Evaluation of the pathological pattern of Knee aches and injuries in Northwestern Nigeria: the role of Magnetic Resonance Imaging.

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Abstract

The knee is the largest joint in the body and its stabilityis principally reliant on its supporting ligamentous structures in form of ligaments and menisci which are frequently injured. Magnetic Resonance Imaging (MRI) has proven to bethe best imaging modality in terms of excellent soft tissue and bone marrow contrastresolution. Its additional multi planar abilityhas demystified the intricate framework of the knee joint. This study evaluated the role of MRI and the pathological pattern in patients presenting with knee aches and trauma inNorthwestern Nigeria.

It is a prospective study involving 52 patients referred to the department of radiologyAhmadu Bello University Teaching Hospital Zaria over a period of twelve months. All had history ofknee pain or injury and were imaged using a Canon Vantage Elan 1.5 Tesla MRI System,2020. Otawara, Japan. Ethical approval of the institutions ethical committee was obtained.

The patients mean age was 39±14.9 years, with 11 and 66 year as the youngest and oldest. Majority of the patients were male with a proportion of about 3:7. A slight preponderance of cases were noted in the age groups of 31-40 and 41- 50 years with 13 (25%) and 12 (23.1%)cases respectively. Commonest findings noted are joint effusions, bone marrow contusions, anterior cruciate ligament injury and medial meniscus tear. In this study, MRI has shown great value in the diagnosis of internal derangements in knee pain and injuries, hitherto inaccessible clinically or radiographically. Variety of findings were observed; joint effusion being almost a common denominator, other common findings detected include: bone contusions, anterior cruciateligament tear, medial meniscus tear and arthritic changes in order of significance.

Key Words: Traumatic/non-traumatic, Knee Joint, pain, Injury, MRI.

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Introduction

The Knee is unmistakably the largest joint of the body and has a complex configuration which is easily susceptible to injury especially in sportsmen owing to the absence of bony buffer.^{1,2,3} The stability of the joint is principally reliant on its supporting ligamentous structures; however these ligaments and menisci are frequently injured.² The joint has three compartments, namely medial tibio-femoral, lateral tibio-femoral and patella-femoral joint. The joint capsule encloses the menisci, the ligaments and the bony articular surfaces.⁴

Pain and swelling are the key warning signs to suspect an internal derangement especially after a blunt traumatic experience to the knee. Nevertheless, at times the clinical features may perhaps be puzzling and deferment in diagnosis might cumulate in a worse prognosis. Therefore, confirmation of injuries requires imaging. However the standard ritual clinical examinations and tests to determine the instability and internal derangements still stands as preliminary and cost effective way of diagnosis of ligament and meniscal injury. However, these painful stress examinations are not always accurate in the phase of acute injury. These routine clinical examinations along with supporting radiographs and/or CT scan are usually not adequate to establish diagnosis of the many internal derangements of the knee joint.

Magnetic Resonance Imaging (MRI) has proven to be the best imaging modality in terms of excellent soft tissue and bone marrow contrast resolution, with its additional multi planar ability, it has demystified the intricate framework of the knee joint^{2,5,6} and more so when MRI kinematics is done, pathologies sensitive to motions which would have been missed in Static MRI are easily brought to bear.3,4 All these provide significant advantages over other imaging techniques. Other imaging modalities currently in use for evaluation of pathologic conditions of the knee; are Conventional Radiography (CR), fluoroscopy, ultrasonography (USS), Nuclear Medicine (NM). Medical interventional procedures are usually aided with fluoroscopic and sonographic imaging whereas CT is used to routinely to evaluate complex fractures.⁵

Another modality in the management of internal derangement of knee joint is Arthroscopy, an invasive clinical procedure, which can also be therapeutic.^{5,7}

In most traumatic scenarios, particularly in road traffic and sport accidents, the menisci and anterior cruciate ligament (ACL) are more frequently susceptible to injury in the knee.^[3,4,6] The medial meniscus is most commonly injured compared to the lateral and sometime associated with anterior cruciate ligament tear.³

Because of the paucity of MRI machines in this part of the world and the low tesla strength of the very few available ones, studies involving the MRI management of knee pain in this clime are almost nonexistent.⁸

Hence, this study is intended to determine the role MRI and pattern of pathology in the Knee joint pain in Northwestern Nigeria.

