OSTEOARTHRITIS OF THE KNEE: CORRELATION OF 1.5 T MRI FINDINGS WITH RADIOGRAPHIC SEVERITY BASED ON KELLGREN-LAWRENCE GRADING OF OSTEOARTHRITIS. A RETROSPECTIVE STUDY FROM JANUARY 2012 TO APRIL 2013 IN THE MEDICAL CITY SETTING

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RESEARCH OBJECTIVES

General

To correlate magnetic resonance (MR) imaging-defined abnormalities of osteoarthritis (OA) of the knee with radiographic severity based on Kellgren-Lawrence grading of osteoarthritis.

Specific

- To grade the various stages of OA by using Kellgren-Lawrence grading scale
- To evaluate the OA of knee using MRI and describe each findings
- To determine the prevalence of structural lesions evident in MRI that are associated with OA and to correlate them with radiographic Kellgren-Lawrence grading of osteoarthritis
- To aid orthopedic clinicians in the approach to diagnosis of patients with OA

SIGNIFICANCE OF THE STUDY

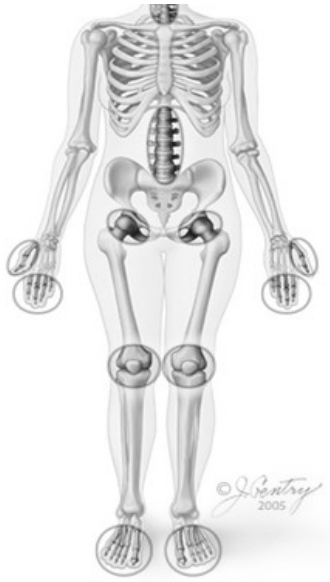
Osteoarthritis (OA) of the knee is a rising prevalent disease of patients with increasing age. Traditional structural changes of OA are assessed with radiographs, mainly the osseous details. However, radiographs lack the sensitivity of soft tissue depiction. MRI, then, will facilitate the evaluation of the soft tissues and cartilage of the knee, thereby, giving a whole-organ approach in assessment. By determining the prevalence of the soft tissue findings in MRI, clinicians could have a picture in mind what to expect in the different grades of OA using only radiography.

INTRODUCTION

Osteoarthritis (OA) is the most frequent form of arthritis, with radiologic and clinical implications that still remains to be under study since no definite effective treatment is available. The committee on OA of the American College of Rheumatology Diagnostic and Therapeutic Criteria Committee defined OA as "A heterogeneous group of conditions that lead to joint symptoms and signs which are associated with defective integrity of articular cartilage, in addition to related changes in the underlying bone at the joint margins" [1].

OA develops when cartilage deteriorates. The degenerative process is usually long and slow. In the early stages of the disease the surface of the cartilage becomes inflamed. The joint loses proteoglycans and water, hence, fissures and pits appears in the cartilage. As the disease progresses and more tissue is lost, the cartilage starts to harden and as a result, it becomes increasingly prone to damage from repetitive use and injury.

This degenerative joint disease frequently affects middle-age to elderly people which is one of the top reasons for functional impairment. It is commonly referred to as "wear and tear" of the joints. Risk factors include genetics, female sex, past trauma, advancing age, and obesity. The clinical diagnosis is based on history of joint pain [2]. ***Figure 1*** shows a schematic depiction of the affected joints in OA.



In the local setting, Filipino patients with OA have the knee as the most common affected site. Majority of the diagnosed patients are females in their 5th decade of life [3].

From an extrapolated data released by US Census Bureau in 2004, the Philippines has an estimated number of more than 6 million individuals diagnosed with osteoarthritis which is approximately 7-8% of the total population. This number is estimated to rise by the hundreds every year.

Figure 1. Schematic illustration of affected joints in osteoarthritis.

BACKGROUND INFORMATION

Radiography

Traditionally, OA structural changes have been assessed with radiographs. The standing anteroposterior (AP) protocol of the knee in extension in the weight-bearing position used to be the most commonly used technique. Standing AP and lateral radiographs suffice for routine clinical assessment of patients diagnosed or suspected with OA.

Radiography is used in clinical practice to establish the diagnosis of OA and to monitor the progression of the disease. Radiographs depict bony features, including marginal osteophytes, subchondral sclerosis, and subchondral cysts, that are associated with OA and provide an indirect estimate of cartilage thickness and meniscal integrity by allowing assessment of joint space width (JSW). Radiographic assessment of OA relies mainly on the evaluation of both osteophytes and joint space narrowing. Osteophytes develop at an earlier stage than joint space narrowing, and they are the most widely applied radiographic criterion for defining the presence of OA, while assessment of the severity of OA relies mainly on joint space narrowing and concomitant subchondral bone abnormalities. The main shortcomings of radiography are its insensitivity to change and its lack of soft-tissue depiction [1], [5], [6].

