

MRI imaging of displaced meniscal tears: Report of a case highlighting new potential pitfalls of the MRI signs

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Abstract

Magnetic resonance imaging (MRI) has been found to be an excellent imaging tool for meniscal injuries. Various MRI signs have been described to detect displaced meniscal injuries, specifically the bucket-handle tears. Although these signs are quite helpful in diagnosing meniscal tears, various pitfalls have also been reported for these signs. Double anterior cruciate ligament (ACL) sign refers to presence of a linear hypointense soft tissue anterior to the ACL, which represented the flipped bucket-handle tear of the meniscus. Disproportional posterior horn and flipped meniscus signs represent asymmetrically thickened horns of the menisci due to overlying displaced meniscal fragments. We report a case wherein MRI of the knee showed tear and displacement of the medial patellofemoral ligament (MPFL) and vastus medialis complex, medial collateral ligament (MCL), and posterior cruciate ligament (PCL) mimicking these signs. To our knowledge, internally displaced MPFL and MCLs have not been described as mimics for displaced meniscal fragments.

Key words: Bucket-handle tear; disproportional posterior horn; double anterior cruciate ligament sign; flipped meniscus sign; knee; magnetic resonance imaging

Introduction

Trauma to the knee often results in tears in the menisci with portion of the torn meniscus being displaced away from the meniscus. Such displaced meniscal tears are important to be recognized by the radiologist since most of these tears would require surgical intervention in the form of reattachment or removal. Multiple magnetic resonance imaging (MRI) signs have been described by various authors, which suggest the presence of displaced meniscal tears, in general, and bucket-handle tear, in particular. Although these signs are quite helpful, one should be aware of various mimics of these signs.

Case Report

A 35 year old male was referred to our department for a MRI of the right knee with history of road traffic accident. MRI was performed on 1.5 T system (Siemens 1.5T Essenza, Erlangen, Germany) and sequences were acquired in sagittal [T1weighted (T1W), T2 weighted (T2W), proton density (PD)-fat saturated], coronal [T1W, short tau inversion recovery (STIR)], and axial (T2W) planes.

MRI showed evidence of multiple bony and soft tissue injuries with mild synovial effusion. There was superior and anterior subluxation of the medial femoral condyle with increased medial tibiofemoral joint space. Subtle bony contusions were seen in the femoral and tibial condyles. There were complete tears of the proximal attachments of the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) with redundant distal ligaments.

Interesting observations were made on sagittal T1W and T2W sequences through the intercondylar fossa, which showed linear band-like soft tissue anterior to the ACL,

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giving a “double ACL sign” [Figures 1 and 2]. Additionally, wedge-shaped soft tissues were seen on sagittal T2W sequences overlying the posterior horns of medial meniscus, resembling “disproportional posterior horn sign” or a “flipped (posterior) meniscus sign” [Figures 3 and 4]. These findings raised the suspicion of displaced meniscal tears.

On careful evaluation, these “signs” were found to be misleading. The “double ACL sign” was due to torn medial patellofemoral ligament (MPFL) and vastus medialis complex being displaced into the joint space [Figures 5A-C].

On coronal STIR sequences, it was observed that the medial collateral ligament (MCL) was completely detached from its femoral attachment and displaced into the medial joint space. It was seen lying over the body of medial meniscus [Figures 6A-C]. Also, the proximal end of the torn PCL was seen lying over the posterior horn of medial meniscus (demonstrated through consecutive images in Figures 7A-C). These structures led to the appearance of “thick” posterior horn of medial meniscus.



Figure 1: T2W sagittal image through the intercondylar fossa showing a thick “band-like” soft tissue (arrow) anterosuperior to the ACL, mimicking the double ACL sign

Subsequently, the menisci were also found to be normal in bulk with no evidence of truncation noted, further confirming these “pseudosigns”.

Discussion

MRI has been found to be extremely useful in diagnosing displaced meniscal tears, particularly, the bucket-handle tears. MRI is often requested to detect displaced meniscal tears because they often require surgery.

Bucket-handle tears are usually longitudinal tears of the menisci with an attached fragment displaced away from the meniscus. Various signs have been described on MRI to diagnose such tears.