Materials and method

This is a prospective study involving 52 patients referred to the Radiology Department of Ahmadu Bello University Teaching Hospital Zaria from within and outside the hospital for knee MRI between April 2021 and March 2022.

Informed consent and ethical approval of the institutions ethical committee was sought and obtained for the study.

Inclusion criteria:

1. All patients with history of significant knee joint pain, who underwent MRI scan.

2. All patients who gave consent for inclusion in the study.

Exclusion criteria:

1. Patients with contraindications for MRI, e.g. those with ferromagnetic implants, pacemakers, and aneurysm clips.

2. Patients who have had previous arthroscopic reconstructions.

3. Patients not consenting for the study.

Method of collection of data: MRI

a. **MRI equipment:** Canon Vantage Elan 1.5 Tesla Whole body MRI System, 2020. Otawara, Japan.

b. **Protocol for imaging:** Patients were placed in supine position with the knee in a closely coupled knee array coil.

The knee was externally rotated $15-20^{\circ}$ to facilitate the visualization of anterior cruciate ligament (ACL) completely on sagittal images and the following sequences were taken.

Localizer sequences in the three orthogonal planes,

T1 weighted sequences in sagittal and axial planes.

T2-weighted sequences in coronal and sagittal planes.

PD-fat sat FSE weighted sequences in axial, coronal and sagittal planes.

A FOV of 18x18 cm, matrix size of 320x256 and slice thickness of 2 mm was used.

Statistical Analysis

Data were initially summarized into means, standard deviations (SD); Mean \pm SD and percentages in a form of comparison tables and graphs. Statistical analysis was performed using the standard Statistical Package for the Social Sciences (SPSS Inc., Chicago Illinois, USA) version 18.A p-value 0.05 considered to be significant.

Result

A total of 52 individual patients amounting to 54 knees, two of which had bilateral knees were assessed, 38 (73%) were male and only 14(27%) were female [Table 1]. They were aged between 11 and 66 years, the mean age of the subject is 39 ± 14.9 years. A slight preponderance of cases were noted in the age groups of 31-40 and 41- 50 years with 13 (25%) and 12

(23.1%) cases respectively, while the age groups 20

and 61 years were the least with 5 cases (9.6%) cases apiece [Table 1].

Majority were of the Hausa/Muslim ethnic stalk with 45 (87%) of the sample population. Majority of the individuals numbering 36 (69%) have history of trauma as against 16 (31%) non trauma cases. The trauma cases is composed of 11(21%) sports injury, 10 (19%) domestic accident, 8 (15%) military exercise and 8 (15%) were due to RTA [Figure 1].

Near equal affectation of both knees with a

	≤20 Years	21-30 Years	31-40 Years	41-50 Years	51-60 Years	≥61 Years	Total
Male	3	8	11	7	5	4	38
	5.8%	15.2%	21%	13.5%	9.6%	7.6%	73%
Female	2	2	2	5	2	1	14
	3.8%	3.8%	3.8%	9.6%	3.8%	1.9%	27%
Total	5	10	13	12	7	5	52
	9.6%	19%	25%	23.1%	13.5%	9.6%	100%

Table 1: Showing Age group vs Sex distribution.