Several grading scales that incorporate combinations of features have also been developed, including the most widely used Kellgren-Lawrence grading scheme, which is the current accepted standard for the diagnosis of OA on radiographs. This scheme was adopted by World Health Organization as the reference standard for cross-sectional and longitudinal epidemiologic studies [7].

Table 1. Kellgren-Lawrence Grading Scheme for OA

Kellgren-Lawrence Grading	Description	Figure
0	No features of OA	
1	Doubtful joint space narrowing and possible osteophyte lipping	A
2	Definite osteophytes and possible joint space narrowing	B
3	Moderate multiple osteophytes; definite joint space narrowing, and some sclerosis and possible deformity of bone ends	C
4	Large osteophytes, marked joint space narrowing, severe sclerosis, and definite deformity of bone ends	D

Source: Kellgren JH , Lawrence JS . *Radiological assessment of osteo-arthrosis* . Ann Rheum Dis 1957 ; 16 (4): 494 – 502 .

Figure 2. Radiographic images of the Kellgren-Lawrence grading scheme

Source: Kellgren JH , Lawrence JS . *Radiological assessment of osteo-arthrosis* . Ann Rheum Dis 1957 ; 16 (4): 494 – 502 .

Magnetic Resonance

Increasingly, MRI has become a useful tool for early detection of OA due to its superior soft tissue contrast that provides maximum diagnostic performance. MRI can visualize various tissues that are clinically relevant not seen on radiography. MRI can show incidental findings in otherwise asymptomatic people. In the knee, MRI visualizes most components of the joint, including articular cartilage, menisci, intra-articular ligaments, tendons, synovium, fat components, bone marrow, and subchondral margins that are not detectable by radiography.

Imaging with a 1.5-T large-bore magnet is still regarded as the clinical standard, and most of the studies in which MR imaging is applied for morphologic and compositional assessment of knee cartilage were performed at this field strength [8], [9].

MRI manipulates image contrast to highlight different tissue types. Common contrast methods include 2D or multi-slice T1-weighted, proton density (PD), and T2-weighted imaging. Spin echo (SE) and Fast-spin echo (FSE) imaging techniques are useful in evaluating focal cartilage defects. Recent improvements in hardware, software, gradients, and radiofrequency (RF) coils have led to the use of fast or turbo-spin echo imaging, fat saturation and water excitation to improve tissue contrast [10],[11].

Recent focus on the acknowledgement that OA as a whole-organ degenerative process, the utility and diagnostic contribution of MRI in the assessment of the disease cannot be overemphasized.

Table 2. Commonly Encountered MRI Findings in OA [11].

MRI Lesion	Description
Cartilage damage	Considered present if there was a small focal loss less than 1 cm in greatest width or areas of diffuse partial or full thickness loss.
Meniscal lesions	Included displaced or non-displaced meniscal tears or evidence of previous surgery (including repair and partial or complete resection) and complete maceration or destruction (that is, loss of normal contour and signal homogeneity within the meniscus) within the Anterior and posterior horns and the body of the medial and lateral menisci.
Osteophytes	Presence of bony projections that form along different margins of the tibiofemoral joint of the knee
Ligamentous abnormalities	Presence of a completely torn anterior or posterior cruciate ligament, or a torn or thickened medial or lateral collateral ligament
Bone marrow lesions	Subchondral bone marrow lesions, also known as "bone marrow edema-like lesions," were considered present if there are non-cystic subchondral areas of ill defined high signal on proton density weighted MR images with fat signal suppression
Subchondral cysts	Areas of markedly increased signal intensity in the subarticular bone with sharply defined rounded margins and no evidence of internal marrow tissue or trabecular bone on the fat saturated proton density weighted images
Synovitis	Synovial cavity was distended and filled with fluid (high signal intensity on fat saturated proton density weighted images), representing synovial thickening and joint effusion
Attrition	Flattening or depression of the articular surfaces of the tibia or femur was termed bone attrition, and any degree of deviation from the normal bony contour was considered abnormal

