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## Case Report

# Abnormal displacement of discoid lateral meniscus with snapping knee detected by full extension and deep flexion MRI: Report of two cases

Yusuke Hashimoto<sup>a,\*</sup>, Nishino Kazuya<sup>a</sup>, Junsei Takigami<sup>b</sup>, Shinya Yamasaki<sup>c</sup>,  
Tomohiro Tomihara<sup>b</sup>, Nagakazu Shimada<sup>b</sup>, Hiroaki Nakamura<sup>a</sup>

<sup>a</sup> Department of Orthopaedic Surgery, Osaka City University Graduate School of Medicine, Osaka, Japan

<sup>b</sup> Department of Orthopaedic Surgery, Shimada Hospital, Habikino, Japan

<sup>c</sup> Department of Orthopaedic Surgery, Osaka General Hospital, Osaka, Japan



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## ABSTRACT

We evaluated the abnormal displacement of a complete discoid lateral meniscus in two patients with symptoms of a large popping sound during knee flexion and extension, so-called “snapping”, and no displacement of the discoid meniscus on routine Magnetic Resonance Imaging (MRI) analysis. MRI images indicated an anterocentral shift of the lateral discoid meniscus on knee deep flexion in one case and a posterocentral shift of the meniscus on knee full extension in the other case. Abnormal meniscal instability was confirmed under arthroscopy in both knees. After arthroscopic partial meniscectomy, one case of posterior horn instability was treated with an inside-out arthroscopic technique, whereas the other case of anterior horn instability was treated with an all-inside repair technique. We conclude that the symptom of a large popping sound during knee motion may indicate abnormal displacement of a complete discoid lateral meniscus and that further MRI analyses on knee full extension and deep flexion may reveal discernible meniscal displacement.

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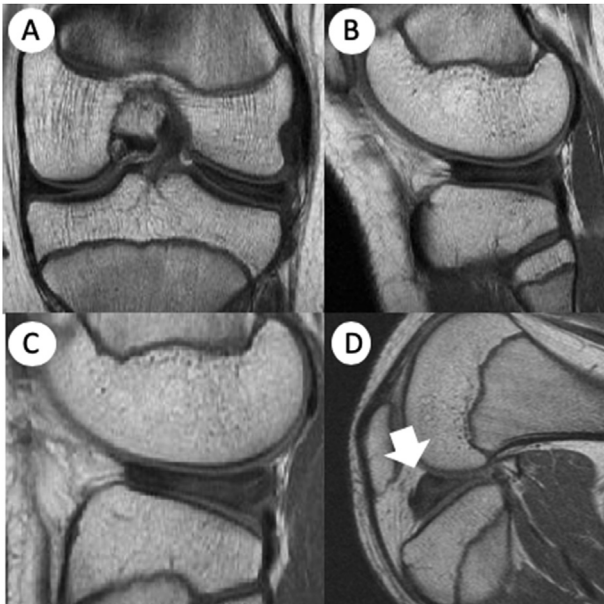
## Introduction

A discoid lateral meniscus is a common abnormality of the meniscus. The typical symptoms of a discoid meniscus include pain, popping, snapping, and limited knee extension. Many of these symptoms are caused by instability and/or tearing of the meniscus.<sup>1</sup> Recently, surgical management of a symptomatic discoid meniscus has been changing toward preservation of the meniscus. After arthroscopic partial meniscectomy to reshape the meniscus (saucerization), meniscal instability is diagnosed depending on whether the remaining meniscus can be displaced with a probe. Anterior horn instability is treated with an outside-in or all-inside arthroscopic repair technique, whereas posterior horn instability is treated with an inside-out arthroscopic repair technique.<sup>2</sup> Ahn

et al.<sup>3</sup> used MRI images to classify a complete discoid lateral meniscus into four categories: no shift; anterocentral shift; posterocentral shift; and central shift. The no shift-type knees presented with a stable meniscus, whereas the other three shift types had unstable menisci. They also reported that the low sensitivity of no shift for predicting the absence of a peripheral tear must be considered. Because these cases were frequently associated with a loud click or clunk during the preoperative physical examination, the meniscus may have a peripheral tear but appear to have no shift if it is reduced when the MRI is performed.<sup>3</sup> Thus, it is not clearly determined whether the suture is required before the operation when routine MRI scans show no abnormal displacement of the meniscus of a snapping knee. Snapping is sometimes apparent in patients with discoid meniscal problems. Although Smile<sup>4</sup> suggested that the actual snapping sound was produced by backward or forward movement of the discoid lateral meniscus during the knee motion, there are no reports showing the abnormal displacement of a discoid lateral meniscus with MRI in the same patients. In this report, two patients who presented with snapping

\* Corresponding author. Department of Orthopaedic Surgery, Osaka City University Graduate School of Medicine, 1-4-3 Asahi-machi, Abeno-ku, Osaka, 545-8585, Japan.

