


## CASE REPORT

# Symptomatic Complete Discoid Medial Meniscus Completely Coalesced with the Anterior Cruciate Ligament: A Case Report and Literature Review

Guorong Jin, MD<sup>1</sup> , Tong Xin, MD<sup>2</sup>, Zheng Weng, MD<sup>1</sup>, Yun Zhu, MD<sup>1</sup>, Hao Qiu, MD<sup>1</sup>, Dun Liu, MD<sup>1</sup>, Shimou Chen, MD<sup>1</sup>, Jiangtao Dong, PhD<sup>3</sup>, Fang Huang, MD<sup>4</sup>, Yu Chen, PhD<sup>1</sup>

<sup>1</sup>Center for Traumatology, Ninth People's Hospital of Chongqing, <sup>2</sup>Chongqing Key Laboratory of Translational Research for Cancer Metastasis and Individualized Treatment, Chongqing University Cancer Hospital and <sup>4</sup>Department of Respiratory Medicine, Ninth Peoples's Hospital of Chongqing, Chongqing and <sup>3</sup>Department of Joint Surgery, the Third Hospital of Hebei Medical University, Shijiazhuang, China

**Background:** Complete discoid medial meniscus is an extremely rare abnormality of the knee joint whose meniscus has a discoid shape rather than a normal semilunar one. Several medial meniscus anomalies including anomalous insertion have been reported in the literature. This report presents a rare case of symptomatic complete discoid medial meniscus whose anterolateral (apical) portion was completely coalesced with the ACL. MRI, radiographic, and arthroscopic findings in the medial compartment are to be submitted.

**Case Presentation:** A 29-year-old male presented with intermittent pain and swelling of the right knee for 2 years. Based on radiographic, MRI, and physical examination findings, he was diagnosed with discoid medial meniscus tears. Arthroscopic saucerization was performed for the torn discoid medial meniscus of the right knee. Arthroscopic examination revealed a complete discoid medial meniscus and the anterolateral (apical) portion of which was completely coalesced with the ACL. Careful Probing of the meniscal surface revealed there was a longitudinal tear extending from the tibial spine to the midportion of the meniscus. Arthroscopic saucerization of the discoid meniscus was performed after closely cutting the meniscus around the ACL. The patient reported no symptoms, and he had returned to his daily and sports activities, including football, basketball, and jogging, at the 12-month follow-up.

**Conclusion:** Complete discoid medial meniscus is an extremely rare abnormality, and this case presents the third complete discoid medial meniscus whose anterolateral (apical) portion was completely coalesced with the ACL. The current case we present strongly supports the hypothesis that ACL and meniscus were differentiated from the same mesenchyme.

**Key words:** Anterior cruciate ligament; Arthroscopy; Case report; Discoid medial meniscus

## INTRODUCTION

Discoid meniscus is an abnormality of the knee whose meniscus has a discoid shape rather than a normal semilunar one. It was first described in the lateral meniscus by Young<sup>1</sup> in 1889 in a cadaver specimen, while Cave and Staple<sup>2</sup> found that there was also discoid medial meniscus in

1941. Discoid medial meniscus is an extremely rare abnormality with a reported incidence of 0.03% to 0.3%<sup>3,4</sup>. Several medial meniscus anomalies including discoid variants and anomalous insertion have been reported in the literature<sup>3-5</sup>. However, only two reports of medial discoid meniscus completely coalesced with anterior cruciate ligament (ACL)

**Address for correspondence:** Yu Chen, Center for Traumatology, Ninth People's Hospital of Chongqing, Chongqing 400700, China. Email: [chenyu@vip.163.com](mailto:chenyu@vip.163.com) and Fang Huang, Department of Respiratory Medicine, Ninth People's Hospital of Chongqing, Chongqing 400700, China. Email: [huangfang@vip.163.com](mailto:huangfang@vip.163.com)

Guorong Jin and Tong Xin contributed equally to this study.  
Received 10 December 2021; accepted 27 May 2022



