

# Molar Tooth in the Knee – A Case of Simultaneous Medial and Lateral Bucket Handle Tear with Arthroscopic Correlation and a Review of Literature

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## Learning Point of the Article:

A bucket handle tear is rare, with simultaneous bucket handle tears of both the medial and lateral menisci rarer, an unmissable entity for accurate preoperative diagnosis for timely management.

## Abstract

**Introduction:** Simultaneous bucket handle tear of both lateral and medial menisci is a rarely encountered entity. MR imaging helps in pre-operative diagnosis for optimal operative planning. However, as this condition is not seen in routine practice, awareness of various imaging signs is essential to identify this condition. Few signs on coronal and sagittal images have been described in the literature but none so far on axial images.

**Case Presentation:** We propose a novel “molar tooth sign” in the knee on axial MRI images, in which we identified in the case of a young male with recurrent knee locking after a fall from height.

**Conclusion:** Different modes of injury can lead to different patterns of meniscal and ligament tears. Having an allied sign which is, furthermore, easy to imagine will help, not only the radiologists but also the surgeons, to identify rare types of meniscal tears similar to the index case.

**Keywords:** Bicompartamental bucket handle tear, molar tooth, arthroscopy of knee, meniscal repair.

## Introduction

“Molar tooth” sign has been talked about in the radiological literature for pathologies in the brain and abdomen. Because the eyes do not see what the brain does not know, it is essential not only to be aware of rare entities such as simultaneous bicompartamental bucket handle tears but also be able to diagnose them preoperatively for optimal surgical planning. Signs help the human brain to use the power of imagination for identifying conditions that they might not have yet encountered. We present a rare case and point out an imaginable sign to identify the condition on planning magnetic resonance imaging (MRI) and also validate our finding on arthroscopy.

locking and pain in the left knee following a fall from a height of 7 feet, 4 years back, presented to the orthopedic clinic for management. On examination, there were evident quadriceps wasting of 3 cm with a positive Lachman test, anterior drawer test, pivot shift test, McMurray test, and Apley’s grinding test. There was no laxity in the coronal plane and the dial test was negative. A clinical diagnosis of anterior cruciate ligament (ACL) tear with meniscal tear was made and the patient was advised radiological examinations. Kellgren-Lawrence Grade II osteoarthritis was noted on a plain radiograph of the knee which did not reveal any fracture. His Lysholm knee score was 62/100.

MRI was performed on a 3T scanner using a dedicated knee coil. Proton density fat-saturated images were acquired in all planes in addition to a T1-weighted image and gradient echo image. The MRI was diagnostic of a complete chronic ACL tear, medial, and

## Case Report

A 39-year-old male presented with complaints of recurrent knee

## Author’s Photo Gallery



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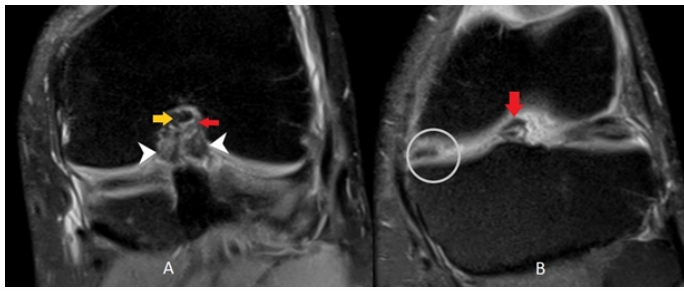
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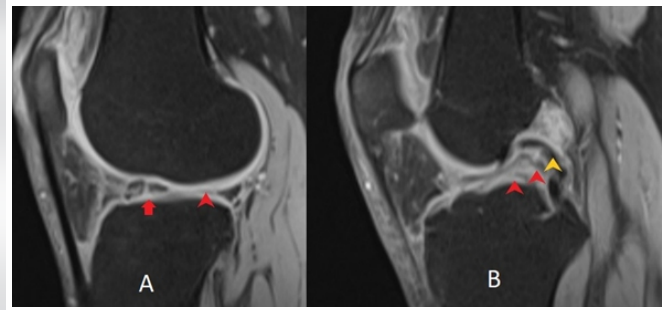
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**Figure 1:** Coronal proton density fat-saturated MRI images show the quadruple cruciate sign in the intercondylar notch (a) formed by the menisci (arrowheads), PCL (yellow arrow), and ACL (green arrow). (b) The truncated meniscus (encircles) with medial meniscus double anterior horn sign (red arrow).



