Pictorial Essay

Understanding the Ramp Tears of the Knee Joint: Types, Consequences, and Treatment

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Abstract

Ramp lesions or meniscocapsular separation are peripheral injuries that affect the posterior horn of the medial meniscus (PHMM) and the posteromedial capsule and are described as a tear or injury to the meniscocapsular junction or the meniscofemoral ligaments, particularly in the posteromedial aspect of the knee joint in the setting of pivot shift injuries. These almost always occur with a concomitant anterior cruciate ligament (ACL) tear. The meniscocapsular junction is the area where the peripheral attachment of the meniscus meets the joint capsule. In the context of ramp lesions, this region is susceptible to damage when there is an injury to the ACL. The medial meniscus serves as a firm attachment between the tibia and the femur, functioning as a stabilizer for the knee. It plays a crucial role in preventing anterior translation, particularly in knees with ACL deficiency, making it particularly prone to injuries. The ACL tear can cause the tibia to excessively translate anteriorly, leading to stress on the posterior aspect of the medial meniscus. Ramp lesions have significant biomechanical implications, and their occurrence is more prevalent than previously believed. Untreated ramp lesions may contribute to persistent knee symptoms, instability, and impaired function. These lesions are frequently underdiagnosed, leading to a lack of timely surgical intervention in standard knee arthroscopies. This limitation arises from the reliance on anterior portals, restricting a comprehensive evaluation of the posterior horn and attachment of the medial meniscus. Owing to its tendency to go unnoticed during magnetic resonance imaging interpretation and its "blind" spot in arthroscopic vision, achieving an accurate preoperative diagnosis is crucial. The objective of this article is to comprehensively present recent findings in the literature regarding meniscal ramp lesions, encompassing their anatomical, biomechanical, and diagnostic characteristics in an illustrative manner.

Keywords
- meniscocapsular tears
- ramp lesions
- ramp tears

Introduction

Ramp lesions or meniscocapsular separations are peripheral injuries that affect the posterior horn of the medial meniscus (PHMM) and the posteromedial capsule and are described as a tear or injury to the meniscocapsular junction or the meniscofemoral ligaments, particularly in the posteromedial aspect of the knee joint in the setting of pivot shift injuries.

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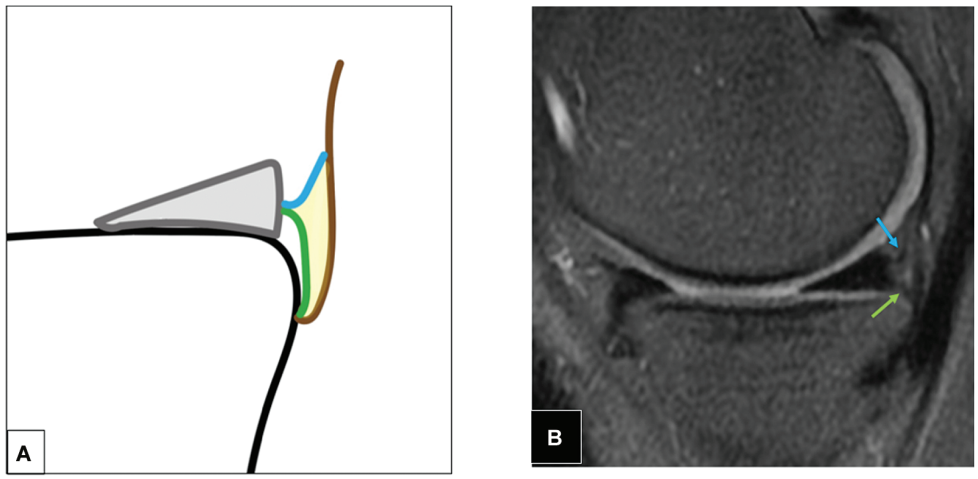

Fig. 1 (**A**) The diagrammatic representation and (**B**) proton density fat-saturated sagittal magnetic resonance image show the normal anatomy of the meniscal ramp. It comprises the posterior horn of the medial meniscus (PHMM), superior meniscocapsular ligament (*blue arrow*) and the inferior medial meniscotibial ligament (*green arrow*), which act as a functional unit to stabilize the knee against anterior or posterior tibial translation and posteromedial rotation. These ligaments snugly reinforce the posterior wall of the meniscus to the posterior capsular attachment.