Source: *BMJ* 2012;345:e5339 doi: 10.1136/bmj.e5339 (Published 29 August 2012

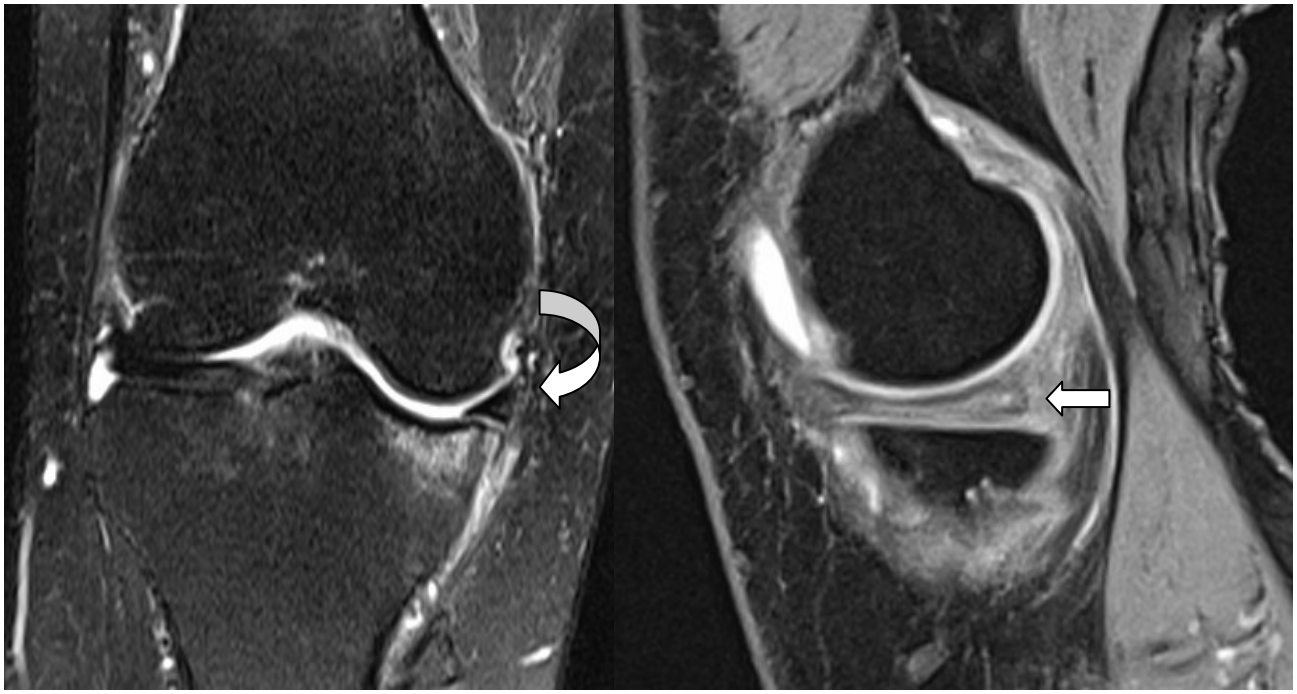


Figure 3. Right knee MRI images of a 58 year old female patient. T2 spin echo coronal fat saturated image of right knee showing full thickness cartilage defect in the medial femoro-tibial compartment (curved arrow) with associated bone marrow edema; the sagittal image showing diffuse hyperintense signals in the posterior root of medial meniscus with extension into inferior articular surface.

Figure 4. Right knee radiograph images of a 58 year old female patient. Anteroposterior and lateral views demonstrate narrowing of the medial femoro-tibial joint space with concomitant sclerotic changes in the medial tibial plateau associated with sharpening of the intercondylar spines. This was given grade 3 in the Kellgren-Lawrence severity scale of osteoarthritis. (Images were taken from PACS images of the outpatient MRI section of The Medical City)

REVIEW OF LITERATURE

Several studies have proven the fact that osteoarthritis leads to progressive cartilage loss and a number of imaging techniques have been developed and standardized to evaluate this qualitatively and semi-quantitatively. According to an article by Brant and colleagues, OA is not exclusively a disorder of the articular cartilage [12]. Apart from cartilage involvement, there are other associated findings in OA, such as bone marrow edema and synovial and ligamentous or tendinous lesions. Together, these lesions have significant effect on the progression of the disease.

It is a scientific fact that MRI can detect features suggestive of knee OA that cannot be appreciated on conventional radiography. Investigations being conducted enhance OA diagnosis through improvements in sensitivity and specificity in detection of this disease entity, thereby improving immensely clinical decision making.

The correlation of MR-imaging defined abnormalities and radiographically determined OA have been studied in several notable articles. In a study by Hayes et al, MR imaging finding depicting osteoarthritic change is detectable even if no radiographic evidence of OA is present [13]. Amin and colleagues investigated the relationship between radiographic progression of joint space narrowing and cartilage loss seen on MR images in patients with symptomatic knee OA and MR imaging–based cartilage loss. They showed that a substantial proportion of knees exhibit cartilage loss on MR images even when no radiographic progression is observed [14].

In a paper by Link and co-workers, the number of osseous, cartilaginous, synovial, ligamentous, and meniscal lesions depicted on MR images are associated with osteoarthritis and that the extent of these lesions correlates with radiographically determined Kellgren -Lawrence scores.

Type of Research:

Retrospective Cross-sectional Study

Materials and Methods

A. Participants

Patients, ages 30 to 85 years old, who had both radiographic and MRI examination of the knee in The Medical City Radiology Section from January 2012 to April 2013 whose images were stored in the picture and archiving system of the hospital. Excluded in the study are the patients with orthopedic implants on the knee.

B. Radiography

The routine AP and lateral radiographs of the knee through the picture archiving system (PACS) with final impression of OA were reviewed and re-evaluated by 2 consultant radiologists. The grading descriptions of Kellgren -Lawrence scheme were utilized in the assessment of the radiographic changes of the knee. There was no specific laterality required but the radiographs under study should be obtained within the same year the MRI was performed on the same knee being investigated. The consultants were blinded to the MRI findings. The data were pooled and arranged according to grade by the principal investigator.