**Figure 2:** Sagittal proton density fat-saturated MRI images show the double anterior horn sign (red arrow) and absent bow tie sign (red arrowhead) in (a) and the triple PCL sign in (b) formed by the PCL (yellow arrowhead) and flipped menisci (red arrowhead).

lateral meniscal tears with bucket handle components giving rise to the “triple posterior cruciate ligament (PCL)” sign, double anterior horn sign, and an osteochondral defect in the medial femoral condyle (Fig. 1, 2). While some signs have been described on coronal and sagittal images in the literature to help identify a bicompartmental meniscal tear, no sign has been described on axial images. We propose a novel “molar tooth sign” on axial images to assist in identification of this rare entity which necessitates pre-operative identification for appropriate procedural planning (Fig. 3).

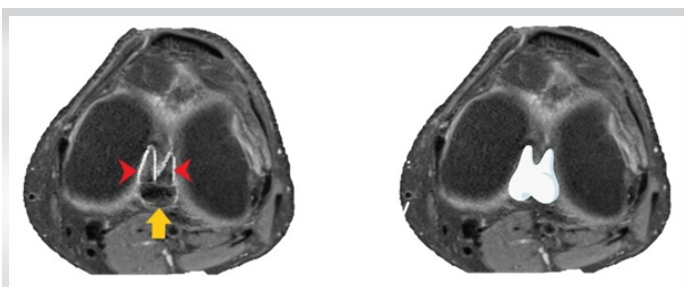
A gait analysis was also performed for the patient using BTS bioengineering 3D gait lab (Italy). His gait examination revealed decreased percentage of stance phase of affected limb, reduced stride length slight, and increase in peak flexion of affected limb.

Based on the clinical and radiological findings, the patient was advised arthroscopic ACL reconstruction with meniscal repair/menisectomy. Intraoperatively, diagnostic arthroscopy confirmed a complete ACL tear with an avulsed femoral attachment, bucket handle component arising from meniscal tears of both medial and lateral menisci, and osteochondral defect in medial femoral condyle and an intact PCL. Arthroscopic single bundle ACL reconstruction was done using a five-strand semitendinosus and gracilis autograft. The bucket handle component of medial meniscus (MM) had a complex morphology due to which subtotal menisectomy was performed. For the lateral meniscus, the bucket handle component was reduced and repaired using two sharp-shooters

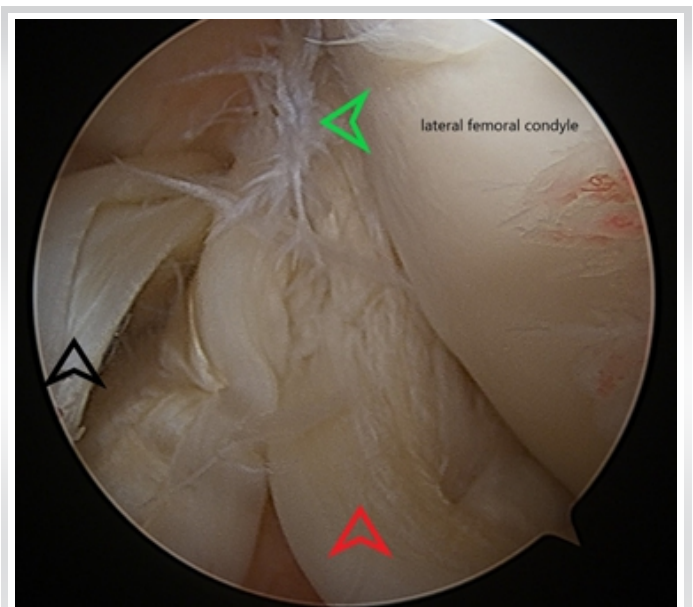
by inside-out method (Fig. 4). Postoperatively, the patient was allowed a range of motion exercises with non-weight bearing protocol for 6 weeks. At 2 months follow-up, the patient had a painless, full range of motion.

