Zagazig University Medical Journal
www.zumj.journals.ekb.eg

Volume 28, Issue 4, July 2022(904-911)

Manuscript ID ZUMJ-1909-1547 (R2)
DOI **10.21608/zumj.2020.17406.1547**

ORIGINAL ARTICLE

Role of MRI in Evaluation of Injuries of Posteromedial Corner of the Knee (Neglected Corner)

Eman Abd Elrahman Abd Elsalam Hussien[1*], Ahmed Mohammed Wafdy Elgebaly[2], Ahmed Mohammed Alaa Eldien[2], Mohammed Ibrahim Amin[2]

[1] *Radiodiagnosis Department, Alahrar Teaching Hospital, Zagazig*
[2] *Radiodiagnosis Department, Zagazig University Hospital, Zagazig*

***Corresponding Author:**
Eman Abd Elrahman Abd Elsalam Hussien
Radiodiagnosis Department, Alahrar Teaching Hospital, Zagazig
Email: emanemiabdelrahman1989@gmail.com

Submit Date 2019-11-06
Revise Date 2020-01-24
Accept Date 2020-04-13

ABSTRACT

Background: Magnetic resonance imaging depicts in exquisite detail the supporting structures of posteromedial corner of the knee. This capsuloligamentous unit plays a central role as a dynamic stabilizer of knee joint and recognition of injury to posteromedial corner. This study provides a resume of anatomy of posteromedial corner as seen with MRI and follows with a review of the MRI appearance of injury to posteromedial corner. The aim of the study is to assess of MRI role in delineation of posteromedial corner of the knee (neglected corner) with regarding the anatomy and types of injuries.

Methods: This study was carried out at Radio diagnosis Department included 36 patients with knee trauma. Conventional MR imaging with dedicated protocol for posteromedial corner injury detection was applied, 12 healthy persons was assigned as control group.

Results: The study showed that ligamentous and meniscal injury was the commonest injury (19.4%) of the study group as SMT lesions was the commonest injury (77.8%) followed by PHMM injuries (75%) while OPL and POL injuries were 69% of the study group.

Conclusions: Our results show that magnetic resonance imaging is the best technique for evaluation the injuries of PMC. In order to obtain high diagnostic accuracy, adequate patient preparation, protocol optimization and MRI reporting expertise are essential.

Keywords: Magnetic resonance imaging; Posteromedial corner; Anteromedial rotational instability

INTRODUCTION

Injuries to the posteromedial corner (PMC) of the knee are often overlooked, yet the major anatomic structures found in the PMC are readily visible on modern high-field-strength magnetic resonance (MR) imaging systems. With proper understanding of these anatomic structures, their normal appearance at MR imaging their static and dynamic roles in supporting the knee, injuries may be easily recognized and understood [1].

Isolated PMC injuries are rare; most occur in conjunction with injuries to other important stabilizing knee structures such as the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) [2]. Unrecognized and unaddressed injury of the PMC is one of the causes of ACL and PCL graft failures. Recognition of PMC injuries is critical, as the diagnosis will often change or require surgical management [3].

The PMC contains the structures lying between the posterior margin of the longitudinal fibers of the superficial medial collateral ligament (SMCL) and the medial border of the posterior cruciate
ligament (PCL). Within these borders are the five major components of the PMC. This includes the posterior oblique ligament (POL), semimembranosus tendon (SM), the oblique popliteal ligament (OPL) and the posterior horn of the medial meniscus (PHMM). The medial head of the gastrocnemius also provides support [4].

Information of the life systems What's more normal pathologic states of the PMC camwood help with prevent misdiagnosis [5].

https://dx.doi.org/10.21608/zumj.2020.17406.1547
Volume 28, Issue 4, July 2022(904-911)

METHODS

This study included 36 patients, referred from Emergency room and Orthopedic outpatient clinic to Radiology Department. The studied group included 14 females and 22 males. Their ages ranged between 19-50 years.

