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MRI Evaluation of Painful Knee Joint.

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ABSTRACT

The painful knee joint is a common presenting complaint in the general population. Here we present a case study involving 65 patients, who complained of chronic knee pain, with no findings on x-ray. The most common MRI finding in patients with chronic knee pain is anterior cruciate ligament injury followed by medial meniscal injury. It was also found that chronic knee pain affected more males than females and was more common in the 20 to 40 year age group. The diagnostic accuracy of MRI varies for different structures in the knee which has been discussed. However it is considered the investigation of choice for knee injury.

Keywords: Knee joint, MRI, Meniscal injuries, Ligament injuries

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INTRODUCTION

Normal knee joint function is essential for day to day activities and in many popular sports. The number of patients with complaints of a painful knee joint is quite significant and therefore magnetic resonance imaging (MRI) of the knee is of great value to diagnose the varied pathologies causing a painful knee joint. The information obtained from conventional skiagrams of the knee is limited.

The developments and advancements in MRI and the introduction of high resolution coils have provided a non-invasive, non operator dependent, cost effective means to diagnose knee pathology. MRI is well tolerated by patients, widely accepted by evaluating physicians and assists in distinguishing pathologic knee conditions that may have similar clinical signs and symptoms.

In the past 15 years, MRI of the knee has become available as an alternative to diagnostic arthroscopy.MRI has proven to be accurate for the diagnosis of intra- and periarticular pathology, especially for meniscal pathology (accounting for 86% of the indications for arthroscopy) and ligamentous injuries. MRI when used in all patients with high clinical suspicion of intraarticularknee pathology, instead of direct arthroscopy can avoid 35% of arthroscopies. By influencing the therapy received by a patient, MRI also has the ability to influence patient outcome and societal costs.Arthroscopy of the knee is an invasive procedure with associated risks and leading to discomfort for the patient. Therefore it should primarily be used for treatment and the fraction of non therapeutic arthroscopies should be limited. Injuries to the intra-articular structures like menisci and cruciate ligaments are diagnosed with high sensitivity and specificity by MRI as compared with arthroscopy, In the evaluation of chronic knee pain, MRI can obviate the need for multiple imaging procedures simultaneously evaluating the structures of the knee, marrow space, synovium and periarticular soft tissues concerning the knee.

MATERIALS AND METHODS

Source of Data

The study population included 65 patients who underwent MR imaging of the knee when they presented with knee joint pain in SreeBalaji Medical College & Hospital. The MRI was done on the advice of the referring doctor and no patient was made to undergo MRI (knee) for the sole purpose of this study.This dissertation evaluates various causes of painful knee joint as diagnosed with the MRI scan of the knee done on these patients.

Study period: September 2012 to March 2013

Study design: Descriptive study

Inclusion and exclusion criteria: The inclusion and exclusion criteria for this study are as mentioned below:

Inclusion criteria: All cases of knee pain where MRI was used as a modality indiagnosing the cause**.**

Exclusion criteria:

- Patients referred from other hospitals for the sole purpose of getting an MRI scan done due to its non availability there.
- Patients who had no history of knee pain but underwent MRI of the knee
- Post operative cases

Data Acquisition

Once a patient satisfied the inclusion criteria for this study, he or she was administered the study proforma.The patients were briefed about the procedure. The noise due to gradient coils (heard once the patient was inside the bore of the magnet) and the need to restrict body movements during the scan time was explained to the patient.All the MRI scans of the knee in this study were performed using GE MR machine with a .5 tesla field strength magnet in a closely coupled extremity.

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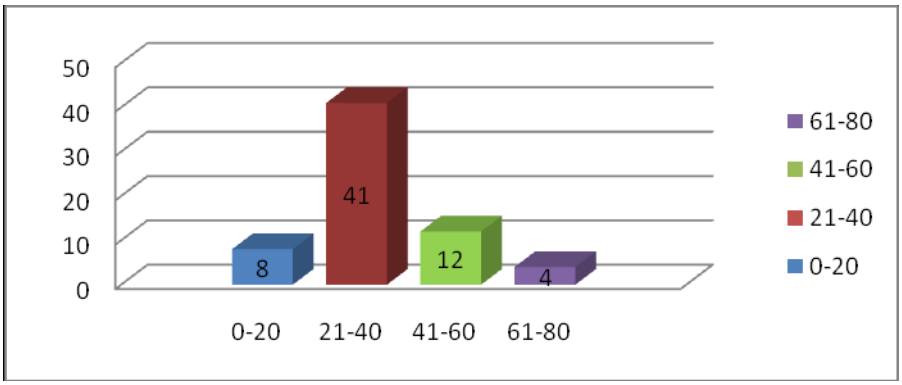
Data Analysis