### Discussion

Simultaneous occurrence of bucket handle tears of both menisci of the same knee is a rare occurrence with interesting and seldom viewed signs on MRI imaging. Few case reports of the same have been published in the literature (Table 1) which shows that a sudden complex twisting injury of the knee results in this condition [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]. In our case, the patient fell from a height, probably twisting his knee with the torque tearing both menisci of his left knee. Most common associated injury is a tear of the ACL, same as our case. Koukoulias et al. [7] reported a case with an accompanying medial cruciate ligament tear, while Lykissas et al. [8] discussed a case with an associated chondral lesion of the medial femoral condyle with the latter resembling the finding in the index case.



**Figure 3:** Proposed novel MRI sign – the molar tooth sign can be seen on this axial image with the roots of the tooth formed by the flipped menisci (red arrowhead) in the intercondylar notch and the crown formed by the intact PCL (yellow arrow).



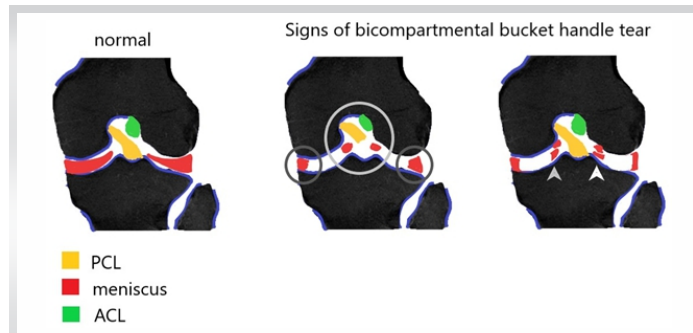
**Figure 4:** Arthroscopic image shows flipped meniscal components – lateral meniscus (red arrowhead), medial meniscus with complex tear anatomy (black arrowhead), and torn remnant ACL fibers (green arrowhead).

Table 1: A brief literature review of all cases of bicompartamental bucket handle tear.

Author name	Year	Age of patient	Time since injury	Mode of injury	Associated ACL tear	Other injuries	Management	Outcome
Sales et al. [1]	2021	16 years, male	-	Twisting injury	Yes		LM-Partial meniscectomy MM – Meniscus repair – ACL-BPTB for reconstruction at same sitting	Pain free full ROM at 10 months follow-up, full return to sports at 1 year.
Idrissi et al. [2]	2021	27 years, male	5 weeks	During volleyball sports	Yes		Subtotal meniscectomy of both meniscus. ACL reconstruction hamstring graft	NA
Guillaume et al. [3]	2021	37 years, female	-	Knee torsion	Yes	-	-	NA
Zabrzynski et al. [4]	2019	22 years, male	2 years	Stepping off stair	Yes		LM- partial meniscectomy MM – repair ACL reconstruction – after 6 weeks of meniscus surgery	NA
Yang and Yang [5]	2015	30 years, male	-	During landing while jumping	Partial tear		Partial meniscectomy of both meniscus	Full ROM with stable knee at 1 year follow-up
Shepherd et al. [6]	2013	18 years, male	2 years	Twisting injury while playing football	Yes		MM – subtotal meniscectomy	NA
Koukoulis et al. [7]	2011	38 years, male	Within 6 h of injury	Fall from height	Yes	MCL injury	MM – partial meniscectomy LM – repair by all inside technique ACL reconstruction – by hamstring graft in same sitting	Return to pre injury level at 8 months follow-up.
Lykissas et al. [8]	2010	28 years, female	Within 24 h of injury	While dancing	No	Chondral lesion on medial femoral condyle	Partial meniscectomy of both meniscus	Pain free ROM at 6 months follow-up.
Wright et al. [9]	2010	38 years, male	-	Twisting injury while dancing	No		Partial meniscectomy of both meniscus	Uneventful recovery at 6 weeks follow-up
Tecklenburg et al. [10]	2007	19 years, female	8 h	While landing during skiing	Yes		Both meniscus were repaired by inside out and by all inside technique ACL – hamstring graft at same sitting	Arthrofibrosis at 3 months follow-up, full ROM after arthroscopic arthrofibrosis at 3 month from injury.
Cetik et al. [11]	2006	30 years, male	8 years	Twisting injury while playing football	Yes		Partial meniscectomy for both meniscus. ACL reconstruction – BPTB graft at same sitting	NA
Bugnone et al. [12]	2005	22 years, female		Motor vehicle accident	Yes		Meniscectomy of both menisci ACL reconstruction in same sitting	NA