MRI Pathologies	C	Percentage (Frequency)	
Cruciate Ligament Tear	Anterior crucial ligament	15.4% (8)	
	Posterior crucial ligament	5.8% (3)	
	Total	21.2% (11)	
Meniscal Tear	Present	19.2% (10)	
	Absent	79.8% (42)	
Bony Contusion	Present	32.7% (17)	
	Absent	77% (35)	
loint Effusion	Present	67% (35)	
	Absent	33% (17)	
Osteoarthritic Changes	Present	17.3% (9)	
	Absent	84.5% (43)	
arcoma	Present	1.9% (1)	
	Absent	98.1% (51)	
nfarct	Present	3.9% (2)	
	Absent	96.1% (50)	
racture	Present	3.9% (2)	
	Absent	96.1% (50)	
Iemathrosis	Present	1.9% (1)	
	Absent	98.1% (51)	
Dislocation	Present	1.9% (1)	
	Absent	98.1% (51)	
Iuscular Contusion	Present	1.9% (1)	
	Absent	98.1% (51)	
Normal Findings	Normal study	15.4% (6)	

Table 2: Showing the distribution of the MRI pathological findings.



Figure 1: Showing distribution of cause of knee pain [Traumatic causes and non-traumatic].

slight right preponderance was recorded i.e. 26 (50%) and 24 (46%) cases in the right and left knee respectively, including 2(4%) bilateral cases.

The most common MRI confirmed pathology is joint effusion occurring in 35 cases (67%) distantly followed by articular bone contusion 17 (32.7%), then cruciate ligament injury 11 (21.2%) with anterior cruciate ligament (ACL) making up the majority, that is; 8 cases and posterior cruciate ligament (PCL) 3 cases. Meniscal injury is next with 10 cases amounting to 19.2%, then osteoarthritic changes 9 (17.3%) and normal findings with 8 (15.4%). Articular bone infarct and fracture 2(3.8%) apiece. Muscular contusion, sarcoma, dislocation, haemarthrosis 1 (1.9%) apiece.



Figure 2: T2W Fat suppressed sagittal knee MRI showing joint effusion with supra patella bursa involvement. Multiple contusion involving the patella, the femoral and tibial condyles and the femoral diaphysis as marrow edema.

[Table 2]

Discussion

Knee pain is a common aging process complaint among adults and most often associated with general wear and tear from daily activities like walking, bending, standing and lifting. Athletes and sportsmen that are involved in jumping or quick pivoting are also more likely to experience knee pain and glitches.³ Whatever the cause of an individual's knee pain, whether it's due to aging or trauma, it can be a nuisance and even debilitating in some instances.

The use of MRI in the assessment of knee pain has been on the increase over the past years,^[1,10] with its accuracy further potentiated by Kinematics.⁴ Due to its excellent and superior soft tissue resolution with its multiplanar and fat suppression protocols, MRI which uses non ionizing radiation is presently regarded as an essential means of examining knee pathologies. However the high cost of the examination and its relative unavailability mitigates against its routine use. Documented studies on the evidence of MRI management of patients with knee aches in this clime is rare.⁸

As observed in most of the other reviewed trauma related studies,^[3,4,11] the male gender is in the majority with 38 (73%) as against 14 (27%) females. This can be related to the high risk activities involving the male gender.^[11]The index study summations closely relate to that of Rajesh *et al*^[3] who had a ratio 4:1 in favor of males. However in a Saudi Arabian study by Mustafa *et al*^[12]involving MRI in knee pains, though they were majorly non-trauma cases, a plethora of the female gender was observed. This was attributed to increase arthropathies due to obesity, pregnancy and post-menopausal



Figure 3: T2W Fat suppressed sagittal knee MRI showing partial visualization of the posterior femoral attachment of ACL with abnormal signal intensity in keeping with tear, with associated joint effusion



Figure 4: T2W Fat suppressed sagittal knee MRI showing a medial meniscal tear.

osteoporosis.¹³

A near homogeneous ethnic and religious composition, comprising 95% Hausa/Fulani Muslims was observed and is a reflection of the composition of the local demographics, these are usually the findings solitary centered studies in this clime.^{8,11}