Age distribution of the patients in the study:

In this study group which comprised of a total number of patients, the age at presentation with knee pain ranged from 16 to 76 years. The mean age was 34.95 years and the maximum number of patients affected belong to the age group of 21 to 40 year.

Chart 1: Age distribution of the patients presenting with painful knee



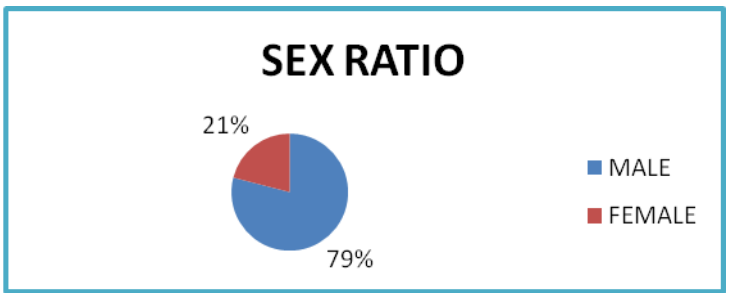
Sex distribution of the patients studied:

There were 51 males and 14 females in the patients included in the study. Males comprised 79% of the group while the females comprised 21%.

Table 1: Sex distribution

SEX	NUMBER OF PATIENTS
MALE	51
FEMALE	14
TOTAL	65

Chart 2: Pie chart depicting the relative percentages of male and female in the study group.



Meniscal Tears

Of the 65 patients evaluated with MRI of the knee for evaluating painful knee joint , 24 patients (36%) had 35 meniscal tears. Of the 35 meniscal tears , 15 (64 %) involved the medial meniscus alone, 3(13%) involved the lateral meniscus and 6 (25 %)involved the medial as well as lateral meniscus.

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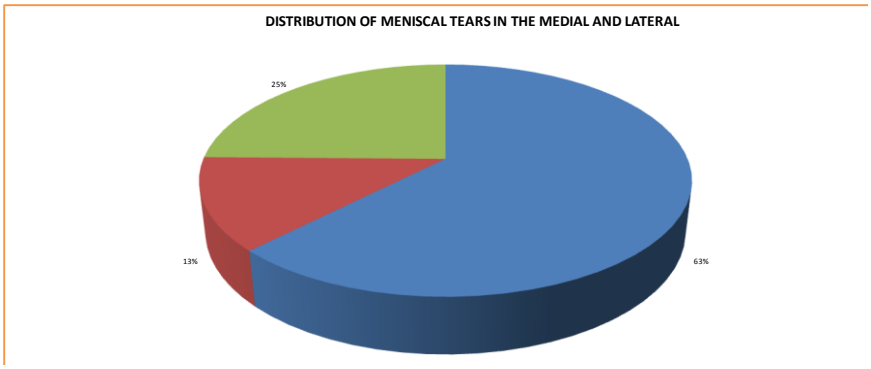
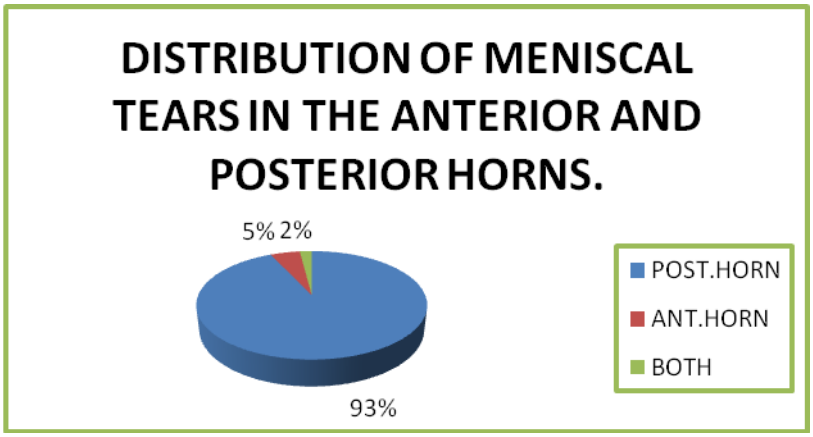
Chart 3: Distribution of meniscal tears in the medial meniscus and lateral meniscus in the patients studied.