E-mail address: [hussy@med.osaka-cu.ac.jp](mailto:hussy@med.osaka-cu.ac.jp) (Y. Hashimoto).



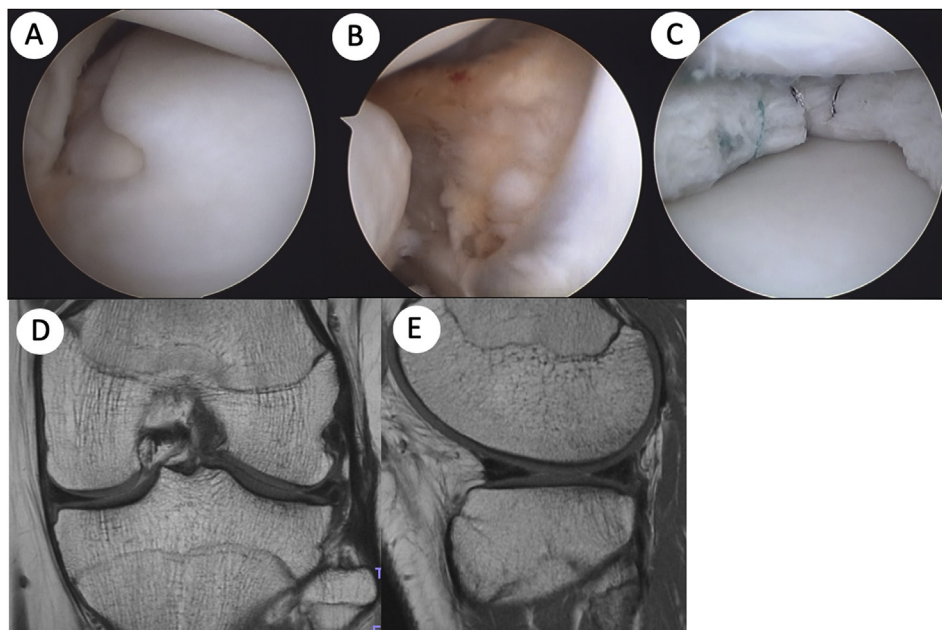
**Fig. 1.** MRI images of the knee of an 13-year-old boy (Case 1), with the knee in (A, B) the normal position (routine MRI) of coronal and sagittal image, (C) full extension and (D) deep flexion of sagittal image. The routine MRI showed no shift in the meniscus with no widening at the popliteal hiatus (B). The discoid meniscus moved anteriorly during deep flexion (white arrow) (D).

but no evidence of a shifted meniscus on routine MRI were examined by further MRI analyses in knee full extension and deep flexion. We could show abnormal displacement of the discoid lateral meniscus with MRI in the same patients.

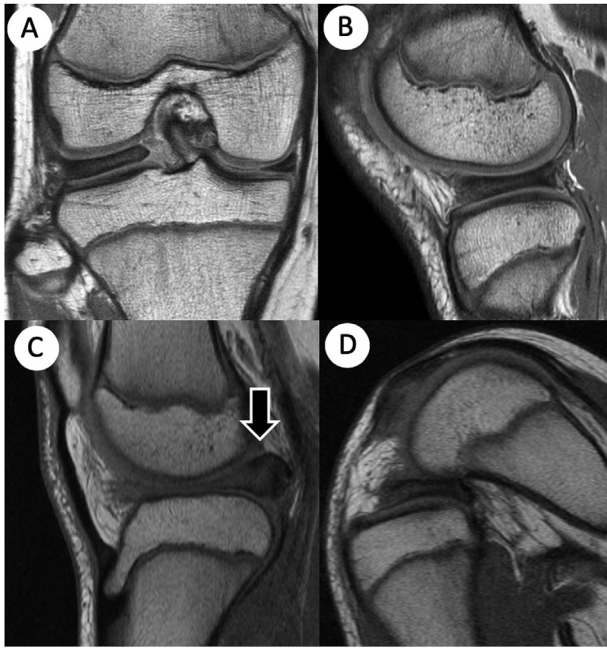
This study was approved by the institutional review board in our hospital and the patients and their families were informed that data from the case would be submitted for publication, and gave their consent.