There is a near equal affectation of both knees with 52% and 48% of cases in the right and left respectively, it is however worthy of note that most cases of trauma involved the right knee. Arumugam et al¹⁴also established in their study that the right knee was most involved, though to a much higher proportion of 6:4 when compared to the index study. This might not be unconnected with the fact that most people are right handed in nature and during contact sports especially football it's the right leg that is usually presented for challenge, hence its susceptibility to injury. It is also the right leg that bears more of the weight during sports whether contact or noncontact and during normal ambulatory session.¹¹

The age group of 31-40 years have the highest frequency of the cases with 13 (25%) and it's closely followed by the contiguous group 41- 50 years with 12 (23.1%) cases. Age group 41-50 years was reported by Sathish *et al*⁴ as the most populous in their study, with 24% of the sample size, while Rajesh *et al*³ and Arumugam *et al* ¹⁴ reported age group 21-30 years, as having the highest frequency with values of 38% and 55% respectively.

Amongst the cases studied, 69% had a history of trauma as against 31% with no such history, these findings were synonymous to that of Hetta *et al*^{\circ} who had about 83% with history of trauma but at variance with the study done by Sathish *et al*⁴ who reported 33% trauma and 77% non-trauma.

Eighty-eight percent (88%) of the scans were found to have positive findings, while only 12% were negative (i.e normal findings) which is in tandem with that of Sathish *et al.*⁴ Out of the 16 cases devoid of history of trauma in this study, 50% (n=8) were aged 50years and above and they had mainly degenerative joint disease. The remaining 50% (n=8), aged less than 50years had normal findings in 5 out of the 8 remaining cases. Of the three outstanding cases with pathology, one had rhabdomyosarcoma of the left adductor longus muscle and was aged 31 years, the remaining two had medial meniscal tear.

The major cause of knee joint trauma were sport injuries (31.4%), followed by domestic injuries (28.6%), road traffic accident (22.9%) and military exercise (17.1%). This shows some similarity with that reported by Rajesh *et al*,^[3] who reported domestic fall of 32% as the major cause, closely followed by road traffic accident of 31%, then sports injury; 27% and lastly twisting injury 10%. Although military exercise related injuries were the least in this study accounting for 17%, it's quite significant when compared with the findings of all other studies reviewed, where it was conspicuously absent. This quite significant figure is as a result of the ongoing military exercises all over the country because of terrorist activities.

Like in most of the other studies^{3,4,5,7} pain was a common denominator presenting complain, it was 100% in the index study, other associated clinical presentations such as soft tissue swelling were noted in about 47% of the cases, knee joint instability was observed in about 19% and joint stiffness occupied about 7.6%.

Most of the patients had combination of findings, and this group make up about 86.5% of the sample population, while only 13.5% had a solitary finding. This attests to the result of Hetta *et al*⁹ in their MRI assessment of sports related knee injuries. Joint effusion which is appreciated on T2W images as high signal collection within the joint spaces, adjacent

muscle planes and related bursae, most times coexisting or sequel to other findings was the most common [Figure 2]. Joint effussion was noted in 67% of the total sample population and in about 80% of the pathologic knee MRI cases, the traumatic and non-traumatic cases all encompassed. It was also the commonest pathology reported by Mustafa *et al*¹² making up about 64% and second most common after ACL injury in the study by Rajesh *et al*³ with 71% of the cases.

Bony contusions have been shown to have close association with anterior cruciate ligament tears following traumatic injuries.¹⁴ We observed a significant number of cases [n=17 (32.7%)] of contusion involving the articulating bones, making it the second most commonest findings after joint effusion. Rajesh *et al*³ reported bony contusion as the third most common finding with as high as 46% cases, while Mustafa *et al*¹² reported about 23%. These are seen as patchy or a focal increased marrow signals on T2 fat suppressed sequences [Figure 1].