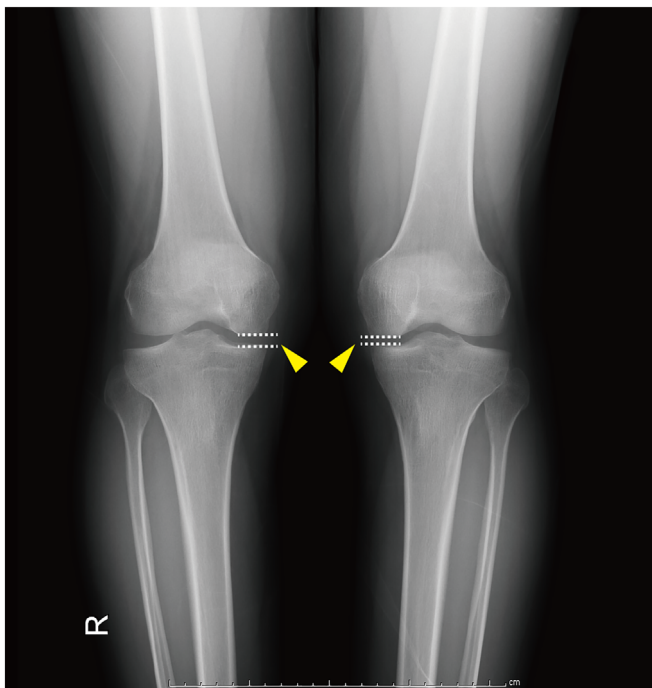
has been reported previously in the literature<sup>6,7</sup>. This report presents a case of symptomatic complete discoid medial meniscus completely coalesced with the ACL. Arthroscopic, standing anteroposterior radiographs and magnetic resonance imaging (MRI) views of the lesions are included.

### CASE PRESENTATION

A 29-year-old man presented to our institution complaining of intermittent pain and swelling of the right knee for 2 years. The patient reported onset of the pain was insidious but gradually became worse during the past 3 months. He did not recall receiving any specific trauma.

Physical examination revealed a moderate degree of effusion and mild quadriceps atrophy with tenderness of the medial joint line. The range of motion of the right knee was from 0° to 130°. The McMurray test was positive, and no ligament instability was noted. The left knee was asymptomatic.

Standing anteroposterior radiography showed an increased medial joint space, squaring of the medial femoral condyle, and cupping of the medial tibial plateau in the right knee (Figure 1). Coronal MRI of right knee revealed that the entire weight-bearing portion of medial compartment was occupied by a square shape of low signal intensity. T2-weighted images showed liner higher signals in the medial meniscus, which reach the articular surface at the midportion of the meniscus. What's more, the ACL was found completely coalesced with the anterolateral (apical)



**Fig. 1** Standing anteroposterior radiographs of both knees. Radiography showed widened medial joint spaces of the right knee

portion of the medial meniscus through three sequential cuts of image. These signals were interpreted to be a discoid medial meniscus with longitudinal tear and intrameniscal degeneration accompanied by abnormal coalescence with the ACL (Figure 2).

