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A Spectrum of MRI Findings in the Knee Joint: A Retrospective Study of Selected Population in South-South Nigeria

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ABSTRACT

The knee is a very important joint and injuries affecting it may cause significant disability and discomfort to the patient. Despite a variety of methods available to assess injuries of the knee joint, Magnetic Resonance Imaging (MRI) continues to play a major role. This study evaluated the spectrum of MRI findings in a relatively low resource environment, with limited access to MRI modality. The outcome should justify further investment in MRI services in this locality. The study involves retrospective analysis of MRI reports of 198 clinically symptomatic patients referred for imaging in a Port-Harcourt. All examinations were performed using GE BRIVO MR 235 machine with 0.35 Tesla field strength in a well-coupled standard knee coil. All images were analyzed for normality or otherwise and radiological reports generated by competent radiologists. The most common findings are traumatic in origin, notably cruciate ligament tears (37.37%) and meniscal tears (33.3%) as well as quadriceps tendon tears (3.03%). The medial meniscus and anterior cruciate ligaments were more frequently involved. Furthermore, patients in the 3rd and 4th decade of life were more commonly involved, with a male preponderance. The less common findings of Synovial chondromatosis, cyst-like lesions, tumors and loose bodies, all buttress the importance of routine MRI in atraumatic cases. The spectrum of MRI findings in this study is a reflection of growing interest and confidence in MRI of the diseased knee joint in our environment. The outcome would be a justification for future investments in MRI.

Keywords: Magnetic Resonance Imaging, knee injuries, tibial meniscal tears, incidental findings
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INTRODUCTION

The knee joint is pivotal in the activities of daily living, work-life as well as recreational and professional sport (Krakowsky et al., 2019). It is therefore susceptible to common injuries especially to tissues such as menisci, ligaments or hyaline cartilage as well as degenerative changes of osteoarthritis (Krakowsky et al., 2019 and Cibere et al., 2011).

The accuracy and timing of diagnosis of intra-articular lesions is an important consideration in the treatment and consequent outcome (Krakowsky et al., 2019).

A variety of methods are available to diagnose knee pathologies which includes physical examination (Krakowsky et al., 2019), Conventional x-rays and CT scan (Wick et al., 2014), arthroscopy (Krakowsky et al., 2019 and Lifevre et al., 2016), ultrasound and magnetic resonance imaging (Alves et al., 2016).

A well-detailed physical examination using defined protocols has been found to be effective with significant sensitivity and specificity in the diagnosis of medial and lateral meniscal lesions (Krakowsky et al., 2019). Plain x-ray of the knee is usually the first-line imaging technique and widely considered a gold standard in the assessment of osteoarthritis. It is however limited when high resolution such as a detailed view of the cartilage is a requirement (Turner et al., 1985).

Arthroscopy is considered the gold standard for the diagnosis of traumatic intra-articular knee injuries but may require hospitalization, use of anesthesia and potential for iatrogenic complications (Waleed and Niazi, 2014).

In recent times, ultrasound has become an invaluable tool to assess patients with complaints in an ambulatory

setting. The popularity of ultrasound hinges on its low cost, comparative accuracy, portability, high spatial resolution, dynamic imaging as well the ability to support "on the spot" interventions (Alves et al., 2016). Specifically, structures of the anterior knee such as quadriceps and patella tendon, retinaculum, supra-patellar joint recess, bursa and femoral cartilage are easy to evaluate with ultrasound (Alves et al., 2016).

Magnetic Resonance Imaging is a valuable tool in the evaluation of patient with acute knee injuries or chronic knee pain (Turner et al., 1985). It is considered a gold standard for non-invasive study of anatomy and pathologies' of intra and extra-articular structures (Waleed and Niazi, 2014). Magnetic Resonance Imaging has suspensor soft tissue contrast, high spatial resolution and the ability to display images in orthogonal planes (Wick et al., 2014; Waleed and Niazi, 2014 and Khanna et al., 2001). Magnetic Resonance Imaging of the knee joint employs a range of techniques and pulse sequences which are part of the imaging protocols (Khanna et al., 2001).

From anecdotal evidence, the availability of MRI machines within the south-south region of Nigeria has a recent history with the first installed MRI scanner in 2014. It could be inferred that experience and popularity of MRI as an imaging tool for knee pathologies is somewhat limited.

MATERIALS and METHOD

This study is meant to evaluate the spectrum of MRI findings in the knee joint of patients referred for symptomatic evaluation in an imaging center in Port Harcourt, Nigeria. It involves retrospective analysis of MRI reports of 198 clinically symptomatic patients referred for imaging. All examinations were performed using GE BRIVO MR 235 machine with 0.35 Tesla field strength in a well-coupled standard knee coil.

Images were obtained using standard protocols in Axial, Coronal and Sagittal planes. T1, T2, STIR, FSE and FLAIR sequences were applied as customary. All patients had been examined in a supine position. Axial projections were obtained with lines parallel to the knee joint line to include the patella and fibular head. Coronals views are parallel to the posterior aspect of femoral condyles to include the entire patella to 2cm posterior aspect of femoral condyles. Sagittal views are obtained parallel to the medial aspect of lateral condyles and include both collateral ligaments (Guideline for MR imaging of sports injuries, 2016). Where applicable, MR contrast media such as Gadovist, manufactured by Bayer healthcare) were used for the enhancement of suspected lesions.