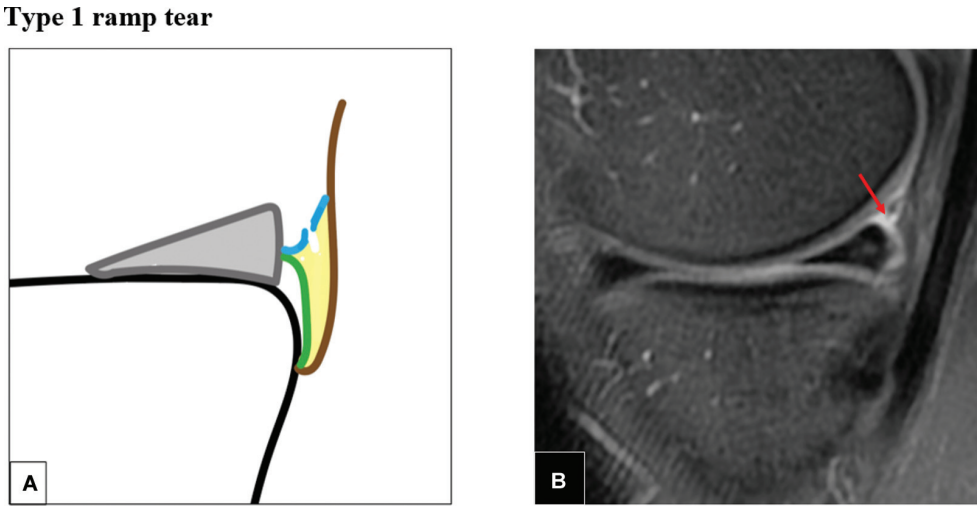

Fig. 2 (**A**) Diagrammatic representation and (**B**) magnetic resonance imaging sagittal proton density fat-saturated image depict a tear of the superior meniscocapsular ligament (*red arrow*), representing a type 1 ramp tear.

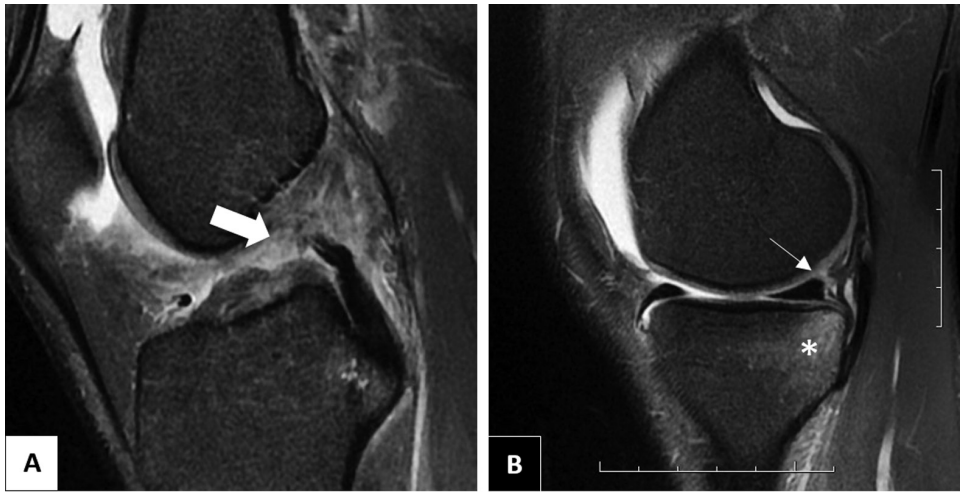

Fig. 3 A 24-year-old male volleyball player presenting with twisting injury and type 1 ramp tear. Sagittal proton density fat-saturated images show (**A**) a full-thickness anterior cruciate ligament tear (*thick arrow*) with (**B**) disruption of the superior meniscocapsular ligament (*thin arrow*) and mild marrow edema in the posteromedial tibial plateau (*).

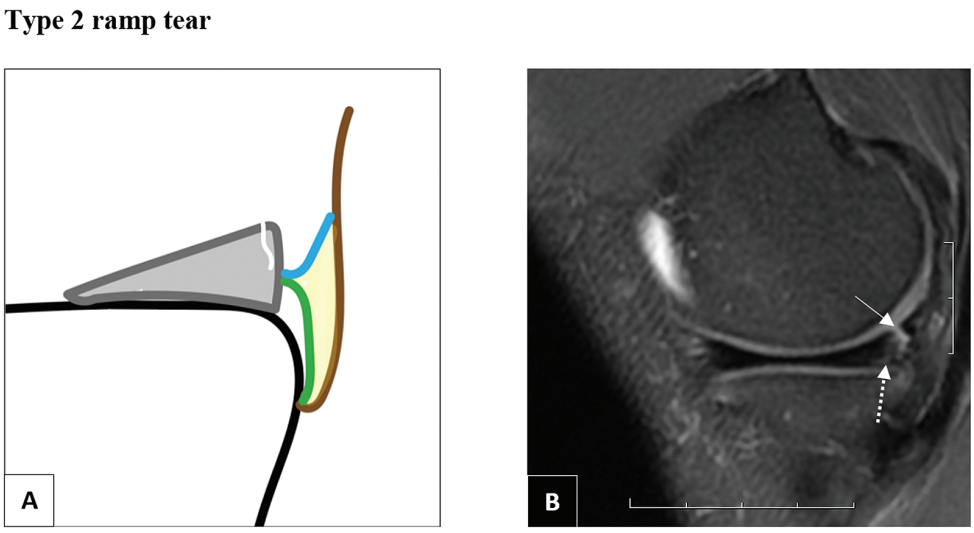

Fig. 4 (A) Diagrammatic representation and (B) magnetic resonance imaging sagittal proton density fat-saturated image demonstrate a partial superior peripheral posterior meniscal horn tear (*thin arrow*), suggestive of a type 2 ramp tear. Subtle nonfluid hyperintensity in the posterior horn represents concomitant meniscal contusion (*dotted arrow*).