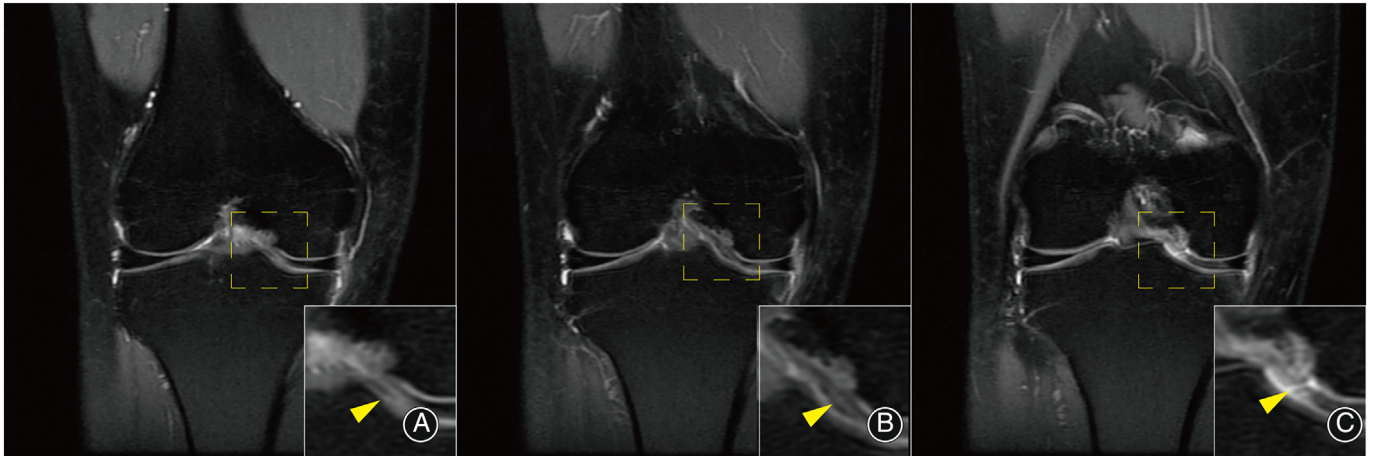
The patient underwent arthroscopy of his right knee under general anesthesia with standard portals and instrumentation. The medial tibia plateau was completely covered by complete type of discoid medial meniscus, and the anterolateral apical portion of medial meniscus was completely coalesced with the ACL. Careful probing of the meniscal surface revealed that no discontinuity existed between the discoid medial meniscus and the ACL, and there was a longitudinal tear extending from the tibial spine to the midportion of the meniscus (Figure 3). After closely cutting the meniscus around the ACL with electric cutters, saucerization of the discoid meniscus was pursued with a standard duckling and meniscal cutter (Figure 3).

The patient was encouraged to perform isometric exercises immediately, ranges of motion exercises were started on the first postoperative day, and partial weight-bearing was allowed within 3 days. During a 12-month follow-up, the patient reported no symptoms, and he had returned to his daily and sports activities, including football, basketball, and jogging.