C. MRI

Data from MRI done with a 1.5 Tesla scanner (Siemens Medical Systems, Erlangen, Germany) with a phased array knee coil was used. The sequences and imaging parameters are summarized in *Table 3*.

MRI images assessment was performed by the investigator wherein the knee cartilages, bony portions, meniscus, ligaments, and synovial cavities were scrutinized for abnormalities. The investigator was blinded to the Kellgren-Lawrence score designated for the knee under study. The morphologic impression of the knee was pooled according to the descriptions enumerated in the previous background information of the research protocol.

Table 3. Imaging Parameters Utilized in 1.5 Tesla Siemens Medical System

Imaging Parameter	Coronal PD FS	Coronal MED2D	Sagittal MED2D	Sagittal PD-T2 FS	Axial T1	Axial PD-T2 FS
TR (msec)	2670	680	20.60	2170	387	3470
TE (msec)	33	23	7.57	75	21	32
Matrix Size	314x448	179x256	288x384	288x384	314x448	192x256
Field of View (cm)	18	18	18	18	16	16
Slice Thickness (mm)	4	4	1.5	3.5	3	3
Bandwidth (kHz)	192	201	191	189	167	190
Signal to noise Ratio	1	1	1.47	1	1	1
Scan Time (min:sec)	2:31	2:41	3:01	3:24	3:29	3:26

Note: FS = fat suppressed, PD = proton density
MED2D = protocol with low sensitivity to artefacts of motion, susceptibility, and chemical shift
PD-T2 DESS Protocol = for orthopedic series that is good for differentiation between synovial liquid and cartilage definition

Statistical Analysis

MR imaging findings evaluation in relation to Kellgren-Lawrence Scores was performed through construction of contingency tables to correlate the frequency of categoric MR imaging findings to Kellgren-Lawrence Scores.

Statistical analyses were performed using SPSS software version 10.1 (Chicago Il, USA). For the testing of relationship between Kellgren-Lawrence score and MRI morphological findings, Chi-Square test was employed. P-values less than or equal to 0.05 were considered statistically significant.

RESULTS

A total of 144 patients were included in the study. The population presented at an age range from 30 to 85 years old, with average age at 51.9 years old (SD of 11.98).

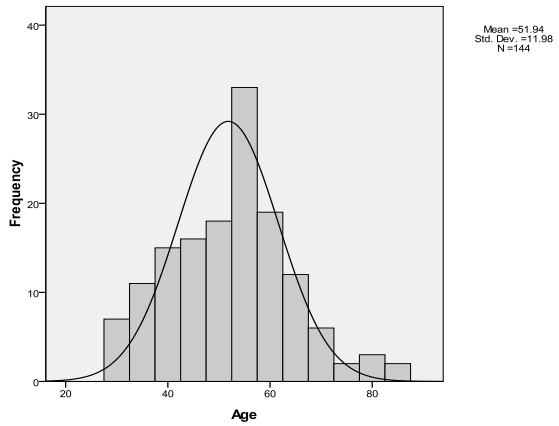


Figure 4. Bar Graph of Age Distribution of Patients

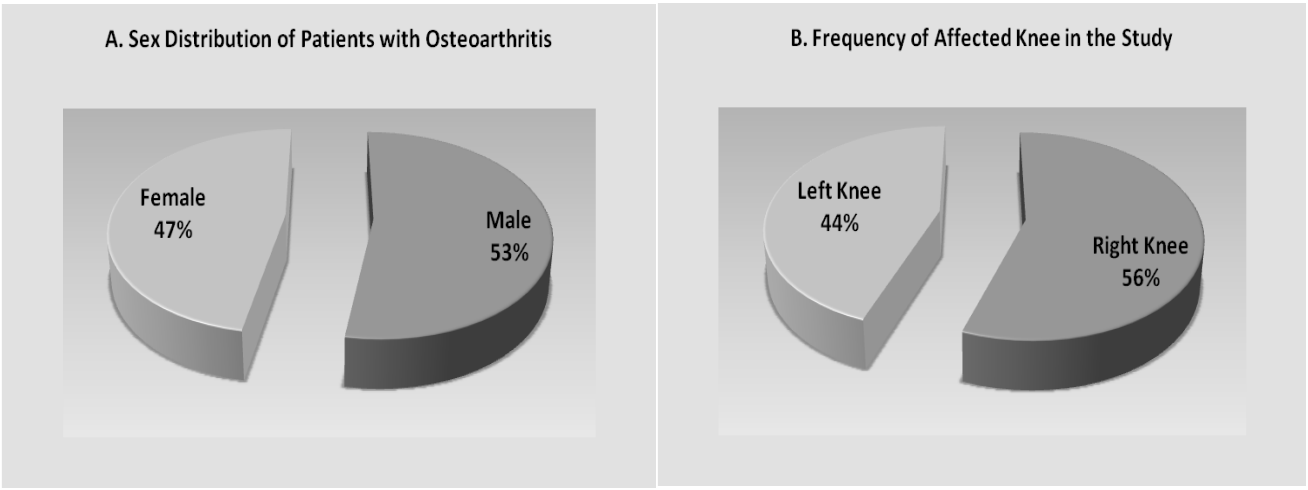


Figure 4. Pie graph representation of A. Sex distribution of patients with osteoarthritis, and B. Frequency of affected knee in the study

Figure 5 shows the study population included 68 females (47%) and 76 males (53%). The affected right knee was demonstrated to be imaged more often in the study.