Of the 35meniscal tears detected on evaluation with MRI of the knee, 32 tears (93%) of the involved the posterior horns, 2 tears (5%) involved the anterior horns while 1(2%) involved both the anterior and posterior horns

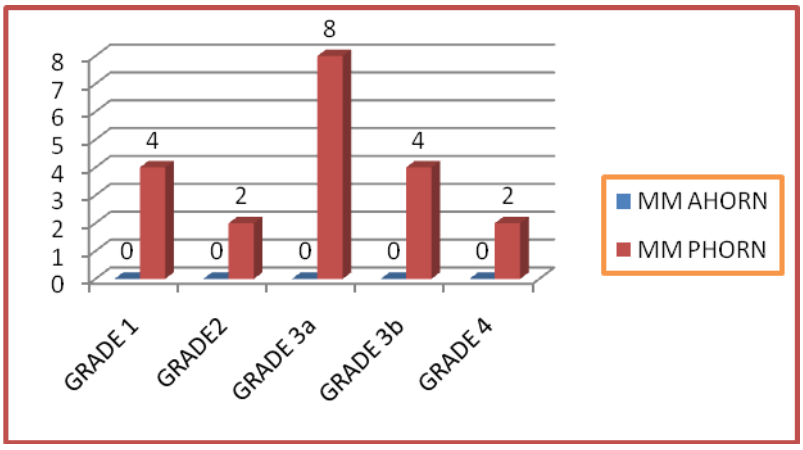
Chart 4: Distribution of meniscal tears in the anterior and posterior horns



Medial meniscal tears

Of the 15patients who had 24 medial meniscal tears in total , 20 tears could be graded. 4 were grade 1 tears , 2 were grade 2 tears, 8 were grade 3a tears , 4 was grade 3b tears and 2 were grade 4 tears. All of the tears in the medial meniscus involved the posterior horn.

Chart 5: Bar graph showing grades of meniscal tear in the anterior and posterior horn of medial meniscus



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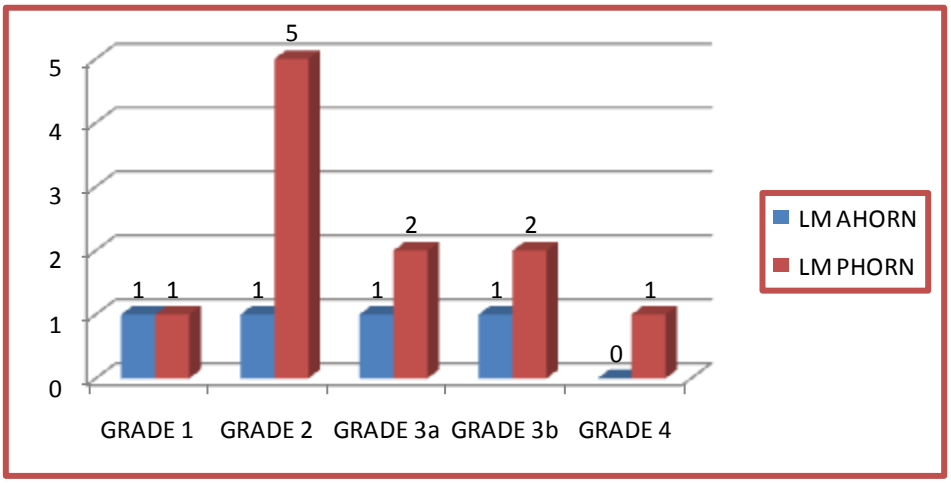
Lateral meniscal tears

Of the 9 patients with lateral meniscal tear, 15 tears could be graded as below:

Table 2: Grades of lateral meniscal tears

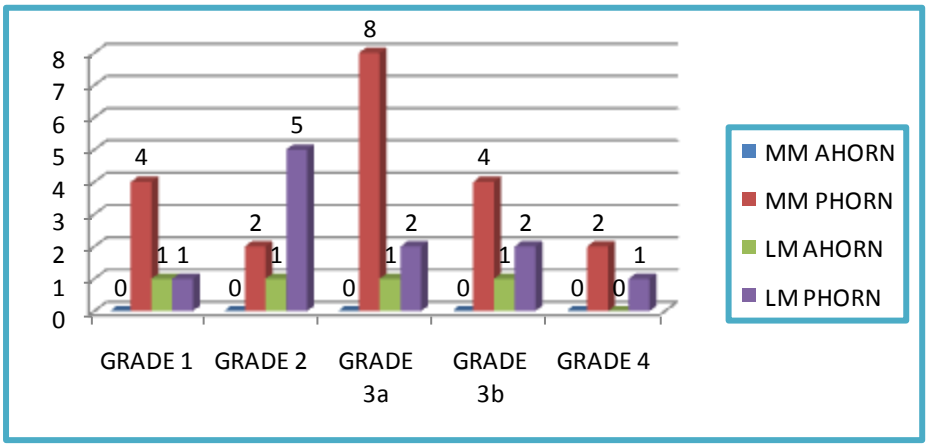
LATERAL MENISCUS	GRADE 1	GRADE 2	GRADE 3a	GRADE 3b	GRADE 4
ANTERIOR HORN	1	1	1	1	0
POSTERIOR HORN	1	5	2	2	1

Chart 6: Bar graph showing the different grades of lateral meniscal tear



The following bar diagram gives us a representative picture of the distribution of meniscal tears in the anterior and the posterior horns as well as the grades of the meniscal tears

Chart 7: Bar graph showing distribution of meniscal tears in the anterior and posterior horns and the grades of tears



MM A HORN – Anterior horn of medial meniscus
MM P HORN- Posterior horn of medial meniscus
LM A HORN- Anterior horn of lateral meniscus
LM P HORN – Posterior horn of medial meniscus

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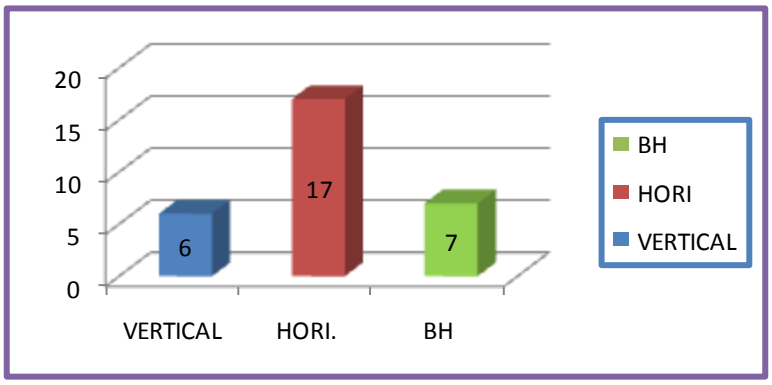
Types of meniscal tears

Of the 35 meniscal tears , 30 tears could be classified into types with 6 having vertical tears , 17 having horizontal tears and 7 having bucket - handle tears which has been represented in the bar graph below.

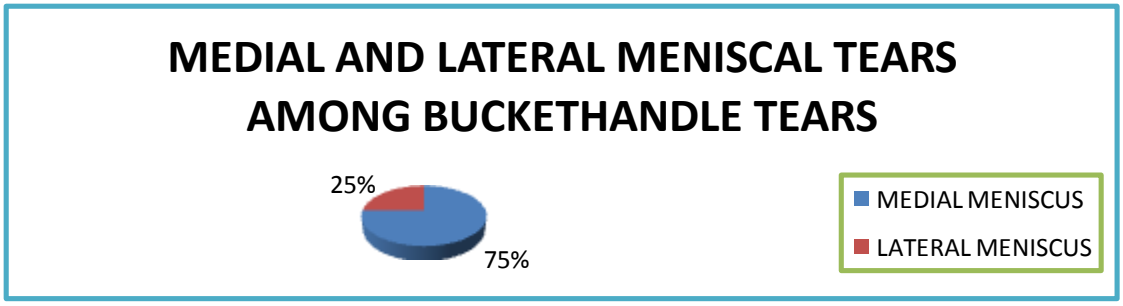
Chart 8: Bar graph showing the distribution of the meniscal tears into types



Bucket Handle tears:

Among the 8 patients with bucket handle tears, 6 (75%) had tears involving the medial meniscus and 2 (25%) had tears involving the lateral meniscus.