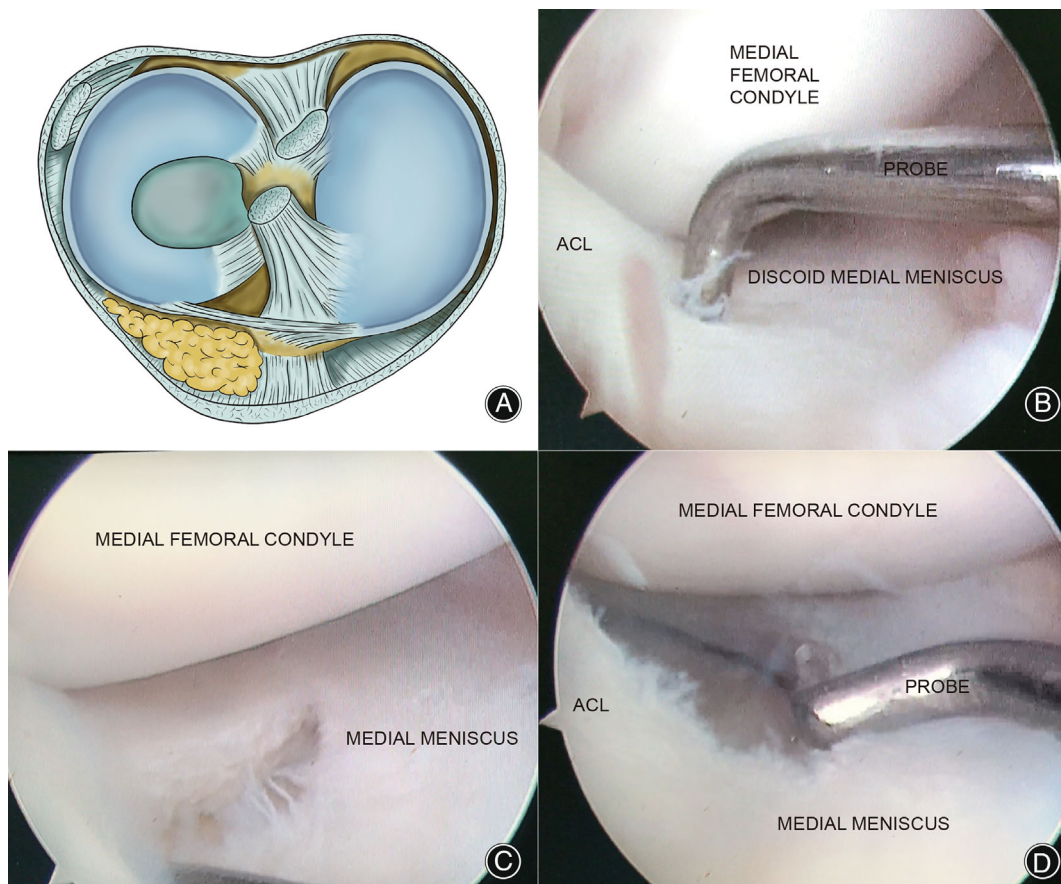
### DISCUSSION

Discoid medial meniscus is an extremely rare anomaly with an estimated incidence of 0.03% to 0.3%<sup>8-11</sup>, and this case represents the third discoid medial meniscus completely coalesced with ACL. Different speculations and hypotheses about the etiology of discoid meniscus have been explained but not yet been completely ascertained<sup>11-14</sup>. Smillie<sup>12</sup> postulated that the meniscus existed as a cartilaginous disc at an early stage of development, and that the congenital discoid meniscus was attributable to the congenital developmental arrest leading to resorption processing failure of the central meniscus at varying stages of embryologic development. Kaplan<sup>13</sup> found in an embryological study that the meniscus did not appear to be a discoid form at any stage of normal development of the fetus. Discoid menisci were definite pathologic entities that developed under specific conditions, he concluded, and they resulted from hypermobility on the unstable meniscal attachment of the posterior horn. Clark and Ogden<sup>11</sup> found that both the medial and lateral meniscus showed a semilunar shape in the early stages of prenatal development. But mild to moderate instability (absence of the meniscofemoral attachment) may result in filling in of the central area of the meniscus (Table 1).

Owing chiefly to the work of Gardner and O'Rahilly<sup>15</sup>, it is now clear that the cruciate ligaments and meniscus were developed at stage 19-20 (approximately 7 postovulatory weeks) of fetal development. Bardeen and Lewis<sup>16</sup> observed fetal knee development and recorded the sequence of differentiation as follows: menisci, capsule, cruciate ligaments,



**Fig. 2** The anterolateral portion of the meniscus was completely coalesced with the anterior cruciate ligament, yellow arrow indicates the tear of meniscus



**Fig. 3** Schematic diagram and arthroscopic image of discol medial meniscus completely coalesced with the ACL. (A) Schematic diagram of discol medial meniscus completely coalesced with the ACL. (B) Arthroscopic image of discol medial meniscus completely coalesced with the ACL. (C) Longitudinal tear of medial meniscus. (D) Medial meniscus and ACL after saucerization of discol meniscus