Double PCL sign represents a displaced meniscal fragment lying anterior and parallel to the PCL.^[1,2] Flipped meniscus sign is an anteriorly displaced meniscal fragment lying superior to the native anterior horn.^[3,4] Visualization of only one or no meniscal body segment in consecutive peripheral sagittal MR images constitutes the absent bow tie



Figure 2: T1W sagittal image at the same level as Figure 1 showing the thick band-like soft tissue (arrow) isointense to the anterior cruciate ligament

sign.^[5] In double anterior horn sign, the displaced meniscal fragment and intact anterior horn are located next to one another in the same horizontal plane.^[6] Recently described

disproportional posterior horn sign denotes the presence of a larger meniscal posterior horn in the central sections than that in the peripheral sections on sagittal MR images.^[7]

In an extensive study involving 654 menisci in 327 patients, Aydingoz *et al.*^[8] evaluated various MRI signs of meniscal bucket-handle tears and correlated the MRI findings and



Figure 3: T2W sagittal image through the medial aspect of the knee joint showing a wedge-shaped soft tissue (arrow) superior to the body and posterior horn of medial meniscus, resembling the “posteriorly flipped meniscus sign”



Figure 4: T2W sagittal image through the intercondylar fossa of the knee joint showing a small triangular soft tissue (arrow) seen superior to the posterior horn of medial meniscus, resembling the disproportional posterior horn sign

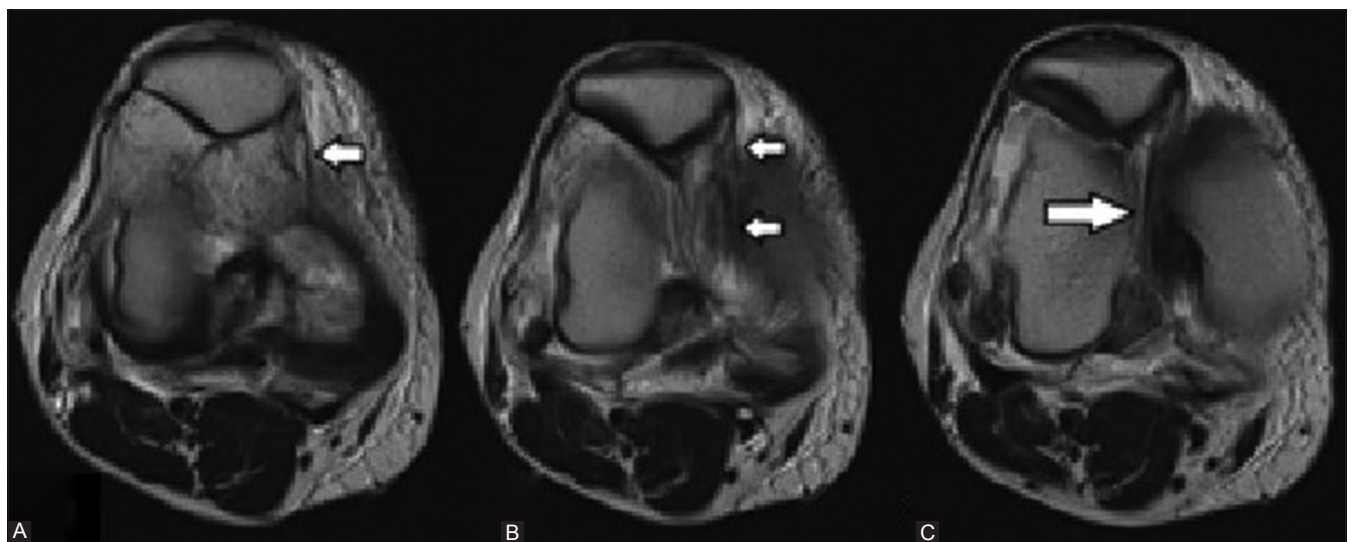


Figure 5 (A–C): Consecutive T2W axial images at the level of patellofemoral joint showing torn medial patellofemoral ligament which is displaced internally (arrow), causing a fallacious double ACL sign