### Case 1

Case 1 was a 13-year-old boy who first injured his left knee during running at 12 years of age. After the injury, he sometimes felt catching and pain during walking, stairs and running. He suffered from right knee pain and snapping during knee movement from deep flexion to full extension. A physical examination revealed no ligament laxity, swelling, or limitation of movement of the knee. Range of motion of his knee were 0° in extension and 140° in flexion. A dramatic snapping occurred every time he straightened his knee from deep flexion to full extension without pain. proton-density routine 1.5T MRI (Signa; GE Healthcare Medical System, Milwaukee, WI) revealed a discoid lateral meniscus with no suggestion of abnormal displacement and no widening at the popliteal hiatus but horizontal tear (Fig. 1A and B). To determine the presence or absence of a peripheral tear, additional MRI images taken in knee full extension (Fig. 1C) and deep flexion (Fig. 1D). On full extension MRI, the meniscus revealed no shift. However, during deep flexion, the posterior horn of the meniscus appeared empty with an anterior meniscal shift, otherwise known as the antero-central shift type.<sup>3</sup> Under arthroscopy (Fig. 2A), the posterior horn of the meniscus was disconnected from the posterior meniscocapsular junction area (Fig. 2B) and repaired with fourteen 2-0 braided polyester sutures using the inside-out technique (Fig. 2C). The snapping phenomenon during her knee motion disappeared postoperatively. He started to play table tennis again without any symptom at six months after the surgery. At 2 years postoperatively, the treated meniscus had a normal shape on MRI (Fig. 2D and E). At the 4-year follow-up, He continued to play table tennis every day with no symptom. Postoperative range of motion were between 0 and 140. The Lysholm score improved from 69 preoperatively to 100 postoperatively, the Ikeuchi score improved from fair to excellent, and the Tegner activity score improved from 5 to 7 postoperatively.



**Fig. 2.** Intraoperative finding and the postoperative MRI of Case1 (A) Lateral portal view of discoid lateral meniscus in Case1 (B) The view from lateral gutter revealed disconnected the posterior horn of the meniscus from the posterior meniscocapsular junction area. (C) Residual meniscus looked normal shape after saucerization and repair with inside-out technique. Coronal (D) and sagittal (E) image two years after the surgery revealed normal shape of menisci.



**Fig. 3.** MRI images of the knee of a 12-year-old girl (Case 2), with the knee in with the knee in (A, B) the normal position (routine MRI) of coronal and sagittal image, (C) full extension and (D) deep flexion. The routine MRI showed a no shift-type knee with no widening at the popliteal hiatus (B). The discoid meniscus moved posteriorly during full extension (black arrow) (C) and was reduced to the normal position during deep flexion (D).

## Case 2

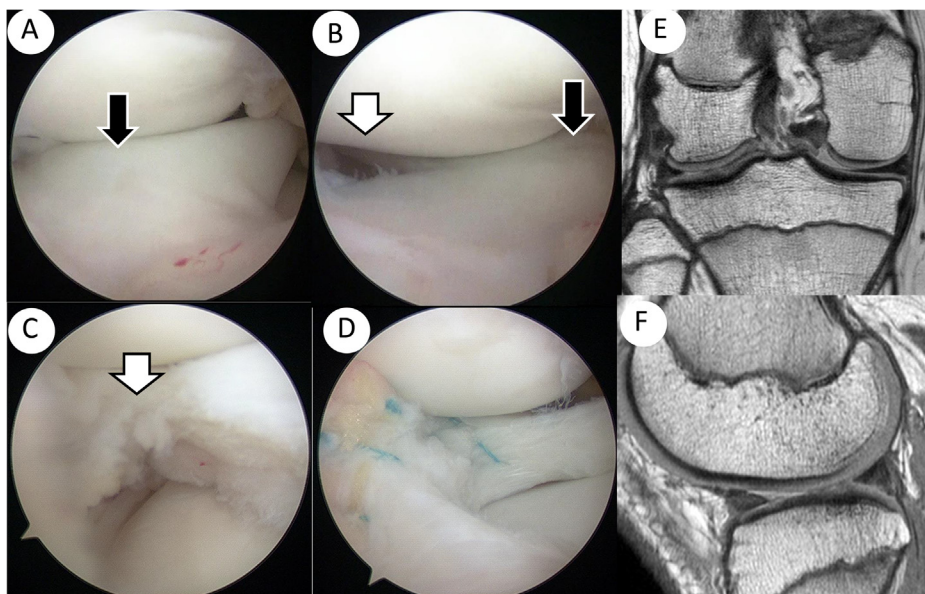
Case 2 was a 12-year-old girl who first noticed the painless snapping of her right knee at 11 years of age without trauma. She suffered right knee pain and feelings of her knee ‘giving way’ during walking at 12 years of age. Range of motion of her knee were 0° in