For comparison, 12 age-matched healthy subjects were enrolled, with no obvious knee trauma who served as a control group. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University.

All patients were subjected to clinical assessment by history taking including age and sex excluding any contraindication of MRI such that patients with implanted pacemaker and other cardiological devices or ocular implants or aneurysmal clips incompatible with MRI or metallic implants in the knee joint area (checked by complementary X-ray examination or from history) or patients have claustrophobia (relative contraindication).Also, the assessment was done by clinical examination to find out subjective sensations of valgus instability combined with objective findings of significant abduction laxity and associated anteromedial rotational instability and radiological assessment of the affected knee by conventional MRI imaging with dedicated protocol for PMC injury detection.

Technique: The patients were positioned supine with the affected knee is near completely extended in the knee coil and rested over knee pad in a just 15^{o} flexion.

Knee MRI protocol

Localizer images in Axial, coronal and Sagittal planes.

Fast spin echo T1-weighted echo (FSE) (TR 600 ms, TE 17 ms, matrix 512 ×224, slice-thickness: 3.5mm and FOV 30mm) in sagittal plane.

Fast spin echo T2-weighted images (FSE) (TR 3600 ms, TE 100 ms, matrix 512 ×224, slice-thickness: 3.5mm and FOV 30mm) in axial and sagittal plane.

Fast spin echo PD-weighted images (TSE) (TR 3200 ms, TE 30 ms, matrix 512 ×224, slice-thickness: 3.5mm and FOV 30mm) in axial, coronal and sagittal plane.

Statistical Analysis:

Data were statistically described in terms of frequencies (number of cases) and percentage when appropriate. Data were checked and analyzed by using SPSS version 20. Data were presented as follow: mean and median for quantitative variables. Number and percentage for categorical variables (different injury patterns of components of PMC).

RESULTS

This study included 48 persons (replaced by participants as including healthy and patients), they were 29 males and 19 females. Regarding age distribution the mean age of the study group was (34.5±9) years with age ranged from 19 to 50 years, the most dominant age group is from 19 to 40 years.

Of the 48 examined knees reviewed, 28 knees had a documented injury to SMT, as partial tears of any of its five expansions (30.6%) were more common than complete tear (5.6%). The POL was injured in 25 knees; 16 had focal injury (43.75%) of them had focal injury at its femoral attachment followed by focal injury at its tibial attachment (37.5%) while 9 had multifocal injury (44.5%) of them at its femoral and tibial attachments followed by multifocal injury at its femoral attachment and interstitial (33.3%) *as shown in table (2)*.

The OPL was injured in 25 of 36 traumatic knees; 15 of them were tear while 9 of them were sprain, also its MRI appearance was noted as 15 of injured knee appeared as disruption while 11 of them appeared intact and 5 knees showed thickening of OPL *as shown in table (1)*. PHMM injuries had been recorded in 36 traumatic knees—8 degeneration, 4 root tears, 3 horizontal tears, 2 vertical tears and 16 complex that involved both the body and periphery. 72.2% of traumatic knees showed posteromedial capsular separation.

CASES:

Case (1) A 23-years-old male patient referred to Radiology Department for MRI examination, the patient gave history of contact sport trauma injury week ago. He was complaining of pain and giving away.

Figure (1): Sagittal FS PD Weighted TSE Image shows continuous fibers of ACL with fuzzy outline at its tibial attachment denoting ACL sprain (red arrow).

Figure (2) and (3): coronal and axial FS PD Weighted TSE Images show partial thickening of POL at the femoral attachment with surrounding edema denoting acute POL injury (red arrows).

https://dx.doi.org/10.21608/zumj.2020.17406.1547
Volume 28, Issue 4, July 2022(904-911)

Case (2) A 46-years-old female patient referred to Radiology Department for MRI examination, the patient gave history of twisting knee trauma with weight bearing 3 days ago. She was complaining of severe pain and swelling.

Figure (4): Sagittal FS PD Weighted TSE Image shows abnormal high intrinsic signal within posterior horn of medial meniscus abutting the inferior articular surface denoting grade III abnormal signal of PHMM (red arrow).