Fig. 5 A 31-year-old man presented with a history of injury while playing basketball 8 months ago. (A) Sagittal proton density fat-saturated (PDFS) magnetic resonance image shows a partial posterosuperior posterior horn medial meniscal tear (*thin arrow*)—consistent with a type 2 ramp tear. Subtle posteromedial tibial plateau marrow contusions (*) and high posterior tibial slope (*dotted line arrow*) are seen, which are recognized risk factors for ramp tears. (B) Sagittal PDFS image reveals a chronic full-thickness tear with nonvisualization of the anterior cruciate ligament and associated buckling of the posterior cruciate ligament (*thick arrow*).

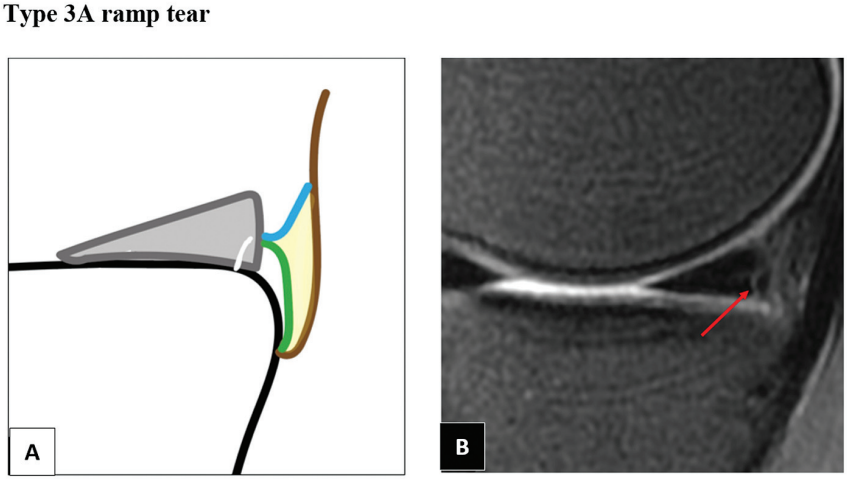

Fig. 6 (A) Diagrammatic representation and (B) sagittal proton density fat-saturated magnetic resonance image depict a partial inferior peripheral posterior horn meniscal tear (*red arrow*) extending up to the tibial articular surface—consistent with a ramp type 3A tear.

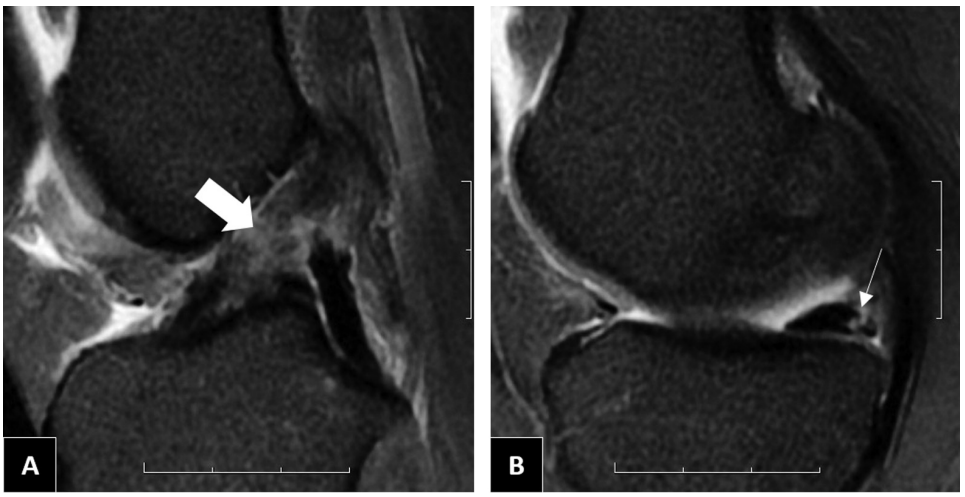

Fig. 7 A 27-year-old female football player presenting with twisting injury. Proton density fat-saturated sagittal magnetic resonance images reveal (**A**) a high-grade partial-thickness anterior cruciate ligament tear in its midsubstance (*thick arrow*) with (**B**) a partial peripheral oblique longitudinal undersurface tear in the posterior horn of the medial meniscus reaching up to the tibial articular surface (*thin arrow*)—suggestive of a type 3A ramp lesion.