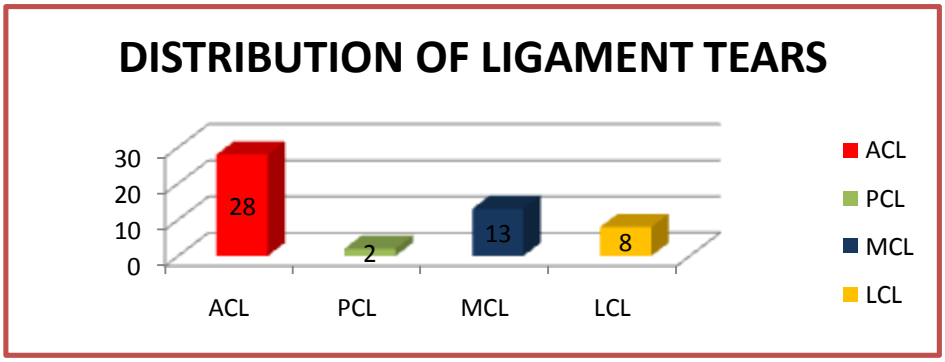
Chart 9: Pie chart showing distribution of bucket-handle tears in the medial and lateral meniscus



Ligament tears:

Ligament tears were seen in 35 patients on evaluation of MR images of knee out of 65 patients included in the study. Of the 35 patients with ligament tears, 28 patients (80.1 %) had ACL tears, 2 patients (5.7 %) had PCL tears, 13 patients (35.5 %) had medial collateral ligament tears and 8 patients (22.8 %) had lateral collateral ligament tears.

Chart 10: The bar graph showing distribution of ligament tears



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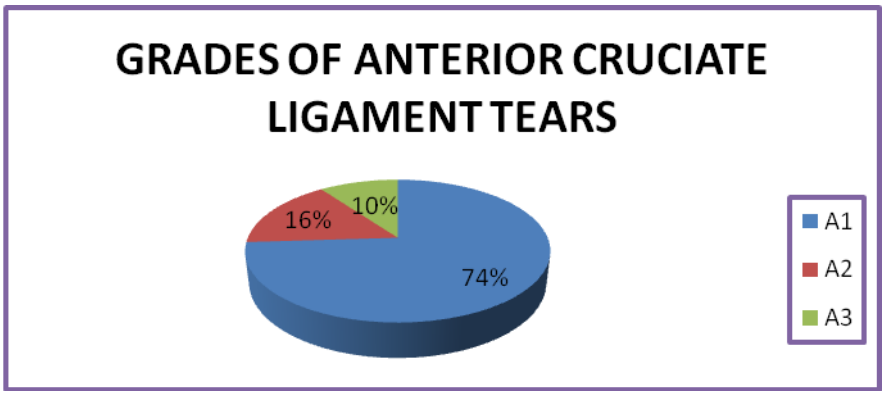
ACL tears

Of the 28 patients with ACL tear, 20 patients had acute complete tear, 5 patients had acute partial tear , 3 patients had chronic tears of ACL.