Figure (5) and (6): Axial and sagittal FS PD Weighted TSE Image show irregularity of oblique popliteal ligament at its tibial attachment denoting its sprain (red arrows).

Table (1): MRI findings of OPL in the studied group:

MRI findings of OPL	NO (36)	%
Irregularity	2	5.5%
Thickening	5	14%
Disruption	15	41.7%
Intact with surrounding oedema	3	8.3%
Intact	11	30.5%

Table (2): MRI findings of POL in the studied group

MRI findings of POL	NO (36)	%
• ***Focal injury:***	16	44.5%
a- Femoral attachment	7	43.75%
b- Interstitial attachment	3	18.75%
c- Tibial attachment	6	37.5%
• ***Multifocal injury:***	9	25%
a- Femoral & tibial attachment	4	44.5%
b- Femoral attachment & interstitial	3	33.3%
c- Tibial attachment & interstitial	2	22.2%
• ***Intact***	11	30.5%

Case1:

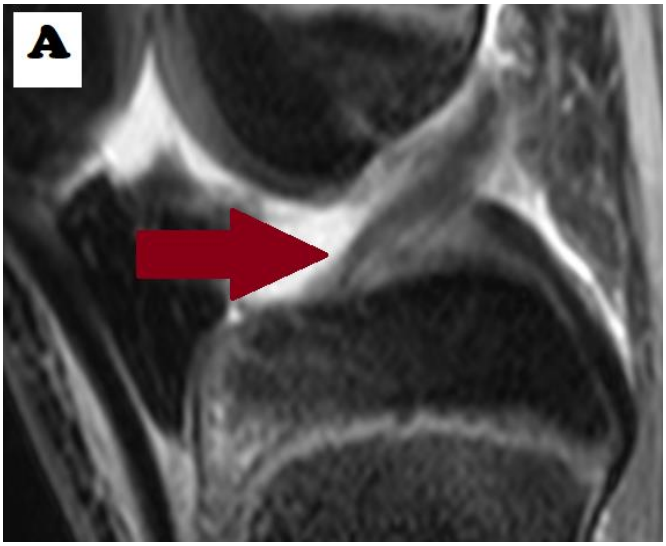

Figure (1): Sagittal FS PD Weighted TSE Image

https://dx.doi.org/10.21608/zumj.2020.17406.1547
Volume 28, Issue 4, July 2022(904-911)

