

## Meniscus tear developed by pulling of the anomalous insertion of medial meniscus on anterior cruciate ligament

Joon Ho Wang · Andrew K. Wong ·  
James R. Romanowski II · Freddie H. Fu

Received: 20 September 2010 / Accepted: 21 February 2011 / Published online: 6 April 2011  
© The Author(s) 2011. This article is published with open access at Springerlink.com

**Abstract** There is no report regarding a medial meniscus tear arising from an anomalous insertion of medial meniscus on the ACL, which seemed to be developed by the same mechanism as ACL tear. A case of a combined medial meniscus tear with ACL tear in the presence of an anomalous insertion of the medial meniscus on the ACL is reported.

**Keywords** Anomalous insertion of medial meniscus · Anterior cruciate ligament · Meniscus tear · Knee · Arthroscopy

### Introduction

It is not difficult to find developmental abnormalities of the lateral meniscus, such as a discoid meniscus, during arthroscopic surgery [1, 2, 7–9]. It is rare, however, to find an abnormality of the medial meniscus [6, 10, 13]. For that reason, arthroscopic surgeons normally do not pay close attention to such abnormalities. One of the rare variants of the medial meniscus is the anomalous insertion of medial meniscus (AIMM) onto the anterior cruciate ligament (ACL) [3, 6, 13]. Cases of AIMM evaluated by arthroscopic

examination or by MRI have been reported, but there is no English literature to our knowledge regarding a medial meniscal tear arising from an AIMM on the ACL. A case of a combined medial meniscus tear with ACL tear in the presence of an anomalous insertion of the medial meniscus on the ACL is reported.

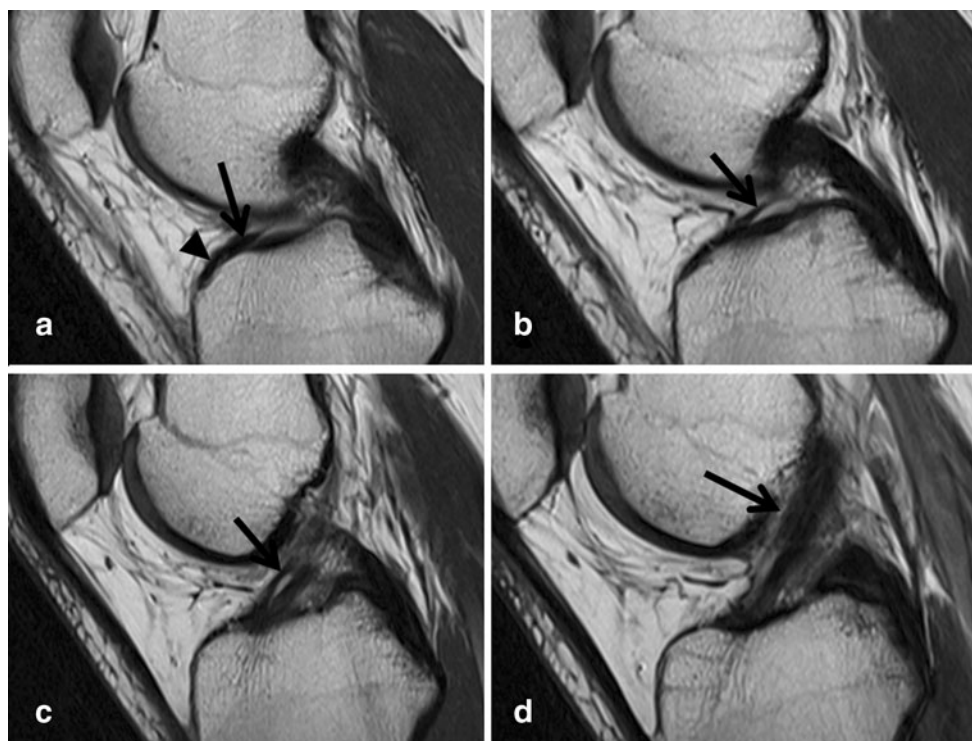
### Case report

A 20-year-old female college-level soccer player presented to the senior author's clinic due to symptoms of left knee instability. Her height was 177.8 cm, and her weight was 70.3 kg. Her past surgical history was remarkable for contralateral (*right*) knee ACL double-bundle reconstruction performed approximately 2 years prior to this visit. Two months ago, the patient suffered a non-contact cutting injury to her left knee (valgus and internal rotation of the tibia) during a game. She heard a pop in the left knee, immediately felt pain, and was unable to continue playing. She had a positive Lachman test and positive pivot shift test. Interestingly, 1 month before her injury, she had been involved in a clinical research program comparing the MRI studies of reconstructed and normal anterior cruciate ligaments. Thus, we were able to obtain a pre-injury 3T MRI of the left knee joint. On the MRI image, we found an abnormal band originating from the medial meniscus, coursing in the front of the ACL (Fig. 1). Post-injury MRI revealed increased signal and complete loss of continuity of the ACL fibers. The corresponding sagittal MRI slice showed a slackened low-signal band which we suspected as an AIMM.