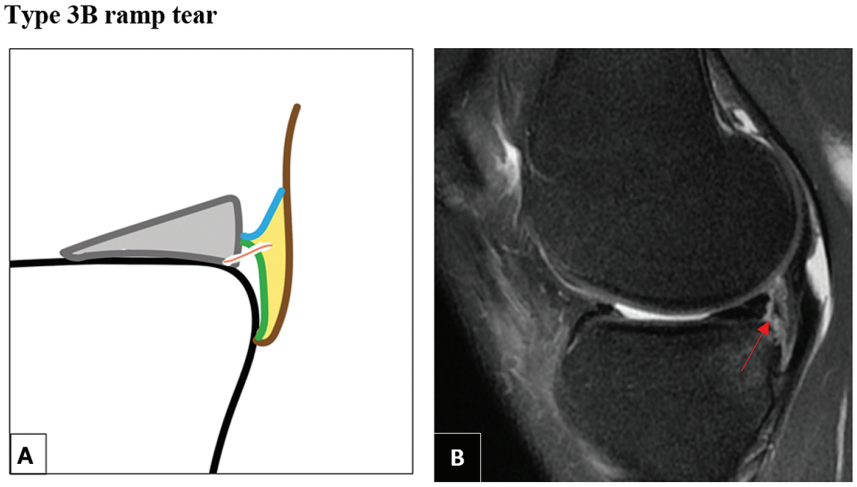

Fig. 8 (**A**) Diagrammatic representation and (**B**) sagittal proton density fat-saturated magnetic resonance image demonstrate tear of the meniscotibial ligament (*red arrow*) at its meniscal attachment with extensive edema at the meniscocapsular gutter—suggestive of a type 3B ramp tear.

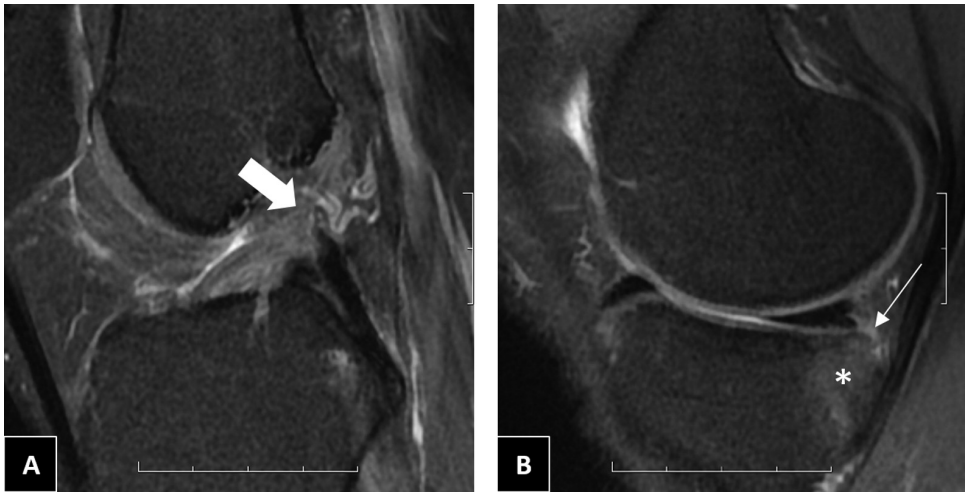

Fig. 9 Sagittal proton density fat-saturated images in a hockey player presenting with twisting injury reveals (**A**) a full-thickness tear of the anterior cruciate ligament in its cranial one-third portion (*thick arrow*) with (**B**) tear of the meniscotibial ligament from its tibial attachment (*thin arrow*) and mild marrow contusion in the posterior medial tibial plateau (*), consistent with a type 3B ramp tear.

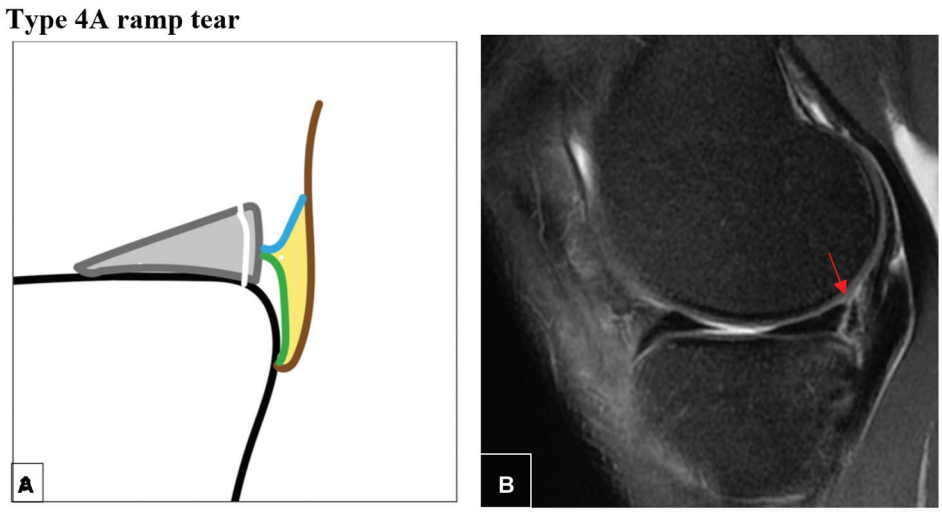

Fig. 10 (A) Diagrammatic representation and (B) sagittal proton density fat-saturated magnetic resonance image demonstrate a complete peripheral longitudinal tear (*red arrow*) in the posterior horn of the medial meniscus—suggestive of a type 4A ramp tear.