RESULTS

The most common findings in this study are cruciate ligament tears (37.4%), meniscal tears (33.3%) and synovial chondromatosis (12.1%) (Table 1). The medial meniscal compartment is most frequently affected with a frequency of 52.17%, followed by the lateral compartment (26.09%). Both compartments were involved in 21.7% of cases (Table 2). Table 3 describes the various types of cruciate ligament involvement. The anterior cruciate ligament was mostly involved, followed by the medial collateral and posterior cruciate ligaments with a frequency of 27.9% and 26.1% respectively. Horizontal and vertical tears were more frequent, followed by Bucket Handle tears with 15.15% frequency. Table 4 describes the age distribution of pathologies. The highest frequency is within 32-42 years and 43 - 53%, representing the active age groups.

DISCUSSIONS

Several studies have evaluated the spectrum of MRI findings with variable results. Injuries to the cruciate ligaments and associated meniscal tears account for about 71% of all pathologies in our study. Cruciate ligament tears were identified in 37% of all patients, while ganglionic cysts were the least pathology (1.01%)(Table 1).

This finding is in agreement with those of Naraghi and White (2016). Typically, machines with low to high field strengths can provide diagnostically clear images of meniscal lesions. A sensitivity of 86 – 94% and specificity of 84 – 94% have been reported for medial meniscal tears. Lateral meniscal tears have lower sensitivity (68 – 80%), however with a comparable specificity (92 – 98%) (Lifevre et al., 2016). The MRI findings in our study appear to agree with arthroscopic findings in a study conducted by Cibere et al (2019).

Our study showed that medial meniscal tears are more common (52.17%) compared to lateral meniscal tears (26.09%) and bilateral tears (21. 74%) (Table 2). This agrees with arthroscopic findings (Editorial Review, 2016). The anterior and posterior cruciate ligaments are important stabilizers of the knee joint. Injuries of the cruciate ligaments are common in sports and motor vehicle accidents. From literature, the anterior cruciate ligament is more commonly affected in injuries compared to the PCL (Kam et al., 2010). This agrees with our findings of (Anterior cruciate ligament (ACL) (37.1%) compared to posterior cruciate ligament (PCL) (26.09%). Further analysis of types of tears, shows that horizontal tears are more common, accounting for 57.58%. 18 patients had vertical tears (27.27%) while 10 patients had "bucket handle tears (15.15%) (Figure 1).

Table 4 shows there is a significant relationship between age and incidence of knee injuries. Table 4 shows a higher incidence among patients in the 3rd and 4th decade which combined represents 51.5% of all cases. This perhaps is because these age groups are very active and likely to be involved in accidents resulting in traumatic knee injuries. In a study by Gimhavanekar et

Table 1. Spectrum of MRI findings and frequency distribution.

MRI Findings	Frequency (n)	Percentage (%)
Menisci tear	66	33.3
Cruciate ligament tears	74	37.37
Synovial chondromatosis	24	12.12
Bakers cyst	8	4.04
Ganglion cyst	2	1.01
Tumors	4	2.02
Discoid Menisci	4	2.02
Quadriceps Tear	6	3.03
Loose bodies	10	5.06
Total	**198**	**100%**

Table 2: Pattern of Meniscal involvement.

Compartment	Frequency	Percentage
Medial	48	52.17%
Lateral	24	26.09%
Bilateral Menisci	20	21.74%
Total	**92**	**100%**

Table 3: Cruciate Ligament Involvement.

Pattern of Tear	Frequency	Percentage
Anterior	64	37.01
Posterior	39	26.09
Lateral Collateral	24	13.95
Medical Collateral	48	27.91
Total	**198**	**100**

Table 4: Age Distribution of the patients.

Age group	Frequency	Percentage
10 – 20	14	7.07
21 – 31	30	15.15
32 – 42	60	30.30
43 – 53	42	21.21
54 – 64	28	14.14
65 – 75	16	8.08
76 - 86	8	4.05
Total	**198**	**100**

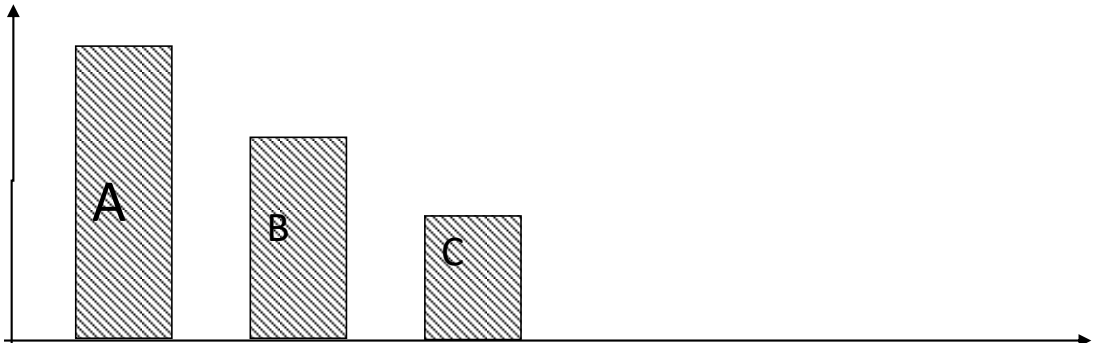

Figure 1. The various types of tears possible with ligaments. A = Horizontal tears (n-38, 57.58%) B = Vertical tears (n-18, 27.27% C = Bucket Handle (n-10, 15.15%).