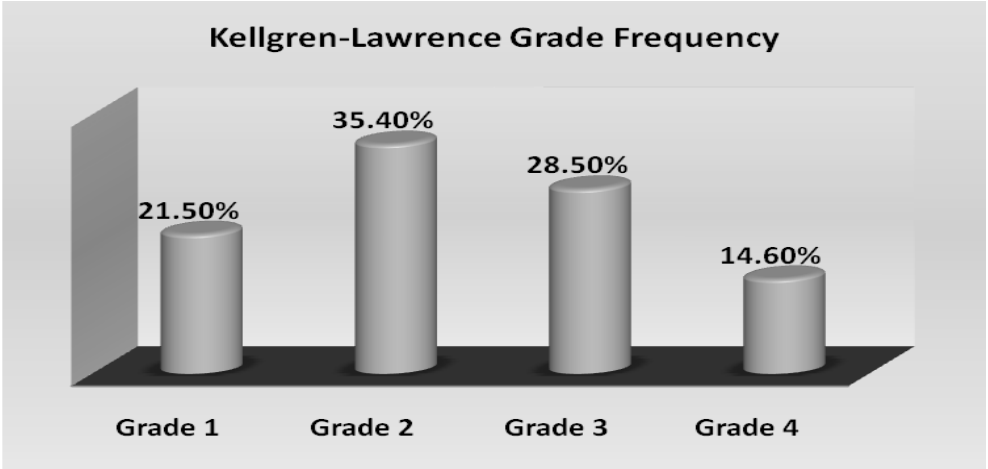


Figure 5. Column graph demonstration of the frequency of Kellgren-Lawrence Grading Scheme

The population was graded by Kellgren-Lawrence scores according to the severity of OA as diagnosed on radiograph features. ***Figure 6*** shows that more than one-third was given a Kellgren-Lawrence Grade of 2 comprising of 35.4%. Next to this value was Grade 3 at 28.5% subsequently followed by Grade 1 at 21.5%. Grade 4 had the fewest number of patients, hence, the lowest frequency value.

The association between various compartment specific MRI findings and KL score has been shown in ***table 4***.

Table 4. MRI findings and their overall prevalence per Kellgren-Lawrence Grade (KL)

MRI Lesions	KL – 1 (Subjects = 31)	KL – 2 (51)	KL – 3 (41)	KL – 4 (21)
Cartilage Damage	50%	62%	100%	100%
Meniscal Damage	56%	70%	85%	100%
Osteophytes	100%	100%	100%	100%
Ligamentous Abnormalities	47%	39%	46%	43%
Synovitis	53%	90%	100%	100%
Joint Space Narrowing	9%	37%	85%	100%

