genant HK. Osteoarthritis of the knee: comparison of radiography, CT, and MR imaging to assess extent and severity. *AJR Am J Roentgenol.* 1991 Oct;157(4):799–806.

8. Braun HJ, Gold GE. Diagnosis of osteoarthritis: imaging. *Bone*. 2011;51(2):278–88. doi:10.1016/j.bone.2011.11.019
9. Saadat E, Jobke B, Chu B, Lu Y, Cheng J, Li X, Ries MD, Majumdar S, Link TM. Diagnostic performance of in vivo 3-T MRI for articular cartilage abnormalities in human osteoarthritic knees using histology as standard of reference. *Eur Radiol*. 2008 Oct;18(10):2292-302. doi: 10.1007/s00330-008-0989-7. Epub 2008 May 20.
10. Biswal S., Hastie T., Andriacchi T.P., Bergman G.A., Dillingham M.F., Lang P. Risk factors for progressive cartilage loss in the knee: a longitudinal magnetic resonance imaging study in forty-three patients. *Arthritis Rheum*. 2002; 46: 2884–92.
11. Wang Y., Ding C., Wluka A.E., Davis S., Ebeling P.R., Jones G., et al. Factors affecting progression of knee cartilage defects in normal subjects over 2 years. *Rheumatology*.2006; 45: 79–84.
12. Ding C., Cicuttini F., Scott F., Boon C., Jones G. Association of prevalent and incident knee cartilage defects with loss of tibial and patellar cartilage: a longitudinal study. *Arthritis Rheum*.2005a; 52: 3918–27.
13. Ding C., Cicuttini F., Scott F., Cooley H., Boon C., Jones G. Natural history of knee cartilage defects and factors affecting change. *Arch Intern Med*. 2006; 166: 651–8.
14. Hsu H, Siwec RM. Knee Osteoarthritis. In: *Stat Pearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK507884/>

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