Chart 11: Pie chart showing types of ACL tear

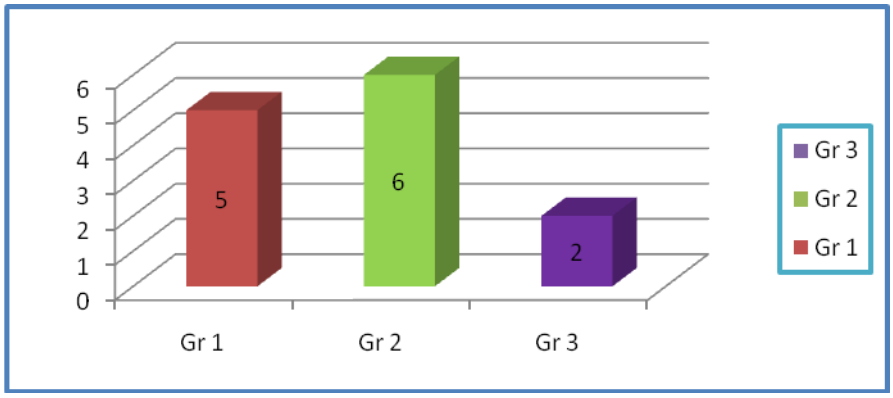


A1 -acute complete tear
A2- acute partial tear
A3- chronic tear

MCL tears

Of the 35 patients with ligament tears, 13 patients had medial collateral ligament (MCL) tears.Of these 13 patients, 5 patients (44%) had Grade 1 tear, 6 patients (48%) had grade 2 tears and 2 patients (8%) had grade 3 tears.

Chart 12 : Bar diagram showing the different grades of medial collateral ligament tears



DISCUSSION

Disease processes and injuries that disrupt ligaments, menisci, articular cartilage and other structures of the knee cause painful knee that cause significant morbidity and disability.

Imaging of knee therefore present a special challenge because of its complex structure. A variety of imaging modalities are currently used to evaluate knee abnormalities. These modalities include standard radiography, scintigraphy, computed tomography (CT), planar tomography and arthrography.

MR imaging has revolutionized knee imaging. There are many reports in literature comparing magnetic resonance imaging with arthroscopic findings. These studies have helped validate the role of MR imaging in the clinical arena; especially for the evaluation of meniscal and ligamentous injuries. Also MR

imaging plays a valuable role in the evaluation of a variety of acute and chronic knee disorders causing painful knee joint. Moreover, MR imaging does not require intraarticular or intravenous injection of contrast material, does not require manipulation of the knee joint, and is painless.

The wide spectrum of indications for MR imaging of the knee include: traumatic causes of knee pain (meniscal tears , ligament tears, overuse injuries); chronic causes of knee pain (osteochondritisdissecans, osteonecrosis, chondromalacia patellae, synovial/meniscal/popliteal cysts, intraarticular soft tissue tumours); degenerative changes(arthritis, synovial hypertrophy) and others(infections, synovial chondromatosis, pigmented vilonoduarsynovitis, loose bodies.

This study included 65 patients who had history of knee pain and underwent MRI of the knee joint. All the scans were done using a 0.5 tesla GE scanner and using a scan protocol which included T1 and T2 coronal and sagittal FSE images, axial ,coronal and sagittal proton density images, and STIR images in coronal and axial planes.

The study population consisted patients in the age group of 16 - 76 years with a mean of 34.95 years. Maximum number of patients who underwent MRI of the knee for painful knee belonged to the age group of 21-40 years. This study also showed a male preponderance for knee pain , accounting for 78% of the case load.Of 65 patients MRI of the knee was normal in 2 patients.

In this study 36% patients evaluated with MRI of the knee for evaluating painful knee joint had meniscal tears. Of these, 63% had medial meniscal tears only,13% had lateral meniscal tears only and 25 % had medial as well as lateral meniscal tears.Crues et al[1] in their study of meniscal tears and correlation with arthroscopy in 142 patients found meniscal tears in 66% involving the medial meniscus and 33% involving the lateral meniscus.

Of the 35 meniscal tears noted in 65 patients, 32 tears involved (93%) the posterior horn and 2 involved (5%) the anterior horn and 1 tear(2%) involved both the anterior and posterior horns. Crues et al [26] in their study also found meniscal tears involving the posterior horns which accounts for 57% compared to the 16% involving the anterior horn. Weiss et al [2]. Also reported meniscal tears involving the posterior horn accounting for 50%-60% and tears involving the anterior horn accounting for 5%- 20%.

Of the 9 pts meniscal tears involving the lateral meniscus, 15tears could be graded with 2 tears classified as grade 1 tear, 6 tears as grade 2, 3 tears as grade 3a , 3 tears as grade 3b and 1 tear as grade 4 with maximum number of tears belonging to grade 2 and 3.This is in similar to the study done by Ismael Silva et al [3].who in their study of 44 patients with meniscal tears graded them, with the maximum number of tears belonging to grade 3 and minimum number of tears belonging to grade 1.