In cruciate ligamentous injuries, the ACL is most affected compared to PCL.^{3,9} This study shows cruciate ligament injuries occupying the third position in occurrence with 21.2% of cases with an ACL:PCL ratio of 2.6:1. This trend is similar to those of previous studies, however the index study's percentage size and proportion are much lower than those of Rajesh *et al*³, Hetta et al^9 and Arumugam et al^{14} where ACL was the leading findings with values of 76%, 60% and 45% respectively and their corresponding PCL having 15%, 8% and 12.5% tears respectively. This significant higher values may be chiefly due to their larger sample sizes.^{4,9,14} ACL tears were diagnosed either by abnormal signal intensities, abnormal course or a Blumensaat angle <0 or > 15 degrees.¹⁵ PCL tear was similarly diagnosed by abnormal signal intensity, abnormal course or discontinuity [Figure 2].

Meniscal injuries closely follows that of ACL with 10 (19.2%) of cases in index study, a trend noted in most other studies.^{3,4} However on the contrary Jamal *et al*¹⁶ with a similar sample size as that of the index study, observed that amongst the 54 patients examined, medial meniscal tear had the lead with 31 cases (57.4%), followed by lateral meniscal tear with 12 cases (22.2%) and ACL tear in a distant 3rd with 11 cases (20.3%). In this study only a case of lateral meniscal tear was reported, the proclivity of the medial meniscus being the most involved has been recorded in most other studies.^{3,4,9,10,14}

Meniscal tears are graded asfollows: Grade 1- Meniscal signal change is globular and do not communicate with articular surface.

Grade 2- The tear is linear, intra substance and do not interconnect with the articular surface. Grade 3- Here it extends to involve the articular surface. It is either linear or irregular [Figure 3]. Grade 4- Menisci are distorted in addition to signal changes similar to grade 3.

Osteoarthritic changes which is characterized by bony erosions, articular cartilage irregularities and/or osteophytic spurs were noted in 9 (17.3%) of the cases, a similar finding to that of Mustafa *et al*^[12] who reported about 12.1% of the cases in his study as having osteoarthritic changes. Nearly all the reported cases, which is; 8 out of 9 were aged 50 years and above with no discernable history of trauma, only one was aged 25 years and was due to post traumatic osteoarthritis from sports injury.

Normal reports in this study, also amounts to 15.4%, which was quite significant, probably the result of poor clinical appraisal and screening as well as indiscriminate use of MRI as a screening or clerking tool.¹⁷ Bone infarct and fracture made about 4% of the cases in this study, in the works of Rajesh *et al*³ they recorded 9% cases of fracture involving the articulating bones. Hemarthrosis, muscular contusion, rhabdomyosarcoma and dislocation make up the least occurring pathologies about 2% each. Sathish⁴ and Rajesh *et al*³ in their various studies documented similar percentage of cases of rhabdomyosarcoma and articular dislocation as in the index study.

It is important to note that many studies^{4,6,8,10,11} have shown significant setbacks in using clinical diagnosis only, when compared to MRI diagnosis of internal derangements of the knee joint. In this study over 90% had no provisional clinical diagnosis, but inadequate clinical notes, therefore radio-clinical correlation was not possible as the diagnosis were solely radiological (MRI).

Conclusion

Magnetic resonance imaging with its tremendous excellent soft tissue contrast resolution, multiplanar imaging capabilities and non-invasive nature, has shown great value in the diagnosis of internal derangements in knee pains and injuries.Clinical features and radiographics are usually suggestive of the soft tissue injury and are inadequate to make diagnosis of an actual internal derangement, therefore MRI with its exceptional ability in resolving ligamental, meniscal, articular cartilage and capsule, and bone marrow injuries is a necessity. Asides the joint effusion which was almost a common denominator, other common findings detected were; bone contusions anterior cruciate ligament tear, medial meniscus tear and arthritic changes.

Disclosure

The author declares no conflicts of interest. No funding was received for this study.

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