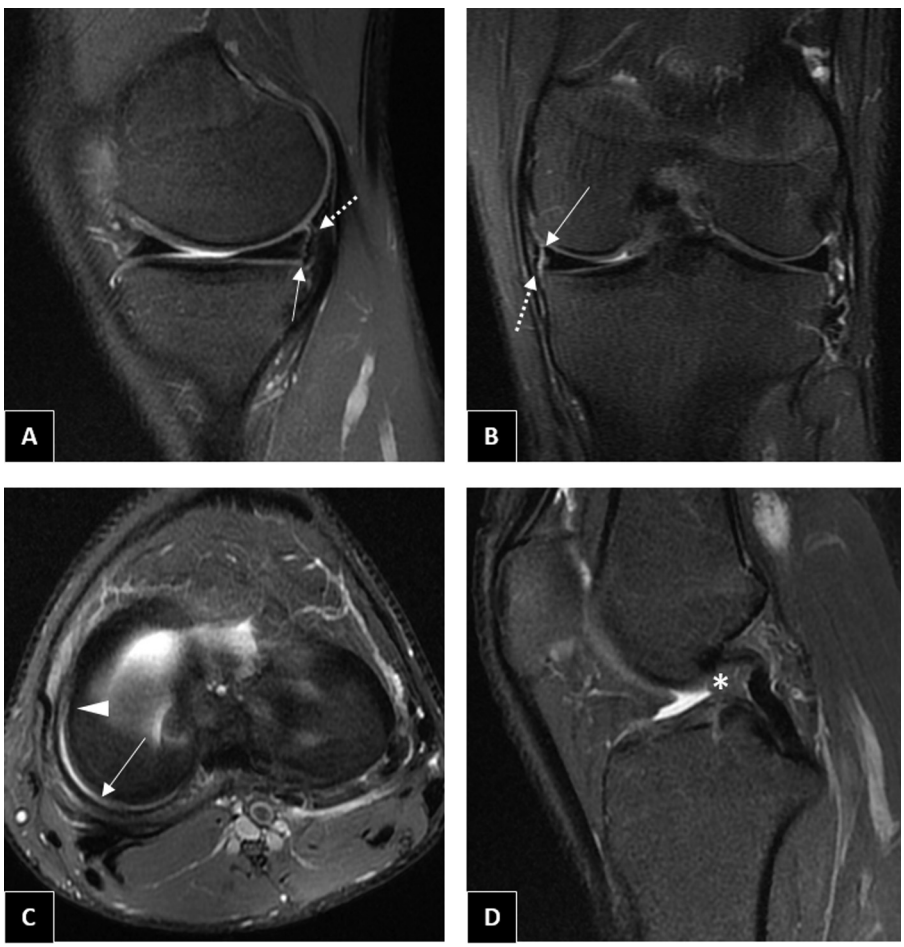

Fig. 11 A 16-year-old boy presenting with a history of twisting injury while playing football. (**A**) Sagittal and (**B**) coronal proton density fat-saturated (PDFS) magnetic resonance images reveal a complete peripheral longitudinal tear in the posterior horn of the medial meniscus near the meniscocapsular junction (*thin arrow*) with a thin sliver of detached meniscal tissue (*dotted arrow*) suggestive of a type 4A ramp tear. (**C**) Axial PDFS image shows the tear (*thin arrow*) extending into the meniscal body (*arrowhead*). (**D**) PDFS sagittal image reveals a chronic full-thickness anterior cruciate ligament tear (*) with associated buckling of the posterior cruciate ligament.

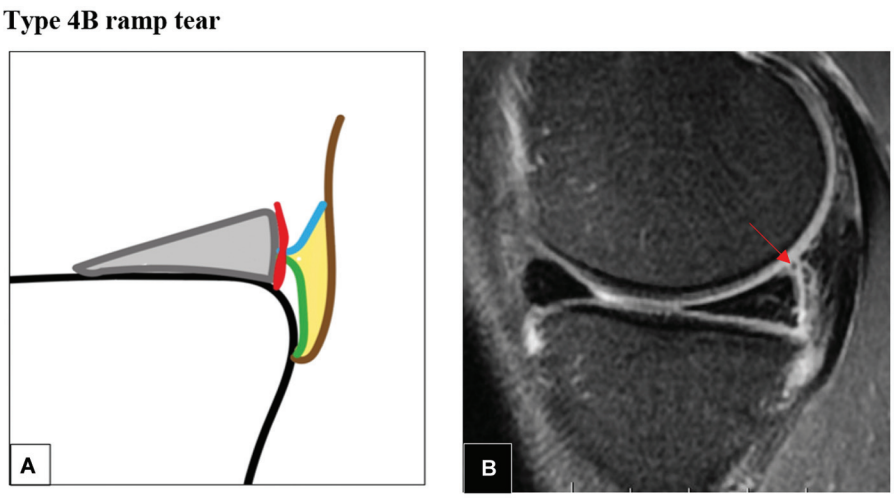

Fig. 12 (**A**) Diagrammatic representation and (**B**) sagittal proton density fat-saturated magnetic resonance image show a linear fluid cleft at the meniscocapsular junction (*red arrow*) suggestive of a complete meniscocapsular junction tear—type 4B ramp lesion.