Of the meniscal tears involving the medial meniscus, 4 tears were classified as grade 1, 2 tears as grade 2, 8 tears as grade 3a , 4 tear as grade 3b and 2 tears as grade 4.A study done by Ismael Silva et al [3], also showed that maximum number of tears involving the medial meniscus were of grade 3.

Of the 35 meniscal tears , 30 tears could be classified into types with 6 vertical tears, 17 were horizontal tears and 7 were of the bucket handle type of tear. All the 6 vertical tearshad history of associated trauma .Berquist[4] states that most of the vertical tears have a traumatic cause.

The number of patients with bucket handle tears were 8 of which 6 (75%) involved the medial meniscus and 2(25%) involved the lateral meniscus. Wright et al [5]. in their study of 46 patients with bucket handle tear found that the medial meniscus(72%) is involved more than the lateral meniscus(15%).

The MRI features of bucket handle tears – The displaced fragment was seen in 5(83%) of the 8 bucket handle tears.The incidence of “double posterior cruciate ligament sign” involving the medial meniscus was 3(50%) and none of the 2 bucket handle tears involving the lateral meniscus showed this. The “flipped fragment sign” was found in 2(33%) of tears involving the medial meniscus whereas it was seen in 1 (50%) tear involving the lateral meniscus. The “fragment in notch” sign was seen in 4 tears involving the medial meniscus and 1 involving the lateral meniscus. Wright et al [5]. In their study found that the “displaced fragment sign”was seen in 84% of the menisci, the double posterior cruciate ligament sign was seen in 53% of the

medial and none of the lateral bucket-handle tears; the flipped fragment sign was noted in 44% of medial and 29% of lateral menisci and a fragment was noted in the intercondylar notch in 66% of medial and 43% of lateral menisci.

Of the 28 patients of 65 who had anterior cruciate ligament tears, 20 patients (74%) had acute tear(complete), 5 (16%)had acute tear(partial) and 3 (10%)had chronic tears. An ACL tear was considered acute if the MR examination was performed within 6 weeks of injury and chronic if MR examination was performed more than 6 weeks after injury as by Vaheyet al [6]. Vahey et al [6] in his study of 81 patients with ACL tear correlated with arthroscopy findings had a sensitivity of 100 % specificity of 93% and an accuracyof 96% for the diagnosis of acute complete tear and a sensitivity of 87%, specificity of 93% and an accuracy of 90% with a diagnosis of chronic ACL tear .

Acute ACL tears were usually associated with bone bruise with 16 having associated posteroateraltibial bruise and 11 having associated lateral femoral bruise. All the acute tears were usually associated with moderate to significant joint effusion. 2patients with ACL tears did not have associated bone bruise. Buckling of PCL was seen in 1 patient with no bruise which is suggestive of instability.

The bone fractures associated with ACL tear were lateral femoral condyle in 2 patients, tibial condyles in 1 patient and 1 associated with fracture at the fibular head. Only 1 patient had associated Segond fracture (avulsion fracture involving the proximal lateral tibia, immediately distal to the lateral plateau). Robertson et al. [7] in their study of multiple signs of anterior cruciate ligament on MR imaging in 103 patients found that the most accurate and reliable sin of an ACL tear was discontinuity of the ACL in the sagittal and axial planes. Posterolateral tibia bruise associated with ACL tear had 53% sensitivity, 97% specificity and 79% accuracy. The presence of lateral femoral bruise with ACL tear had a sensitivity of 47%, specificity of 97% and an accuracyof 76%. The presence of joint effusion had a sensitivity of 9%, specificity of 73% and an accuracy of 47%. Buckling of PCL had a sensitivity of 49%, specificity of 95% and an accuracy of 76%.

Medial collateral ligament tear was seen in 13 of 65 pateints .Of the 13 patients, 5 (44%) had grade 1 tear, 6 (48%) had grade 2 tear and 2 (8%) had grade 3 tears. The association of bone bruise with medial collateral ligament tears were assessed to identify those bruises that were possibly unique to MCL injury. Bone bruises were quite common (64%) and, were usually seen in the tibia (15 of 16 patients with bone bruises). Typically these bruises were located laterally (12 of 16 patients with bone bruises) and 7 of 16 patients involved the medial tibial condyle. Femoral bruises were less common (7to 10 patients). The femoral bruises in these 10 patients included involvement of the lateral condyle more than the medial condyle. Mark E. Schweitzer et al. evaluated multiple signs, prevelance and location of associated bone bruises associated with MCL tears on MR imaging. A study was conducted on 76 patients found that maximum number of patients with knee pain who had MCL tears belonged to grade 2. Bone bruises was seen in 24% with more located medially in the femur rather than laterally which was in contradistinction to this study.