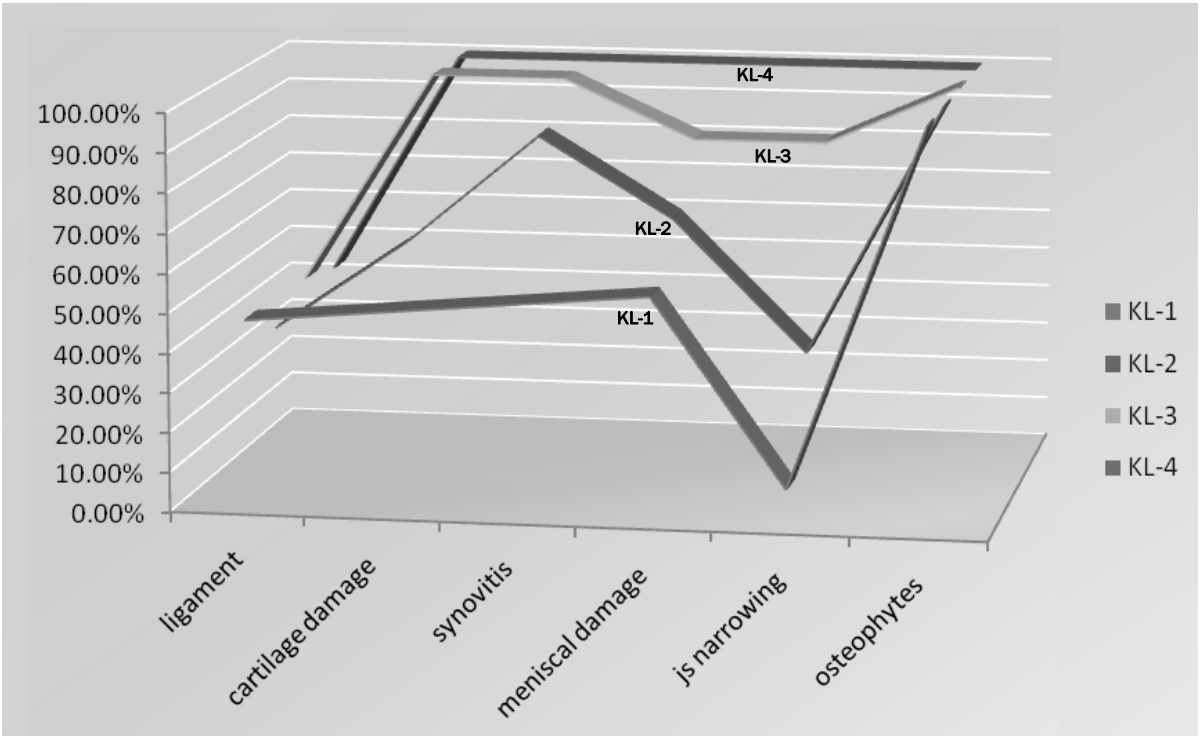


Figure 6. Stacked line graph depicting the frequency of MRI lesions in relation with Kellgren-Lawrence grade

In accordance with the numerous MRI findings, "Sharpening of intercondylar spines" was seen in ALL 144 patients. The next most common finding are "Spurs in patella" with 89.58% incidence, "minimal joint effusion" with 83.33%, "Spurs in femur" with 72.92%, "Spurs in tibia" with 70.83%, "Intrasubstance signal in patello-femoral cartilage" with 56.25%, and "myxoid degeneration, medial meniscus" with 50.69%. "lateral collateral ligament tear" was the least common MRI finding with only 4.17% incidence. Each of the specific frequencies for each of the MRI findings with their corresponding P-values and Chi-square computation are depicted and tabulated in the Appendix.

DISCUSSION

Osteoarthritis (OA) is a chronic and debilitating arthritic lesion that is diagnosed based on radiographic findings and clinical assessment. When radiograph is used, the sensitivity and specificity of diagnosis is at 91% and 85%, respectively [2, 10]. Rising utilization of MRI increases tremendously the effectiveness of early detection of OA lesions.

The noteworthy results of this study had acknowledged the rising fact that OA is a whole-organ disease process, as a brainchild of Dr. Peterfy in 2004 [15].

The male subjects slightly predominated over the female in this study with a 1.1:1 ratio and a mean age 51.9 years old. In a cohort study made by Racaza and colleagues in Philippine General Hospital in 2012, there is a female to male ratio of 3:1, with the female population being diagnosed with OA much more frequently than male. The mean age of OA peak recorded in that study was at 63 years old which is much later chronologically in comparison with the data at hand. According to a paper made by Eckstein et al, males were observed to progress in higher grade of OA over a period of two years than in females.

The data in this study showed there was a high correlation between severity of Kellgren-Lawrence Grade and MRI findings of osteophytes, cartilage, meniscal, and ligamentous damages, synovitis, and joint space narrowing with *P-values of <0.005* at 5% confidence interval. Table 4 and Figure 7 demonstrate the prevalence of MRI findings on each of the Kellgren-Lawrence scores.

Osteophytes. All of the subjects in the population showed osteophytes in the knee from the simple finding of intercondylar spine sharpe-ning prevalent in all the Kellgren-Lawrence grades to more complex osteophytes formations mostly affecting the patello-femoral compartment in grade 2 at 84.3%, grade 3 at 95%, and in grade 4 at 100%. According to Hayes et al in 2005 Radiology journal, there was increased likelihood of MRI detected osteophytes with increasing Kellgren-Lawrence grades.

Cartilage defects. Majority of the patients demonstrate cartilage damage described as focal intrasubstance signals in the femoro-tibial and patella-femoral cartilages

evident in all Kellgren-Lawrence grades with the increasing in area affected proportional to the grade severity. The patella-femoral cartilage was the more involved region at 64.7% in grade 2, 63.4% in grade 3, and 100% in grade 4. In the same study by Hayes et al in 2005, there was a strong association between the Kellgren-Lawrence score and the likelihood that defects of cartilage were present in the knee. 54% of their study population under grade 1 showed cartilage defects, 83% under grade 2, and 88% under grade 3.

Joint narrowing and attrition. The joint space narrowing or attrition changes in this study more severely involved the medial femoro-tibial and patella-femoral compartments, both at 37.5%, in relation with the lateral femoro-tibial region. The greatest prevalence of medial femoro-tibial attrition was detected in Kellgren-Lawrence grade 3 at 56.1% and grade 4 at 100%. Majority of attrition changes and radiographic sclerotic changes were reported by Joshi and colleagues to occur in the femoro-tibial and patella-femoral joints.