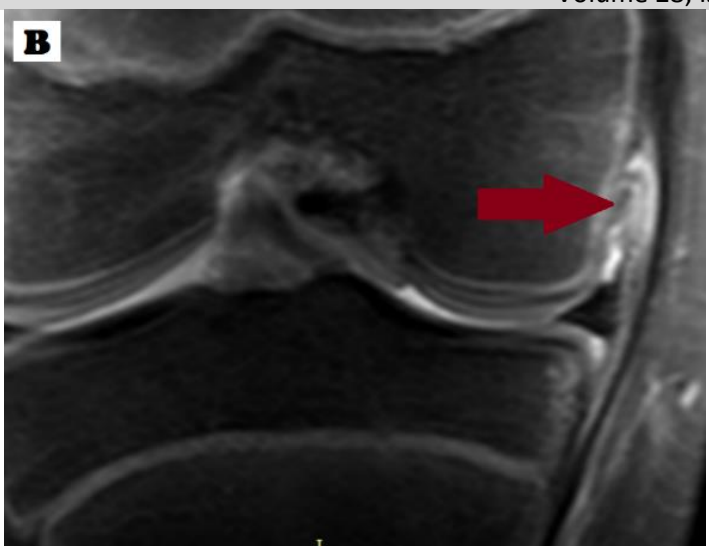

Figure (2): Coronal FS PD Weighted TSE Image

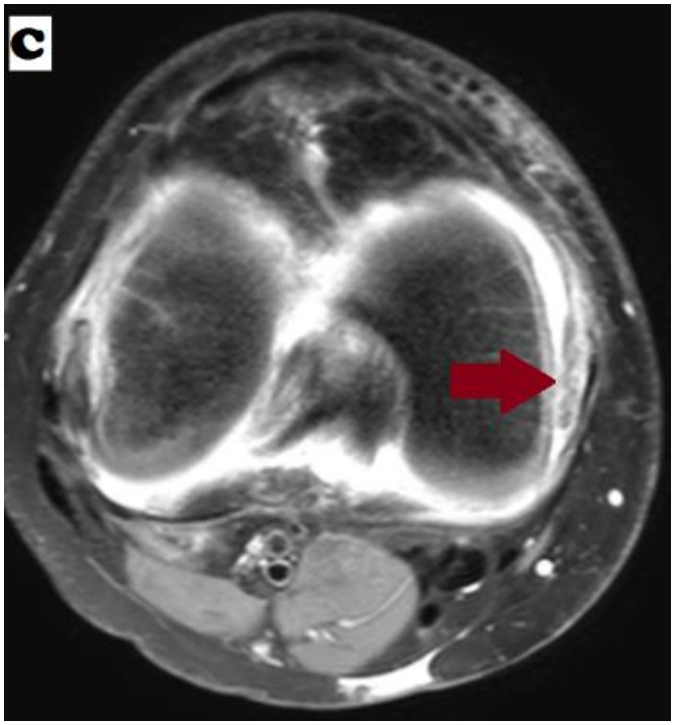

Figure (3): Axial FS PD Weighted TSE Image

https://dx.doi.org/10.21608/zumj.2020.17406.1547
Volume 28, Issue 4, July 2022(904-911)

Case2:

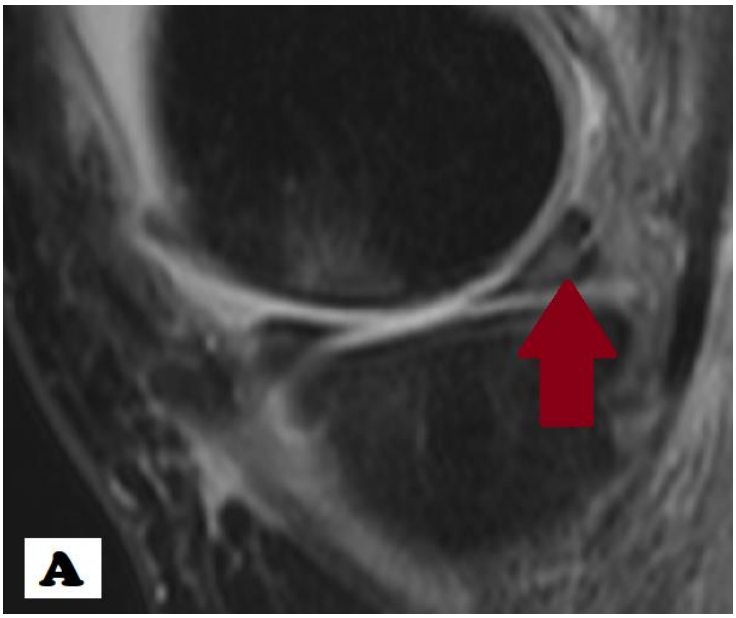

Figure (4): Sagittal FS PD Weighted TSE Image

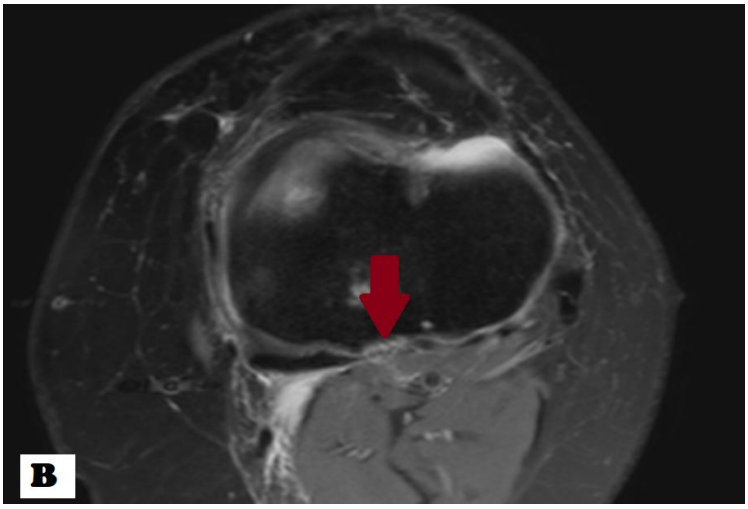

Figure (5): Axial FS PD Weighted TSE Image

https://dx.doi.org/10.21608/zumj.2020.17406.1547
Volume 28, Issue 4, July 2022(904-911)

Figure (6): Sagittal FS PD Weighted TSE Image

DISCUSSION

The knee joint is the most frequently injured joint of the human body. The knee injuries affect both the general population and the athletic population of different age groups [6].

The initial evaluation of knee injuries usually consists of taking the clinical history and performing a physical examination, which involves various manipulative tests [7].

MRI has the superiority over other radiological modalities in being able to detect different important etiologies and predisposing factors causing knee pain. Suppressing the signal from fat may enhance the diagnostic yield of some pulse sequences. Fat suppression techniques include spectral suppression of water protons, a phase-dependent method, such as the Dixon method or short-TI inversion recovery (STIR). The latter two techniques may be necessary on low-field systems. Methods also exist for generating separate water and lipid images, or for selectively exciting water protons, which essentially nulls the contribution of fat in the final images [7].

The importance of the "semimembranosus corner" has been emphasized often by Müller, who states, "As long as the semimembranosus corner functions efficiently as a stabilizer, even a weak or damaged cruciate ligament can function in a compensated fashion. But if this stabilizing action is lost, the anterior cruciate ligament alone is incapable of compensating and becomes increasingly insufficient." Approaching the topic from the perspective of why ACL reconstructions fail, unrecognized, unaddressed corner injuries have been implicated [8].

Although not currently a widely held concept, there is a subset of patients with medial-sided injuries in whom the injury requires surgical repair. The patient referred is one with either an isolated posteromedial injury or a posteromedial injury with an associated ACL injury who demonstrates AMRI. In the case of a patient with AMRI with ACL insufficiency, it is certainly possible to stabilize anterior translation of the knee initially, but the long-term viability of the ACL graft and the long-term function of the knee—in particular that of the medial meniscus—may be compromised [9].

The purpose of our study is to prove the existence of this type of injuries by describing the posteromedial pattern of knee injury, draw attention to the posteromedial knee structures and to describe associated injury patterns.

In summary, there are 3 concepts with regard to PMC injuries that the authors believe to be important:

(1) Not all PMC injuries are created equal;

(2) The posteromedial corner structures, motored by the semimembranosus, act in a dynamic fashion to resist AMRI.

(3) Although less anatomically complex than the posterolateral corner, the posteromedial corner is no less important functionally.

The first is evidenced by the pathoanatomy in the patients described in our series while the second and third are based on previously published works by Müller and Hughston and associates [10].

Our study included 48 persons, 36 patients and 12 age-matched healthy subjects, their age ranged between 19 and 50 years old, mean age in the studied group was approximately 34.5 years ± 9 years. The peak incidence of presentation lies in the second and third decades which represent the highly active periods of life. The third decade predominance could be explained by the fact of deteriorating elasticity of ligamentous and cartilaginous elements throughout progression of age and increased level of activity in the mentioned age group which is nearly consistent with the study carried out by Majewski and Susanne [11], who stated that the peak incidence of knee trauma was between 30-39 years of age.

In our study the percentage of males patients was 60.4% and the females was 39.6%, which is nearly consistent with the study carried out by Majewski and Susanne [11**]** with percentage of male subject suffering from traumatic knee insult about 68.1% in comparison to 31.6 % female subjects, This could be explained by the fact that males are more vulnerable to such traumatic knee injury during daily activity and sports injury, while females are more vulnerable to meniscal degeneration resulting from weight bearing due to obesity.