**TABLE 1** Different hypotheses and findings about the etiology of discoid meniscus and ACL

Author	Year	Hypotheses and findings
Smillie <sup>12</sup>	1948	The meniscus existed as a cartilaginous disc at an early stage of development, and that the congenital discoid meniscus was attributable to the congenital developmental arrest leading to resorption processing failure of the central meniscus at varying stages of embryologic development.
Kaplan <sup>13</sup>	1957	The meniscus did not appear to be a discoid form at any stage of normal development of the fetus. Discoid menisci were definite pathologic entities that developed under specific conditions, and resulted from hypermobility on the unstable meniscal attachment of the posterior horn.
Clark and Ogden <sup>11</sup>	1983	Both the medial and lateral meniscus showed a semilunar shape in the early stages of prenatal development. But mild to moderate instability (absence of the meniscofemoral attachment) may result in filling in of the central area of the meniscus.
Gardner and O'Rahilly <sup>15</sup>	1968	The cruciate ligaments and meniscus were developed at stage 19–20 (approximately 7 postovulatory weeks) of fetal development.
Bardeen and Lewis <sup>16</sup>	1901	The sequence of fetal knee differentiation as follows: menisci, capsule, cruciate ligaments, patella, and ligamentum mucosum.
Fukazawa <sup>17</sup>	2009	ACL and menisci develop from the same blastema in the midline of the joint which separate from each other and form a mass of semilunar young fibroblasts attached to the capsule and the ACL during the 9th to 10th week of fetal development.
Min <sup>6</sup>	2001	At a specific time during developing, there must be some factors that lead to the failure of separation of ACL and meniscus and, as a result, the apical and central portion of the medial meniscus fails to be absorbed, and remains a discoid shape coalesced to the ACL.

patella, and ligamentum mucosum. Thus, they stated that the meniscus and the ACL are differentiated directly from the same blastema. Fukazawa<sup>17</sup> stated that ACL and menisci develop from the same blastema in the midline of the joint which separated from each other and formed a mass of semilunar young fibroblasts attached to the capsule and the ACL during the 9th to 10th week of fetal development.

The third discoid medial meniscus completely coalesced with ACL presented in this paper supports the hypothesis that ACL and meniscus were differentiated from the same mesenchyme. At a specific time during developing, there must be some factors that lead to the failure of separation of ACL and meniscus and, as a result, the apical and central portion of the medial meniscus fails to be absorbed, and remains a discoid shape coalesced to the ACL.

Discoid medial meniscus is likely to be much less mobile and its anterolateral apical portion was completely coalesced with the ACL, which may further reduce the mobile range of meniscus. Such type of meniscus is easily torn constantly under the weight load of the condyle. The complex and altered stress on the superior and inferior surfaces of the complete discoid medial meniscus combined with much less mobility may eventually lead to a horizontal tear in this case.

The treatment of discoid medial meniscus depends on the tear pattern, including longitudinal tear, horizontal tear, bucket-handle tear. Surgical techniques include saucerization, partial meniscectomy, and total meniscectomy. Total meniscectomy and partial meniscectomy are currently not first-line treatment due to the potential of degenerative arthritis.<sup>18</sup> Therefore, the treatment of discoid medial meniscus is usually performed with arthroscopic saucerization. Nonetheless, there is a lack of consensus on how much peripheral rim of medial meniscus should be preserved when performing saucerization. In this case, we recommend preserve 6–8 mm peripheral rim of meniscus, referring to the guideline for discoid lateral meniscus<sup>8,19</sup>.

## CONCLUSIONS

Complete discoid medial meniscus is an extremely rare abnormality, and in this case we present the third complete discoid medial meniscus completely coalesced with the ACL. The current case we present strongly supports the hypothesis that ACL and meniscus were differentiated from the same mesenchyme. The treatment of discoid meniscus should consider its tear pattern and whether it is symptomatic. With the development of arthroscopic techniques, the treatment of discoid meniscus has gradually changed from total meniscectomy or partial meniscectomy to saucerization.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this published article.

## DISCLOSURE OF INTEREST

The authors declare that they have no conflicts of interest concerning this article.

**COMPETING INTERESTS**

All authors have read and approved the content and had no conflicts of interest. There are no ethical/legal conflicts involved in the article.

**FUNDING**

This research did not receive any specific grant from funding agencies in the public.

**AUTHORS' CONTRIBUTIONS**

Guorong Jin and Tong Xin carried out the data collection, literature review, and drafting of the manuscript.

Zheng Weng and Yun Zhu contributed to the drafting of the manuscript and aided in the literature review. Hao Qiu, Dun Liu, Jiangtao Dong participated in the data collection and the drafting of the manuscript. Yu Chen and Fang Huang help to draft the manuscript and revised the final version of the manuscript. All authors read and approved the final manuscript.