During the arthroscopic examination, a white-colored, round band could be seen running from the medial meniscus to the torn ACL remnant (Fig. 2a). The distal end

J. H. Wang · A. K. Wong · J. R. Romanowski II · F. H. Fu (✉)  
Department of Orthopaedic Surgery, University of Pittsburgh  
School of Medicine, 3471 Fifth Avenue, #1011,  
Pittsburgh, PA 15213-3221, USA  
e-mail: ffu@upmc.edu

J. H. Wang  
Department of Orthopaedic Surgery, Sungkyunkwan University  
School of Medicine, Samsung Medical Center,  
Seoul, South Korea



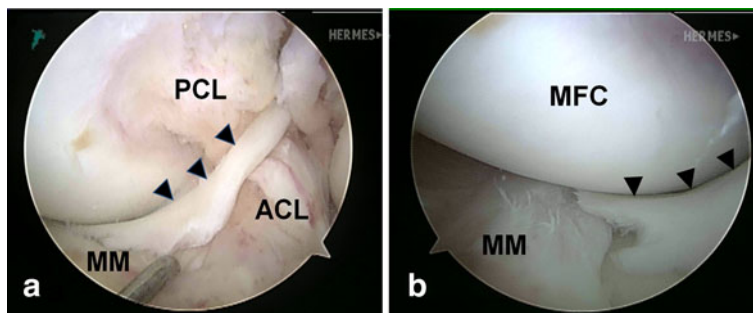
**Fig. 1** Four consecutive cuttings of proton density image of 3T MRI show abnormal band (*arrow*) originated from the medial meniscus (*arrowhead*) **a**, directed to the femoral insertion site of the

ACL **d**. Abnormal band was completely separated from the lower half of the ACL fiber **b**, **c**

of this structure fanned out in the shape of a “hockey stick blade.” The proximal end of the abnormal band was directed toward the femoral ACL insertion site and attached on the bony surface adjacent to the remnant ACL tissue on the ACL insertion site. Next, careful examination was performed to determine the tear pattern of the meniscus. The medial meniscus that was attached to the abnormal band was torn along the inner meniscus from the

anterior insertion site on the tibial plateau to the antero-medial corner of the medial meniscus (Fig. 2b). The torn inner meniscus was still attached to the outer meniscus, similar to a posterior-based flap tear.

After inspection, the abnormal band and torn meniscus were excised using a basket forcep. Abrasion was performed by a motorized shaver. Finally, the planned double-bundle ACL reconstruction was performed [12].



**Fig. 2** **a** The white-colored, tubular-shaped band (*arrowhead*) originated from the anterior horn of medial meniscus (MM) with a broad base shaped like a hockey stick blade. A tear surface was observed between the outer and inner portions of the medial meniscus where the abnormal band inserted into the meniscus. The band was separated from the remnant fibers of torn anterior cruciate ligament (ACL) and

coursed toward the femoral insertion site of the ACL. *PCL* Posterior cruciate ligament. **b** Inner portion of the medial meniscus (*arrowhead*), attached to the band of the AIMM, was retracted to the inner side to show the torn surface. The meniscus was torn from the anterior horn to the anteromedial corner. *MM* Outer portion of the anterior horn of medial meniscus, *MFC* Medial femoral condyle

## Discussion

The most important finding of this study was the unique pattern of meniscus tear developed by pulling of the anomalous insertion of medial meniscus on anterior cruciate ligament, which was rare abnormality of medial meniscus. Rainio et al. reported 11 cases of AIMM among 987 consecutive arthroscopies. The reported incidence of AIMM was 1.2% [13]. Cha et al. reviewed the arthroscopic examination data from 1,326 patients with knee injuries and/or pain. They reported the incidence of AIMM onto the ACL to be 2.3% (30/1,326 cases) [3]. Medial meniscus abnormalities are an uncommon finding during the arthroscopic examination [13]. During human fetal development at 10–11-week gestation, the internal femoromeniscal and meniscotibial joints are organized. At that time, the anterior horn of the medial meniscus is attached to the anterior aspect of the upper surface of the tibia [11]. Some authors postulated that the infrapatellar plica might be related to the AIMM onto ACL due to the chronological similarity [3]. We can also postulate that AIMM onto ACL is mirror structure of the Wrisberg ligament of lateral meniscus. The incidence of the Wrisberg ligament was reported from 33 [15] to 93% [4].