We found that combined injuries had occurred in 5 of the 36 injured knees (13.9%). Associated ACL injuries were found in 3 knees and associated posterior cruciate ligament injuries in 2 knees.

The most common injury in our study is that of SMT (77.8%) which is not consistent with the study carried out by Sims and Jacobson [2] who had documented POL injuries (99%) are the most common in their study, this could be explained by a greater number of patients included in their study (93 patients) and long study period (6 years).

In our study SMT injury occurred in 77.8% of cases, 39.2% of them had partial tear which seen as a lack of visualization of the anterior arm of the semimembranosus in the coronal images and 14.2% of them had avulsion fracture the level of the posterior medial tibial plateau while 39.2% had tendinosis which seen in association with chronic, repetitive injuries and stress of the tibial insertion of the semimembranosus, resulting in thickening and circumferential fluid SI at the level of the posterior medial tibia findings that are nearly consistent with study carried out by Al-taki et al. [12] who found that semimembranosus and its expansions were injured in 64% of patients 31.8% of them had a partial injury, and 31.8% had MRI findings of tendinosis.

Of the 36 injured knees, 25 knees had documented injury to POL (69.4%), 69% of them had focal injury most common at its femoral attachment (43.75%) *as shown in case (1) figure (2 and 3)* followed by injury at its tibial attachment (37.5%) and interstitial injury (18.75%) while 36% of them had multifocal injury most commonly at the femoral and tibial attachments (44.5%) followed by injury at its femoral attachment and interstitial (33.3%) and multifocal injury at its tibial attachment and interstitial (22.2%) *as shown in table(2)*, which is consistent with study carried out by Sims and Jacobson [2] who found 70.6% were focal injuries and 29.3% were multifocal injuries.

Also, 60 % of examined knees had grade III POL injury followed by grade I (sprain) POL injury (48%) and grade II POL injury (28%) ,results that are consistent with study carried out by Al-taki et al. [12] who documented POL was injured in 64% of patients with 64.3% of them having grade III injury while 35.7% having a grade I injury.

The OPL was injured in 25 of 36 injured knees *as shown in table (1)*; most common injury pattern was tear (64%) that appeared in MRI as disruption while 36% of them had sprain which appears in MRI as irregularity *as shown in case (2) figure (5 and 6)*, thickening or even intact with just surrounding edema with statistically significant difference between diseased and normal persons (P value: 0.001) which is not consistent with study carried out by Benninger and Delamarter [13-14] who stated that partial tears of the semimembranosus complex and its associated structures, including OPL , 14.6% had either avulsion or partial tears of the semimembranosus with respect of fact that nearly 60 percent of anatomical texts and atlases as well as over 90 percent of specialty journal articles state that the distal semimembranosus tendon contributes fibers to OPL.

PHMM injuries had been recorded in 27 knees (75%), 44.4% of them reported complex tear involved both the body and periphery followed by isolated degenerative changes at PHMM (16.7%) *as shown in case (2) figure (4)* and its root tear (14.8%) as statistical analysis revealed significant differences between the knees with and without PHMM lesions in different types of tear and degeneration (P value: 0.001)which is not consistent with the study carried out by Choi et al. [15] who found that PHMM injuries were found in 28.6% of all examined 419 knees: degeneration in 14.3% knees, partial tear in 11.7%, root tear (21.7%) and complex tear in 2.6% due to the

large number of patients included in their study (419).

Posteromedial meniscocapsular separation was identified in 28 of 36 patients in our study, giving an incidence of 77.8%, all of them was associated with mild AMRI which is consistent with study carried out by Bollen [16].