**ACKNOWLEDGEMENTS**

The authors thank Qiu-Xia Zhang for the assistance in editing figures.

**REFERENCES**

1. Young RB. The external semilunar cartilage as a complete disc. *Mem. Memo Anat.* 1889;1:179–80.
2. Cave EF, Staples OS. Congenital discoid meniscus as cause of internal derangement of the knee. *Am J Surg.* 1941;54(2):371–6.
3. Yang SJ, Zhang MZ, Li J, Xue Y, Chen G. A reliable, ultrasound-based method for the diagnosis of discoid lateral meniscus. *Arthroscopy.* 2021;37(3):882–90.
4. Li Z, Fan W, Dai Z, Zhao H, Liao Y, Lei Y, et al. Widening of the popliteal hiatus on sagittal MRI view plays a critical role in the mechanical signs of discoid lateral meniscus. *Knee Surg Sports Traumatol Arthrosc.* 2021;29(9):2843–50.
5. Xu Z, Chen D, Shi D, Dai J, Yao Y, Jiang Q. Evaluation of posterior lateral femoral condylar hypoplasia using axial MRI images in patients with complete discoid meniscus. *Knee Surg Sports Traumatol Arthrosc.* 2016;24(3):909–14.
6. Min BH, Ha HK, Khang SY. Medial discoid meniscus completely coalesced with the anterior cruciate ligament. *Arthroscopy.* 2001;17(7):E27–5.
7. Joshi D, Jain V, Goyal A, Bahl V, Chaudhary D. Discoid medial meniscus completely coalesced with the anterior cruciate ligament. *Orthopedics.* 2013;36(11):e1461–3.
8. Yamaguchi N, Chosa E, Tajima T, Morita Y, Yokoe T. Symptomatic discoid lateral meniscus shows a relationship between types and tear patterns, and between causes of clinical symptom onset and the age distribution. *Knee Surg Sports Traumatol Arthrosc.* 2022;30(4):1436–42.
9. Sun Y, Jiang Q. Review of discoid meniscus. *Orthop Surg.* 2011;3(4):219–23.
10. Yilgor C, Atay OA, Ergen B, Doral MN. Comparison of magnetic resonance imaging findings with arthroscopic findings in discoid meniscus. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(2):268–73.
11. Clark CR, Ogden JA. Development of the menisci of the human knee joint. Morphological changes and their potential role in childhood meniscal injury. *J Bone Joint Surg Am.* 1983;65(4):538–47.
12. Smillie IS. The congenital discoid meniscus. *J Bone Joint Surg Br.* 1948;30B(4):671–82.
13. Kaplan EB. Discoid lateral meniscus of the knee joint; nature, mechanism, and operative treatment. *J Bone Joint Surg Am.* 1957;39-A(1):77–87.
14. Soren A. On the etiology of congenital malformation of the meniscus. *Arch Orthop Trauma Surg.* 1985;104(5):283–8.
15. Gardner E, O'Rahilly R. The early development of the knee joint in staged human embryos. *J Anat.* 1968;102(Pt 2):289–99.
16. Bardeen CR, Lewis WH. Development of the limbs, body-wall and back in man. *Am J Anat.* 1901;1(1):1–35.
17. Fukazawa I, Hatta T, Uchio Y, Otani H. Development of the meniscus of the knee joint in human fetuses. *Congenital Anomalies.* 2009;49(1):27–32.
18. Lee YS, Teo SH, Ahn JH, Lee OS, Lee SH, Lee JH. Systematic review of the long-term surgical outcomes of discoid lateral meniscus. *Art Ther.* 2017;33(10):1884–95.
19. Perkins CA, Busch MT, Christino MA, Willimon SC. Saucerization and repair of discoid lateral menisci with peripheral rim instability: intermediate-term outcomes in children and adolescents. *J Pediatr Orthop.* 2021;41(1):23–7.