Meniscal Damage. Meniscal lesions, comprised of spectrum of changes from simple myxoid degeneration to grank tears of the different parts of the menisci, were shown in all Kellgren-Lawrence grades. The degenerative myxoid changes without frank tears dominated the data affecting mostly the medial meniscus under Kellgren-Lawrence grade 3 and 4 at 58.5% and 100%, respectively. However, the number of meniscal tears was mostly prevalent in grade 3 at 32% affecting the medial meniscus. As stated in the study of Joshi, incidence of medial and lateral meniscal injuries are almost equal at 90.6% and 96.8%, respectively, of which tears were present in 46.9% of medial meniscus and 53.1% of lateral meniscus.

Ligamentous Damage. It is noticeable that anterior cruciate ligament tear was the only ligamentous abnormality that was noted to be statistically significant with the greatest prevalence found at grade 4 at 43%. In the two separate studies by Hayes and Joshi, the ligamentous injuries were uncommon. in the latter research the author stated that 25% of the population under investigation showed ligament injury affecting the anterior cruciate ligament.

Joint effusion or Synovitis. The presence of synovitis or effusion was shown to be apparent in all grades, with grade 3 and 4 demonstrating 100% prevalence. Hayes et al also reported strong correlation of joint effusion and Kellgren-Lawrence score. Joint effusion of varying gradfes was reported in a study by Joshi stating that it was found in 78.1% of the study population.

Other MRI findings. In terms of other MRI findings, Baker's cyst was found in all Kellgren-Lawrence grades most notably in grade 2 and 4 at 24% and 38%, respectively. This was followed by suprapatellar bursitis which was also evident in all Kellgren-Lawrence grades but the most prevalence was seen in grades 2 and 4 at 24% and 29%, respectively.

The contingent data of the study found a statistically significant correlation between majority of MRI changes of OA in patella-femoral and medial femoro-tibial compartments of the knee. These changes include osteophytes, cartilage damage, attrition or joint space narrowing, meniscal damage, and joint effusion. However, there was weak correlation between MRI finding of ligamentous injury and severity of Kellgren-Lawrence grades.

CONCLUSION

In conclusion, MRI has strengthened its indispensable role in diagnosing and defining abnormalities of osteoarthritis of the knee evident in significant correlation between majority of MRI changes of the knee and Kellgren-Lawrence grade.

There was a general pattern that the older age group, the higher the prevalence of the features of OA. All of the participants had at least more than one (1) feature of OA on MRI. There were more frequent and more severe abnormalities detected at MRI as the radiographically determined Kellgren-Lawrence scores increased.

MRI features of OA were highly prevalent in the patella-femoral and medial femorotibial compartments. Osteophytes were the most common finding detected in all of the Kellgren-Lawrence grades. Next was the cartilage defect most prevalent in grades 3 and 4. These were then followed by effusion, attrition, and meniscal damage which were prevalent in grades 3 and 4 as well. Only ligamentous lesions showed no significant MRI and Kellgren -Lawrence grade correlation.

Reinforcement of the concept of assessing OA as a whole-organ disease through significant correlation of MRI and radiographic Kellgren-Lawrence grades were satisfied in this study. Clinicians would have in their references the findings in this study that each of the Kellgren-Lawrence grades could predict the most prevalent soft tissue expected findings that could be encountered in MRI.

LIMITATION

a. Disparity in the number of males and females in the population as well as in the division of the number of subjects per Kellgren-Lawrence grades.

b. Single center data review

RECOMMENDATION

a. Larger and equal distribution of subjects per gender and per Kellgren-Lawrence grade may prove prudent in decision making for better outcome and stronger statistical correlation.

b. Multi-center approach may improve immensely the subject number outcome. in addition, Multicenter research initiative could provide better results that could formulate a uniform diagnostic application of MRI in assessment and definition of OA.