CONCLUSIONS

learning the anatomy of the posteromedial corner of the knee is important in understanding the various types of post-traumatic knee pathology that affect this region. Assessment of PMC with MR imaging remains difficult owing to the intimate nature and intricate course of the capsular structures. Demonstration of posteromedial corner tears with MR imaging may be useful in the preoperative planning of repair and restoration of normal joint stability. However, in order to recognize pathology in this area, it is important to be familiar with the normal MRI appearance of PMC.

Conflicts of interest: None.

Financial disclosure: None.

REFERANCES

1. Lundquist RB, Matcuk GR, Schein AJ, Skalski MR, White EA, Forrester DM, et al. Posteromedial Corner of the Knee: The Neglected Corner. RadioGraphics 2015; 35 (4): 1123–7.
2. Sims WF, Jacobson KE. The Posteromedial Corner of the Knee Medial-Sided Injury Patterns Revisited. Am J Sports Med 2004; 32 (2): 337-45.
3. Charles RH. Case report of atypical bilateral posteromedial knee instability in a male recreational runner. Physiother Theo and Pract 2011; 27 (2): 160-171.
4. **LaPrade R, Wijdicks CA, Griffith CJ, Johansen S, Engebretsen L.** Injuries to Medial Collateral Ligament and Associated Medial Structures of the Knee. JBJS 2010; 92 (5):1266-1280.
5. Griffith CJ, Wijdicks CA, Laprade RF. Force Measurements on the Posterior Oblique Ligament and Superficial Medial Collateral Ligament Proximal and Distal Divisions to Applied Loads. Am J Sports Med 2008; 37 (1) :140–8.
6. Maeseneer M De, Marcelis S, Boulet C, Mey J De , Kichouh M, Shahabpour M. Ultrasound of the knee with emphasis on the detailed anatomy of anterior , medial, and lateral structures. Skeletal Radiol 2014; 43 (8): 1025-39.
7. Standring S. Gray's Anatomy E-Book 41th edition: The Anatomical Basis of Clinical Practice. Elsevier Heal Sci, UK; 2016.
8. Stannard JP, Black BS, Azbell C, Volgas DA. Posteromedial Corner Injury in Knee Dislocations. J Knee Surg 2012; 25 (5): 429-34.
9. Bauer KL, Stannard JP. Surgical approach to the posteromedial corner : indications , technique , outcomes. Skeletal Radiol 2013; 6 (2): 124–31.
10. Lording APT, Ballis LMR, Lustig PNS. The role of the meniscotibial ligament in posteromedial rotational knee stability. Knee Surg Sports Traumatol Arthrosc 2015; 23 (10) : 2967-73.
11. Majewski M, Susanne H. Epidemiology of athletic knee injuries : A 10-year study. Science direct 2006; 13 (3) : 184–8.
12. Al-taki JCM, Pearce D, Leibenberg A, Whelan DB. Injury patterns to the posteromedial corner of the knee in high-grade multiligament knee injuries: MRI study. Knee Surg Sports Traumatol Arthrosc 2010; 18 (8) : 1098–104.
13. Benninger B, Delamarter T. Distal semimembranosus muscle-tendon-unit review: morphology, accurate terminology, and clinical relevance. Folia Morphol (Warsz) 2013; 72 (1 : 1–9.
14. Benninger B, Delamarter T. The " Oblique Popliteal Ligament ": A Macro- and Microanalysis. Anatom Research Internation 2012; 2012: 151342.
15. Choi J, Chang EY, Cunha GM, Tafur M, Chung CB, Jy C, et al. Posterior medial meniscus root ligament lesions: MRI classification and Associated Findings. AJR 2014; 203 (6) : 1286–9222.
16. Bollen SR. Posteromedial meniscocapsular injury associated with rupture of the anterior cruciate ligament apreviously unrecognised association. JBJS 2010; 92 (2): 222–3.

Hussien, E., algebally, A., amin, M., Alaa, A. Role of MRI in Evaluation of Injuries of Posteromedial Corner of the Knee (Neglected Corner). *Zagazig University Medical Journal*, 2022; (904-911): -. doi: 10.21608/zumj.2020.17406.1547