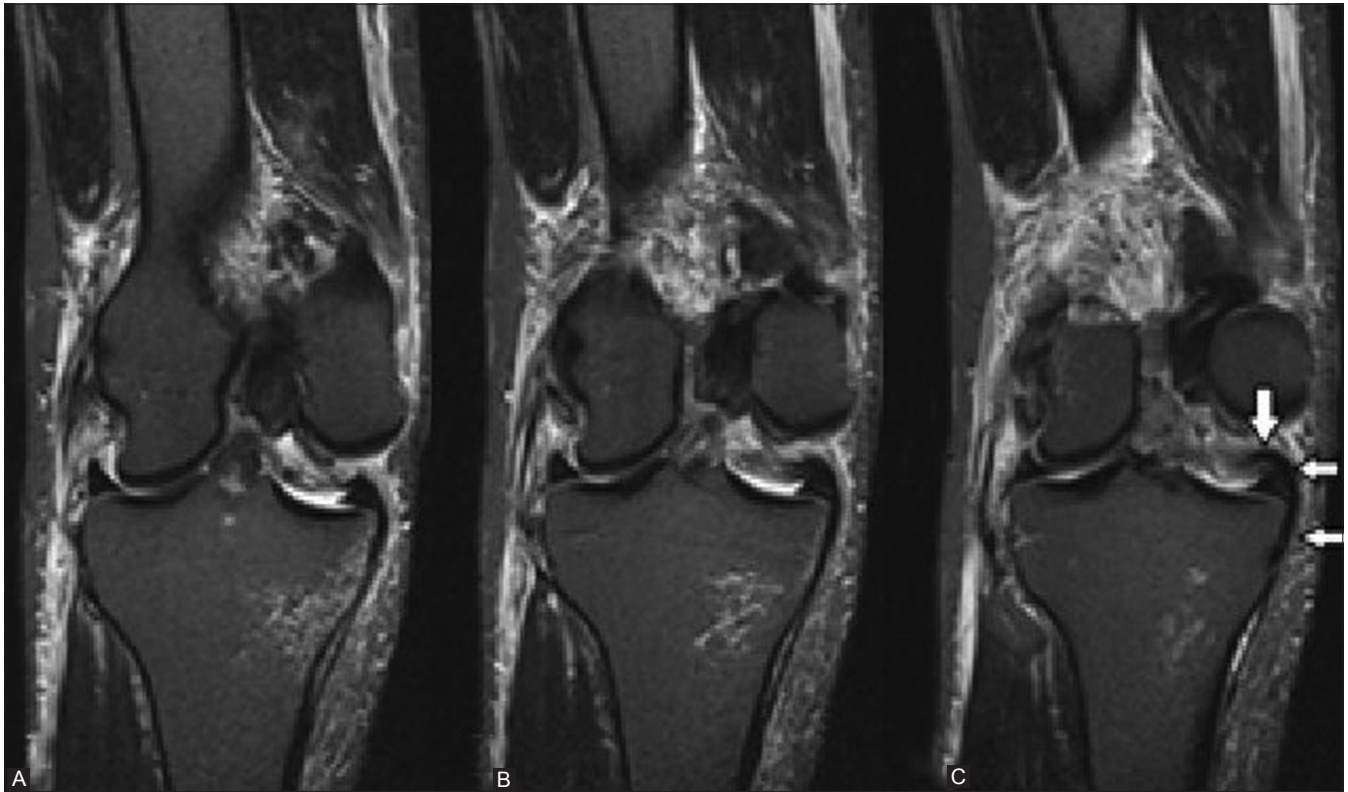


Figure 6 (A–C): Consecutive STIR coronal images showing complete tear of the femoral attachment of medial collateral ligament. The torn ligament is seen internally displaced and lying superior to the medial meniscus (arrows)