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APPENDIX

More males were included in the study

Table 5. Gender

	Frequency	Percent
Female	68	47.2
Male	76	52.8
Total	**144**	**100.0**

Right knee is more prone to being diagnosed for osteoarthritis

Table 6. Affected Knee

	Frequency	Percent
Left Knee	64	44.4
Right Knee	80	55.6
Total	**144**	**100.0**

Table 7. MRI findings vs. Kellgren-Lawrence Grade

MRI Findings		Kellgren-Lawrence Grade				Total	P-Value
		1	2	3	4		
Affected Knee	Left	16	23	18	7	64	1.709; 0.635ns
	Right	15	28	23	14	80	
Age	Mean (SD)	42.23 (9.49)	49.71 (9.09)	56.37 (9.54)	63.05 (13.18)	51.94 (11.98)	21.991; 0.000**
Gender	Female	10	18	27	13	68	13.224; 0.004**
	Male	21	33	14	8	76	
Thinning of Medial Femoro-Tibial Cartilage	No	29	41	17	3	90	48.287; 0.000**
	Yes	2	10	24	18	54	
Thinning of Lateral Femoro-Tibial Cartilage	No	31	47	33	10	121	29.528; 0.000**
	Yes	0	4	8	11	23	
Thinning of Patello-Femoral Cartilage	No	30	41	17	2	90	55.391; 0.000**
	Yes	1	10	24	19	54	
Intrasubstance Signal in Patello-Femoral Cartilage	No	14	18	25	6	63	8.416; 0.038*
	Yes	17	33	26	15	81	
Intrasubstance signal in Femoro-Tibial Cartilage	No	19	20	28	7	74	11.672; 0.009**
	Yes	12	31	13	14	70	
Spurs in Patella	No	5	8	2	0	15	6.391; 0.094ns
	Yes	26	43	39	21	129	
Spurs in Femur	No	19	19	1	0	39	41.449; 0.000**
	Yes	12	32	40	21	105	

MRI Findings		Kellgren-Lawrence Grade				Total	P-Value
		1	2	3	4		
Spurs in Tibia	No	22	19	1	0	42	50.658; 0.000**
	Yes	9	32	40	21	102	
Sharpening of intercondylar spines	No	0	0	0	0	0	-
	Yes	31	51	41	21	144	
Joint narrowing in Patello-femoral space	No	30	41	17	2	90	55.391; 0.000**
	Yes	1	10	24	19	54	
Joint Narrowing in Medial femoro-tibial space	No	29	40	18	3	90	45.152; 0.000**
	Yes	2	11	23	18	54	
Joint narrowing in Lateral femoro-tibial space	No	31	46	31	9	117	31.008; 0.000**
	Yes	0	5	10	12	27	
Myxoid degeneration, medial meniscus	No	21	33	17	0	71	30.488; 0.000**
	Yes	10	18	24	21	73	
Myxoid degeneration, lateral meniscus	No	23	37	18	0	78	38.508; 0.000**
	Yes	8	14	23	21	66	
Tear, medial meniscus	No	19	40	28	12	99	4.349; 0.226ns
	Yes	12	11	13	9	45	
Tear, lateral meniscus	No	29	44	33	18	124	2.522; 0.471ns
	Yes	2	7	8	3	20	
Tear, MCL	No	23	37	27	9	96	6.954; 0.073ns
	Yes	8	14	14	12	48	
Tear, LCL	No	30	49	38	21	138	2.009; 0.571ns
	Yes	1	2	3	0	6	
Tear, ACL	No	21	44	37	12	114	13.242; 0.004**
	Yes	10	7	4	9	30	
Joint Effusion	(none)	5	5	0	1	11	22.520; 0.001**
	Minimal	26	40	40	14	120	
	Moderate	0	6	1	6	13	
TOTAL		**31**	**51**	**41**	**21**	**144**	

As shown in the ***table 7***, Kellgren-Lawrence Grade is statistically & significantly related at 5% level of significance to Age, Gender, Thinning of Medial Femoro-Tibial Cartilage, Thinning of Lateral Femoro-Tibial Cartilage, Thinning of Patello-Femoral Cartilage, Intrasubstance Signal in Patello-Femoral Cartilage, Intrasubstance signal in Femoro-Tibial Cartilage, Spurs in Femur, Spurs in Tibia, Joint narrowing in Patello-femoral space, Joint Narrowing in Medial femoro-tibial space, Joint narrowing in Lateral femoro-tibial space, Myxoid degeneration-medial meniscus, Myxoid degeneration-lateral meniscus, Tear-ACl, and Joint Effusion.

The table below shows that those graded 4 mostly have "Baker's Cyst", "Suprapatellar Bursitis", and "Synovial cyst, poplieus tendon sheath". On the other hand, those with grade 3 mostly have "Baker's Cyst", "Prepatellar edema", and "Suprapatellar Bursitis".

Table 8. Other MRI Findings vs. Kellgren-Lawrence Grade

OTHER MRI Findings	Kellgren-Lawrence Grade				Total
	1	2	3	4	
Baker's cyst	2	5	3	8	18
Infrapatellar bursitis	0	0	1	0	1
Infrapatellar edema	0	0	0	1	1
Infrapatellar synovitis	0	3	0	0	3
Parameniscal cyst	0	1	0	0	1
Popliteal cyst	1	0	0	0	1
Popliteus tendinitis & suprapatellar tendonitis	0	1	0	0	1
Prepatellar edema	0	3	7	1	11
Sprain, gastrocnemius muscle	2	0	1	0	3
Sprain, quadriceps muscle	1	0	0	0	1
Sprain, sartorius muscle	1	0	0	0	1
Superolateral patellar dislocation	0	0	1	0	1
Suprapatellar bursitis	1	5	4	6	16
Suprapatellar bursitis; hematoma gastrocnemius	0	0	0	1	1
Synovial cyst, popliteus tendon sheath	0	2	2	4	8
Synovial osteochondroma	1	0	0	0	1
Villonodular disease	1	1	0	0	2
Total	**10**	**21**	**19**	**21**	**71**