Fig. 13 A 17-year-old adolescent boy presenting with injury while playing football. (**A**) Proton density fat-saturated (PDFS) sagittal magnetic resonance image reveals a full-thickness tear of the anterior cruciate ligament (ACL; *thick arrow*) with a tongue-like projection of the torn ACL fibers in the anterior interval representing type 2 ACL stump entrapment (*dotted arrow*). (**B**) Sagittal and (**C**) axial PDFS images show a fluid cleft (*thin arrows*) at the posteromedial corner with meniscocapsular disjunction, consistent with a type 4B ramp tear.

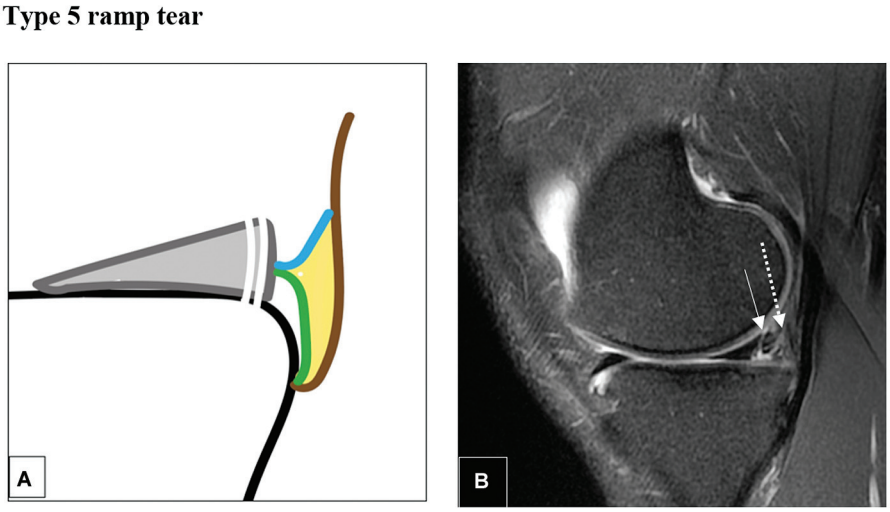

Fig. 14 (**A**) Diagrammatic representation and (**B**) sagittal proton density fat-saturated magnetic resonance image depict peripheral posterior horn double meniscal longitudinal tears, that is, peripheral longitudinal tears within the meniscus (*thin arrow*) and near the meniscocapsular junction (*dotted arrow*)—consistent with a type 5 ramp tear.