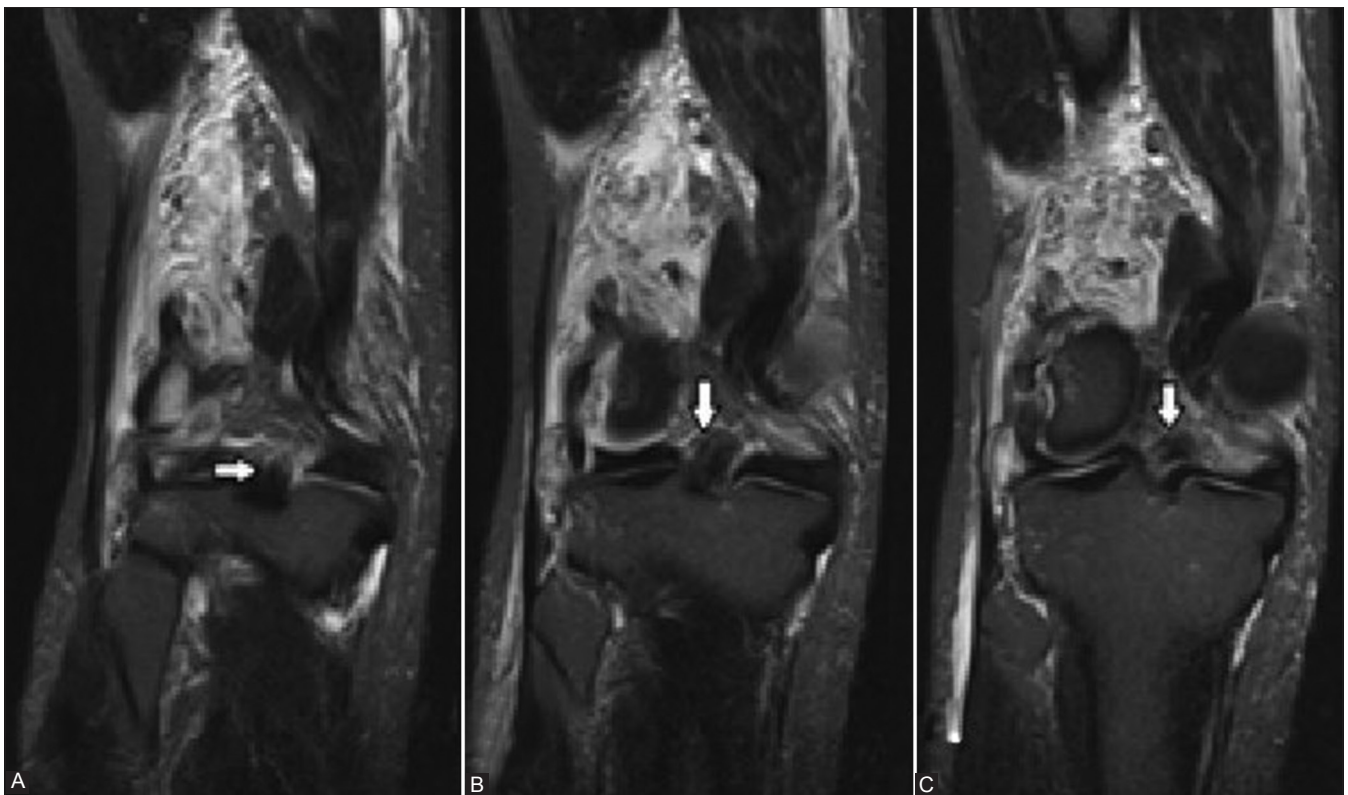


Figure 7 (A–C): Consecutive STIR coronal images in the posterior aspect of the knee joint showing torn redundant PCL (arrow) lying over the posterior horn of medial meniscus

arthroscopic classification of displaced meniscal tears. According to them, the most frequent and sensitive MRI signs of meniscal bucket-handle tears in arthroscopically proven cases of such tears were the fragment in the notch and absent bow tie signs (98% frequency for each). Double PCL, flipped meniscus, double anterior horn, and disproportional posterior horn signs were less common (32, 29, 29, and 27%, respectively) and less sensitive. They also found that when at least three of the six MRI signs of meniscal bucket-handle tears were present, an arthroscopically proven bucket-handle tear was found in all such patients. Sensitivity (as well as positive predictive value) of MRI was 90% in their study. They did not, however, provide the specificity figure of each MRI sign of meniscal bucket-handle tears.^[8]

Absent bow tie sign had a high association with displaced meniscal tears^[8] and was not seen in our case, further supporting the usefulness of this sign. However, absent bow tie sign has been found to be false positive in many cases such as patients with previous surgery (meniscectomy), small menisci (children and small adults), or in osteoarthritis with free edge maceration or wearing.^[5]

Takayama *et al.*^[9] recently described a new MR sign for bucket-handle tears, the double ACL sign, in which the sagittal MR showed the displaced meniscal fragment in front of the ACL. They proposed that this occurs when a longitudinal tear in the anterior horn of medial meniscus extended extensively to the posterior horn. They, however, did not provide any possible mimic or pitfall of this sign. Our case shows that an internally displaced MPFL and/or vastus medialis can mimic this sign.

Guerrero *et al.*^[10] studied the MRI features of MPFL injury in 324 patients with lateral patellar dislocation. They found MPFL tears in 195 cases. The associated findings of MPFL tears were loose bodies, patellar avulsion/fracture, meniscal tears, MCL tears, and osteochondral lesions. However, torn MPFL was not found displaced in the intercondylar fossa in any of the cases.

Various authors have reported the frequency of disproportional posterior horn sign to be 21–27%.^[7,8] This finding has been observed to be false positive in patients with degenerate medial meniscus and lacerations in the posterior horn on arthroscopy.^[8] We observed that appearance of abnormal thickening of the menisci can also result from a torn PCL or MCL lying over the meniscus.

Lecas *et al.*,^[11] in a review of 3686 MRI examinations of the knee, reported 11 cases of torn meniscal fragments displaced inferiorly between the MCL and tibia. They also mentioned that semimembranosus tendon can be

mistaken for such displaced meniscal fragments. We would like to further add that MCL tears should be ruled out when one encounters meniscal fragments in this location.

Double PCL sign is widely used as a reliable sign for medial meniscus bucket-handle tears. However, several mimics of this sign have been reported.^[12] These include several normal and abnormal structures in the intercondylar fossa, such as meniscomeniscal ligaments, accessory meniscomeniscal ligaments (ligament of Humphrey and Wrisberg), loose bodies, osteophytes, and fracture fragments,^[1] fat globules around the PCL, and sometimes a double-barrelled PCL.

This case re-emphasizes that whenever there is evidence of one or more MRI signs of displaced meniscal tears, one should carefully assess the menisci in both sagittal and coronal images, specifically looking for a discrete tear or a truncated/absent meniscus.

In conclusion, there are several normal and abnormal structures in and around the joint mimicking the signs traditionally associated with a bucket-handle medial meniscal tear. It is important for a radiologist to be familiar with the structures that can mimic these signs. Following these structures on the sequential images is of paramount importance in order to avoid erroneous diagnosis of meniscal tears.

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