Posterior cruciate ligament tear was seen in 2 patients with 1 patient having complete tear and 1 patient having partial tear. The incidence of PCL tear in the study group of 65patients was 5%. The PCL being a stronger ligament therefore has low incidence of tears [17] Lateral collateral ligament tears were seen in 8 patients with 4 tears belonging to grade 1, 3 tears belonging to grade 2 and 1 tears belonging to grade 3.

O'Donoghue's triad (anterior cruciate ligament with medial meniscal and medial collateral ligament tear) was seen in 2 patients.Of 65 patients included in this study , chondromalacia patellae was found to be the cause of knee pain in 10 patients which included 6 females and 4 males .Of these 10 patients with chondromalacia patellae, grade 1 was seen in 4 patients, grade 2 in 2 patients , grade 3 in 3 patients and grade 4 in 2 patients. Berquist [4] states that chondromalacia affects men more than females which is in contradistinction to this study. Study by Rose et al. [9] showed that maximum patients with chondromalacia patellae had early disease(stage 1 and stage2). And even in this study the maximum number of patients had early MR features of chondromalacia patellae. Chondromalacia patellae was diagnosed based on the criteria of focal signal or focal contour abnormality on either T2- weighted or proton density- weighted images as per McCauley et al [11].

Cysts of the knee – Of 65 patients , 6 patients had cystic lesions of the knee on evaluation of their knee MR images which was causing them knee pain. Of these 6 patients, 4 patients had popliteal cyst of which

1 was a ruptured popiteal cyst. The prevelance of popliteal cyst in this study is 5% . Fielding et al [10] in his study of Baker's cyst on MR imaging of knee and its prevelance found it to be 5%.

Meniscal cyst was seen in 3 patients and all them involved the lateral meniscus. Of these 2 was associated with horizontal tears of the meniscus and 1 had no associated meniscal tears. Neoplastic lesion – On evaluation of 65 knee MR images features of neoplastic lesion was found in 1 patients. Sessile osteochondroma was seen in 1 patient.

Features of osteomyelitis was seen in 2 patients with evidence of synovial thickening , articular destruction with a possibility of Koch's.Arthritis – Features of arthritis was seen in 6 patients of the total 65 patients included in the study. Osteoarthritis was seen in 5 patients and degenerative arthritis was seen in 1 patients. Most common cause of hyaline cartilage damage is oateoarthritis either primary or secondary. It occurs mostly in patients over 35 years (91) .In this study, all patients with osteoarthritis were over 35 years.

CONCLUSION

Magnetic resonance imaging is an accurate, non invasive technique for examination of the soft tissue and osseous structures of the knee. Studies have shown that it is cost effective when used to evaluate patients with knee pain. In the setting of traumatic knee injuries, MR imaging is the best non invasive modality for the diagnosis of meniscal and ligament tears. Familiarity with the normal anatomy and common pitfalls reduces errant interpretations but does not eliminate them entirely. To help guide the treatment of meniscal and ligament injuries, the MR report should thoroughly describe tears and not simply indicate whether a meniscal tear is present. In patients with ACL tear, the accuracy of MR imaging for meniscal tears, especially lateral tears, diminishes, but still surpasses that of physical examination .

MR imaging of the knee is considered efficacious especially in the setting of indeterminate clinical findings and can stratify patients, guiding further surgical management. This study also demonstrates a valuable role of MR imaging in the examination of a wide spectrum of chronic knee abnormalities unassociated with acute trauma. MR imaging depicts the anatomy of the knee joint without need for intravenous contrast agents or joint manipulation

Its accuracy in the diagnosis of meniscal tears is high as well as in the evaluation of ACL. Disadvantages are the limited accuracy in evaluation of hyaline articular cartilage and in differentiation of complete and partial anterior cruciate ligament tear.

DECLARATION

I, Dr.GirinathVenkat declare that the article is genuine and has not been published in any other journal.

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