MM: Medial meniscus, LM: Lateral meniscus, ACL: Anterior cruciate ligament, PCL: Posterior cruciate ligament, ROM: Range of motion



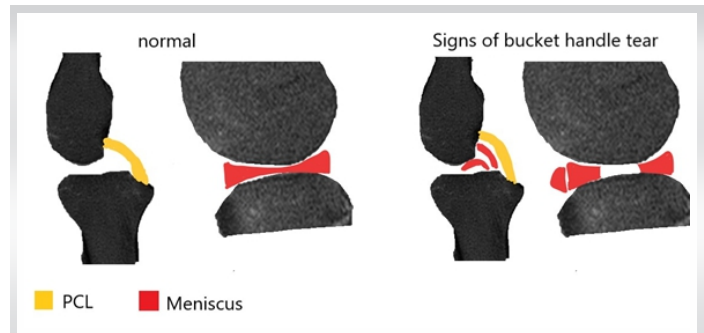


**Figure 5:** Diagrammatic representation of signs of bicompartamental bucket handle tears as seen on coronal MRI image – quadruple cruciate sign (encircled in grey), truncated meniscus sign (encircled in black), and double anterior horn sign (white arrowhead).

The youngest patient reported was a 16-year-old male reported by Sales et al. [1] and the oldest were aged 38 years Koukoulis et al. [7] and Wright et al. [9]. Our patient is 1 year older.

Radiological diagnosis in each case was performed by an MR examination which displayed novel and interesting signs – triple PCL sign, quadruple cruciate sign, double anterior horn sign, truncated meniscus sign, and absent bow-tie sign [1, 12]. With this case, we propose a new radiological sign on axial MRI images – the molar tooth sign which has not been previously described in the literature (Fig. 3, 5, 6). In addition, a medial femoral condyle osteochondral avulsion was also present. We also performed a gait analysis for our patient which has not been done previously in the literature. Gait analysis helps in understanding deranged knee kinematics and in post-procedural rehabilitation.

The surgical intervention was performed 4 years following injury in the index case. In the literature, operative intervention has been done as early as within 8 h of injury [10] up to 8 years after injury [11]. Partial or subtotal meniscectomy was performed in majority of the cases, while meniscal repair was reserved for those cases which on arthroscopy exhibited salvageable, reducible, and non-complex tear anatomy. In our case, the MM was excised, while the lateral was reduced and repaired. Simultaneous ACL reconstruction was done for the patient. Some authors such as Shepherd et al. [6] and Zabrzynski et al. [4] performed a two-step procedure addressing the meniscus pathology before reconstructing the



**Figure 6:** Diagrammatic representation of signs of bicompartamental bucket handle tears as seen on sagittal MRI image – triple PCL sign and double anterior horn sign.

concurrent torn ACL.

## Conclusion

Bi-compartmental bucket handle tear of the meniscus is a rare entity precipitated by a sudden torque to the knee joint. Very few cases have been described in the literature. This article provides a brief summary of all similar cases described in the literature with their imaging diagnosis and operative management. Some signs have been described in the literature to aid diagnosis on MRI. We propose a novel “molar tooth sign” on axial MRI imaging which has not been described before to add to diagnostic confidence.

## Clinical Message

Rare conditions tend not to have a defined course of management. They are usually dictated by the treating physician's preference and it is essential to be aware of possible rare occurrences before entering the surgical field. We suggest to look for a “molar tooth” in axial MRI images of complex meniscal tears with evidence of loss of meniscal volume to ensure to not miss bicompartamental bucket handle tears. The literature review lays out the various surgical approaches used in the past and provides a path for possible future choices. Because this condition is rare, the various signs described in the literature and the novel sign suggested by the authors will continue to be scrutinized and validated over time.

**Declaration of patient consent :** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient's parents have given their consent for patient images and other clinical information to be reported in the journal. The patient's parents understand that his names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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