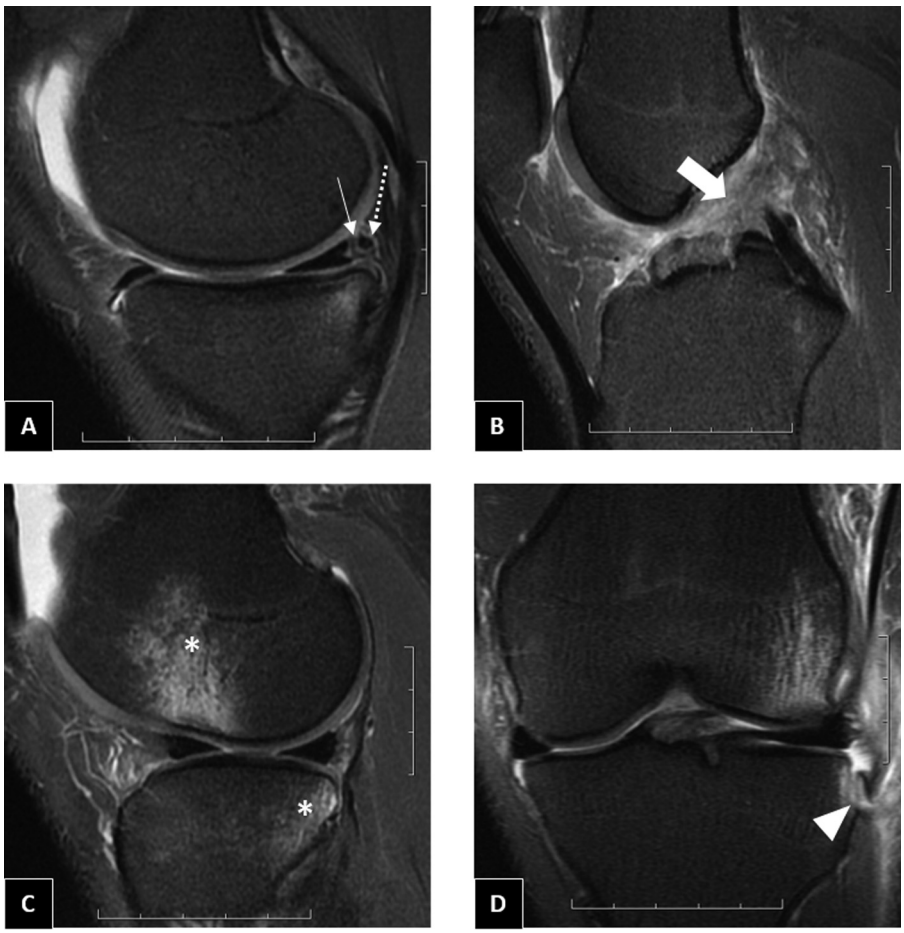

Fig. 15 A 20-year-old male presenting with twisting injury while playing basketball. Sagittal proton density fat-saturated (PDFS) magnetic resonance image (**A**) reveals double vertical peripheral tears through posterior horn of the medial meniscus within the meniscus (*thin arrow*) and near the meniscocapsular junction (*dotted arrow*) indicating a type 5 ramp tear. (**B, C**) Sagittal PDFS images reveal a full-thickness anterior cruciate ligament tear (*thick arrow*) with pivot shift pattern marrow contusions (*) in the lateral femoral condyle and in the posterolateral tibial plateau. (**D**) Coronal PDFS image shows an avulsion fracture (*arrowhead*) in the lateral tibial plateau at the tibial insertion of the anterolateral ligament (Segond's fracture).

These almost always occur with a concomitant anterior cruciate ligament (ACL) tear.[1]

Discussion

The meniscocapsular junction is the area where the peripheral attachment of the meniscus meets the joint capsule. In the context of ramp lesions, this region is susceptible to damage when there is an injury to the ACL. The medial meniscus serves as a firm attachment between the tibia and the femur, functioning as a stabilizer for the knee. It plays a crucial role in preventing anterior translation, particularly in the knees with ACL deficiency, making it particularly prone to injuries. The ACL tear can cause the tibia to excessively translate anteriorly, leading to stress on the posterior aspect of the medial meniscus.

Ramp lesions have significant biomechanical implications, and their occurrence is more prevalent than previously believed. Untreated ramp lesions may contribute to persistent knee symptoms, instability, and impaired function. These lesions are frequently underdiagnosed, leading to a lack of timely surgical intervention in standard knee arthroscopies. This limitation arises from the reliance on anterior portals, restricting a comprehensive evaluation of the posterior horn and attachment of the medial meniscus.

Owing to its tendency to go unnoticed during magnetic resonance imaging (MRI) interpretation and its "blind" spot in arthroscopic vision, achieving an accurate preoperative diagnosis is crucial. The objective of this article is to comprehensively present recent findings in the literature regarding meniscal ramp lesions, encompassing their anatomical, biomechanical, and diagnostic characteristics in an illustrative manner.

Taneja et al[1] included the following criteria to diagnose meniscocapsular ramp tears:

- Fluid signal between the PHMM and the posterior medial capsule.

Fig. 16 A 27-year-old male football player presenting with persistent instability after single bundle anterior cruciate ligament (ACL) reconstruction. (**A, B**) Sagittal proton density fat-saturated (PDFS) images show a full-thickness tear of the ACL graft (*thick arrow*) and an old peripheral longitudinal tear in the posterior horn of the medial meniscus (*thin arrow*) suggestive of a type 4A ramp tear, which was missed during the ACL reconstruction surgery. Also noted in (**B**) the sagittal PDFS image and (**C**) standing lateral scanogram image is the posterior downsloping (*dotted line*) of the medial tibial plateau (slope angle of 120 degrees), which is a recognized predisposing factor for graft failure and ramp injury. (**D**) Sagittal PD image shows a small intercondylar notch osteophyte (*dotted arrow*).

- Vertical tear affecting the peripheral portion of the PHMM.
- Irregular contour of the PHMM, focal discontinuity, or step-like deformity involving the capsular attachment.
- Soft tissue edema at the meniscus and collateral ligament junction.
- Bone bruise/contusion at the posteromedial tibia.
- Anterior translation of the medial tibial plateau (MTP) relative to the femoral condyle with concomitant ACL injury.

Yeo et al[2] and Laurens et al[3] concluded that an irregular contour of the posterior margin of the medial meniscus and vertical fluid cleft filling the meniscocapsular junction are the most sensitive signs on MRI to detect ramp tears.

Kim et al[4] studied the risk factors associated with ramp lesions including bone contusions at the posterior MTP, steeper medial tibial slopes, gradual lateral tibial slope, and varus knee greater than 3 degrees, and concluded their significance. High posterior tibial slope with posterior tibial inclination greater than 12 degrees has been proposed as a risk factor for posteromedial instability leading to ramp tears in the setting of pivot shift injuries in native as well as graft ACL ruptures[5] (►**Fig. 16**).

Recent data and the identification of risk factors provide a more appropriate level of suspicion, aiding in the recognition and planning of effective treatments for ramp lesions. A systematic approach, incorporating MRI and, notably, arthroscopic exploration of the posteromedial compartment of the knee using a specific trans-notch approach, is essential for a thorough assessment of a meniscal ramp lesion.