The combined variable injuries of ACL tear and medial meniscus posterior horn tear in the presence of an AIMM onto the ACL have been reported [13]. Galeazzi [5] reported a case of simultaneous detachment of the anterior cruciate ligament (ACL) and the anterior horn of the medial meniscus (AHMM). It is believed that the injury mechanism of ACL and meniscus could be similar [14]. However, no literature about meniscal injury due to the AIMM onto the ACL has been reported, and the clinical significance of the AIMM onto the ACL has not yet been suggested. In this case, the central portion of the abnormal band of AIMM to the ACL was intact, but the medial meniscus (which was connected to the abnormal band) was torn from the anterior horn to the anteromedial corner. Generally, meniscus is torn by the shearing forces developed between the tibial plateau and the femoral condyle. In this case, we found a different pattern of meniscal tear developed by the force via the abnormal band of the AIMM. Thus, the tear mechanism of the medial meniscus in this case was presumed to be same as the ACL tear.

AIMM onto the ACL could be misinterpreted as a torn ACL, infrapatellar plica, or a medial meniscus tear [3]. In this case, the combined torn meniscus flap and fibrous band of the AIMM and ACL were confused with the common bucket handle tear of the meniscus. However, the flap of a medial meniscus bucket handle tear should be located between the medial femoral condyle and PCL. In this case,

the abnormal band of AIMM was located between PCL and ACL. The posterior limb of the flap was not directed to the posterior horn of the medial meniscus like a bucket handle tear, but instead to the femoral insertion of the ACL.

## Conclusion

An AIMM onto the ACL is a very rare variant of the knee joint. The anterior horn of the medial meniscus may be torn by the abnormal band of the AIMM onto the ACL and may be combined with an ACL tear. This injury pattern must be differentiated with the common bucket handle tear of the meniscus. In order to provide more accurate diagnosis and treatment, we should be aware of the anatomic variants of the medial meniscus such as the AIMM onto the ACL.

**Open Access** This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

## References

- Ahn JH, Lee SH, Yoo JC, Lee YS, Ha HC (2008) Arthroscopic partial meniscectomy with repair of the peripheral tear for symptomatic discoid lateral meniscus in children: results of minimum 2 years of follow-up. *Arthroscopy* 24(8):888–898
- Ahn JH, Shim JS, Hwang CH, Oh WH (2001) Discoid lateral meniscus in children: clinical manifestations and morphology. *J Pediatr Orthop* 21(6):812–816
- Cha JG, Min KD, Han JK, Hong HS, Park SJ, Park JS, Paik SH (2008) Anomalous insertion of the medial meniscus into the anterior cruciate ligament: the MR appearance. *Br J Radiol* 81(961):20–24
- Cho JM, Suh JS, Na JB, Cho JH, Kim Y, Yoo WK, Lee HY, Chung IH (1999) Variations in meniscofemoral ligaments at anatomical study and MR imaging. *Skeletal Radiol* 28(4): 189–195
- Galeazzi R (1927) Clinical and experimental study of lesions of the semilunar cartilages of the knee joint. *J Bone Joint Surg Am* 9:515–523
- Jung YB, Yum JK, Bae YJ, Song KS (1998) Anomalous insertion of the medial meniscus. *Arthroscopy* 14(5):505–507
- Karataglis D, Dramis A, Learmonth DJ (2006) Double-layered lateral meniscus. A rare anatomical aberration. *Knee* 13(5): 415–416
- Kim YG, Ihn JC, Park SK, Kyung HS (2006) An arthroscopic analysis of lateral meniscal variants and a comparison with MRI findings. *Knee Surg Sports Traumatol Arthrosc* 14(1):20–26
- Komatsu N, Yamamoto K, Chosa E (2008) Bilateral congenital separation of the lateral meniscus. A case report. *Knee* 15(4):330–332
- Komatsu T, Hashimoto Y, Sakanaka H, Gotani H, Yamano Y (2007) Bilateral discoid medial menisci accompanied by distal arthrogryposis: a case report. *Knee Surg Sports Traumatol Arthrosc* 15(4):424–426
- Merida-Velasco JA, Sanchez-Montesinos I, Espin-Ferra J, Rodriguez-Vazquez JF, Merida-Velasco JR, Jimenez-Collado J

- (1997) Development of the human knee joint. *Anat Rec* 248(2):269–278
12. Pombo MW, Shen W, Fu FH (2008) Anatomic double-bundle anterior cruciate ligament reconstruction: where are we today? *Arthroscopy* 24(10):1168–1177
  13. Rainio P, Sarimo J, Rantanen J, Alanen J, Orava S (2002) Observation of anomalous insertion of the medial meniscus on the anterior cruciate ligament. *Arthroscopy* 18(2):E9
  14. Tecklenburg K, Schoepf D, Hoser C, Fink C (2007) Anterior cruciate ligament injury with simultaneous locked bucket-handle tears of both medial and lateral meniscus in a 19 years old female professional ski racer: a case report. *Knee Surg Sports Traumatol Arthrosc* 15(9):1125–1129
  15. Watanabe AT, Carter BC, Teitelbaum GP, Bradley WG Jr (1989) Common pitfalls in magnetic resonance imaging of the knee. *J Bone Joint Surg Am* 71(6):857–862