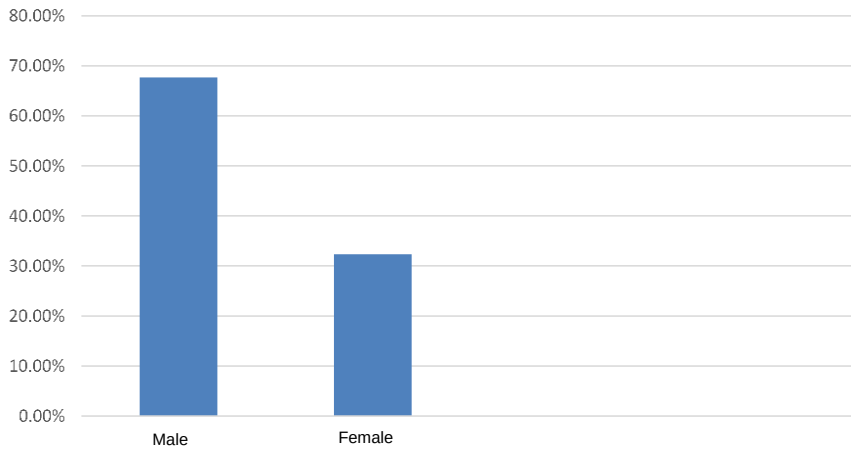

Figure 2: Sex Distribution of Patients (Male n=134 (67.68%) and Female n=64 (32.32%).

al (2016), the highest incidence occurred in 2nd decade, followed by the 3rd decade and combinedly representing 58% of all cases. A similar pattern was seen by Waleed and Niazi (2014).

The slight difference in the age of presentation may be attributed to income variables in our environment. MRI studies are fairly expensive and patients majorly pay out of pocket, which may delay presentation.

Males are more frequently involved in knee injuries as shown in figure 2. This agreed copiously with other studies (Naraghi and White, 2016 and Gimhavanekar et al., 2016).

Some literature suggests that women are at higher risk of suffering ACL injuries due to gender differences in neuromuscular activation pattern, core stability and dynamic movement patterns, with the typical mechanism being a rapid but awkward stop and anticipation of lateral movements (Editorial Review, 2016).

Anatomical and biomechanical differences between men and women have also been implicated (Beacon orthropedicssl Sports medicine: The risk of ACL injuries in female athletics). One source claims that women are 2 to 4 times more likely than men to tear the ACL in their knee (Duke University medical centre, 2018).

Synovial chondromatosis was relatively common in our study, contributing 12.12% of all findings. Primary synovial chondromatosis depicts rare benign neoplastic changes involving the hyaline cartilage nodules which may often detach (Murphy et al., 2007). This is more common in male patients. It has been noted that CT is more profound in identifying one characterizing the calcified intra-articular fragments compared to MR which is variable (Murphy et al., 2007).

Baker's cysts are often common findings in the knee joint and the radiologist may have dilemma in distinguishing it from cyst-like knees such as synovial cysts, meniscal cysts or recess (Perdikalors and Skiadas, 2013).

MRI is an important modality in the assessment and characterization of tumor-like lesions, majorly of which are synovial in origin. The accurate diagnosis may involve a combination of clinical MRI and ultrasound findings (Larbi et al., 2016). In this study, only 2.02% of all findings were seen to be tumor-like intra-articular "loose" bodies which typically originate from degenerative or traumatic events in the knee joint. This was only about 5% of the total NRI findings. Loose bodies can be diagnosed using ultrasound to determine their size position and macroscopic composition (Bianchi and Martinach, 1999) and nevertheless can be the cause of joint distension or pain and should not be missed in routine MRI evaluation (Barros de lima et al., 2016).

CONCLUSIONS

The multiplicity of findings in this study justify MRI evaluation of the knee joint in symptomatic patients. The most common findings are traumatic in origin, notably cruciate ligament tears (37.37%) and menisceal tears (33.3%) as well as quadriceps tendon tears (3.03%). The medial meniscus and anterior cruciate ligaments were more frequently involved. Furthermore patients in the 3rd and 4th decade of life were most commonly involved with a male preponderance. The less common findings of Synovial chondromatosis, cyst-like lesions, tumors and loose bodies all buttress the importance of routine MRI in atraumatic cases.

The spectrum of MRI findings in our setting is a reflection of growing interest and confidence in MRI of the diseased knee joint in our environment.

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