Conclusion

In conclusion, MRI is an excellent modality to diagnose meniscocapsular tears/ramp lesions with a specificity of 84

Fig. 17 A 22-year-old football player with single bundle anterior cruciate ligament (ACL) graft tear and type 4A ramp tear. (**A–C**) Eight-month follow-up images post single bundle ACL reconstruction. (**A, B**) Sagittal and (**C**) coronal proton density fat-saturated (PDFS) images show a full-thickness tear of the ACL graft (*thick arrow*), complete peripheral longitudinal posterior horn medial meniscal tear (*thin arrow*) suggestive of a type 4A ramp tear and normal width of the ACL tibial tunnel (*arrowhead*) with marrow contusions in the lateral femoral and tibial condyles (*). (**D–F**) Images at 11 months after the second revision ACL reconstruction at the time of football injury. (**D, E**) Sagittal and (**f**) coronal PDFS images show high-grade partial-thickness re-tear of the second ACL graft (*thick arrow*) with a widened tibial tunnel (*arrowhead*) and an unrepaired type 4A ramp tear (*thin arrow*) that has propagated into the posteroinferior corner of the meniscus (*dotted line*). The unrepaired ramp has served as a predisposing factor for knee instability resulting in ACL graft tears twice in this patient, thus reinforcing the importance of detection and repair of ramp tears.

Fig. 18 Pitfall of ramp injury. Sagittal proton density weighted images show a prominent superior posteromedial synovial recess mimicking a fluid cleft of a meniscocapsular ramp lesion. However, the superior meniscocapsular ligament is intact and the synovial recess superior to it is smoothly marginated, thereby representing a deep meniscocapsular recess.

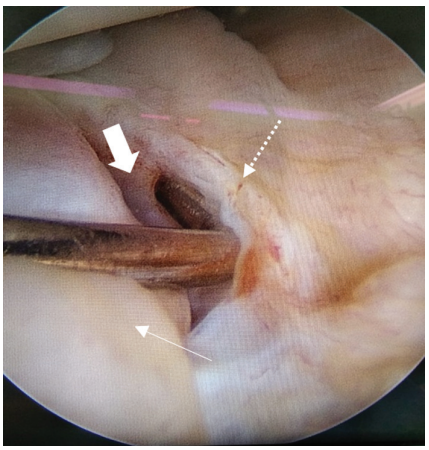

Fig. 19 Arthroscopic image showing a type 4B ramp tear with the probe in the meniscocapsular gutter (*thick arrow*) showing complete separation of the posterior horn of medial meniscus (*thin arrow*) from the posteromedial capsule (*dotted arrow*). (This image is provided courtesy of Dr. Deepak Joshi.)

to 99% and sensitivity of 54 to 92% on 3.0-T magnets.[6] Unstable ramp lesions contribute significantly to anteroposterior and posteromedial instability in an ACL-reconstructed knee and can increase the risk of graft failure.[7] As a rule, ramp lesions should be diligently looked for in all cases of ACL injury to ensure proper surgical planning and reduce the risk of biomechanical instability, enabling better surgical outcomes.

Authors' Contributions

Study conception and design were developed by N.S.B., A.K.S.V., and H.R. Data collection was done by N.S.B. and A.K.S.V. All the authors were involved in the analysis and interpretation of the results. N.S.B. and A.K.S.V. prepared the draft of the manuscript. All the authors reviewed the results and approved the final version of the manuscript.

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Conflict of Interest

None declared.

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References

1 Taneja AK, Miranda FC, Rosemberg LA, Santos DCB. Meniscal ramp lesions: an illustrated review. Insights Imaging 2021;12(01):134
2 Yeo Y, Ahn JM, Kim H, et al. MR evaluation of the meniscal ramp lesion in patients with anterior cruciate ligament tear. Skeletal Radiol 2018;47(12):1683–1689
3 Laurens M, Cavaignac E, Fayolle H, et al. The accuracy of MRI for the diagnosis of ramp lesions. Skeletal Radiol 2022;51(03):525–533
4 Kim SH, Seo HJ, Seo DW, Kim KI, Lee SH. Analysis of risk factors for ramp lesions associated with anterior cruciate ligament injury. Am J Sports Med 2020;48(07):1673–1681
5 Vadhera AS, Knapik DM, Gursoy S, et al. Current concepts in anterior tibial closing wedge osteotomies for anterior cruciate ligament deficient knees. Curr Rev Musculoskelet Med 2021;14(06):485–492
6 Arner JW, Herbst E, Burnham JM, et al. MRI can accurately detect meniscal ramp lesions of the knee. Knee Surg Sports Traumatol Arthrosc 2017;25(12):3955–3960
7 Greif DN, Baraga MG, Rizzo MG, et al. MRI appearance of the different meniscal ramp lesion types, with clinical and arthroscopic correlation. Skeletal Radiol 2020;49(05):677–689