extension and 140° in flexion. Coronal and sagittal image of proton-density routine MRI (Fig. 3A and B) showed a complete discoid lateral meniscus with no displacement. The meniscus showed a posterior shift on full extension MRI (Fig. 3C) known as the posterocentral shift type,<sup>3</sup> instead of no displacement no widening at the popliteal hiatus on deep flexion MRI (Fig. 3D). During arthroscopy, the snapping phenomenon could be duplicated from knee flexion (Fig. 4A) to extension (Fig. 4B). A peripheral tear was observed in the anterior meniscocapsular junction area (Fig. 4C). It was treated with saucerization and repaired with six sutures using the all-inside and outside-in technique. In all-inside technique, a suture hook penetrated the capsule and anterior horn of the lateral meniscus through an anterolateral portal to retrieve a No. 1 Prolene suture and a sliding knot was made (Fig. 4D). The snapping phenomenon during her knee motion disappeared postoperatively. At 2 years postoperatively, the treated meniscus had a normal shape on MRI (Fig. 4E and F). At the 4-year follow-up, she belonged to a tennis club and played tennis every day. Postoperative range of motion were between 0 and 140. The Lysholm score improved from 71 preoperatively to 100 postoperatively, the Ikeuchi score improved from fair to excellent, and the Tegner activity score improved from 5 to 7 postoperatively.

## Discussion

A snapping knee symptom with a discoid meniscus is considered to be the result of a hypermobile or unstable meniscus.<sup>5</sup> However, the snapping phenomenon is not easily detected using routine MRI. This report is to investigate the abnormal meniscus displacement using additional MRI analyses with the knee in deep flexion or full extension for a complete discoid meniscus, in cases with no shift on routine MRI preoperatively and reproduce abnormal meniscus displacement during intraoperative arthroscopic findings in the same patient. This report could provide important information as a confirmatory tool for preoperative evaluation.

The Watanabe classification uses the arthroscopic morphology



**Fig. 4.** Intraoperative finding and the postoperative MRI of Case2 Under arthroscopy, the discoid meniscus (black arrows) moved from a reposition at flexion of the knee (A) to a dislocated position at extension (B) with peripheral tear (white arrow). Peripheral tear was observed in the anterior meniscocapsular junction area (white arrow) (C). Residual meniscus looked normal shape after saucerization and repair with all inside and outside-in technique (D). Coronal (E) and sagittal (F) image two years after surgery revealed normal shape of menisci.



to classify a discoid meniscus into three types: type I, complete; type II, incomplete; and type III, meniscomfemoral ligament-type or Wrisberg variant. The Wrisberg variant occurs when the lateral meniscus has no posterior attachment, and is stabilized only by the meniscomfemoral ligament of Wrisberg or Humphrey.<sup>6</sup> Previous reports<sup>2,7</sup> described a classification of peripheral rim instability based on arthroscopic findings, determined according to intraoperative classifications. It is preferable to diagnose meniscal instability on preoperative images rather than during surgery. Ahn et al.<sup>3</sup> estimated a significantly larger number of peripheral tears in patients with shift-type knees than in patients with no shift-type knees. However, upon arthroscopic examination, 13 of the 43 no shift-type knees had peripheral tears and 6 of these 13 knees presented with a loud 'click' or 'clunk' during the preoperative physical examination. They concluded that a careful examination should be performed to detect peripheral tears even in patients with no shift-type knees.

Smillie<sup>4</sup> first described the cause of snapping knee as the actual sound being produced by backward or forward movement of the meniscus at the moment that the femoral condyle rides over: 1) the thick intact strip of fibrocartilage which forms the anterior boundary of the facet produced by the femoral condyle; or 2) the thick anterior peripheral margin of the meniscus itself. However, snapping phenomenon in the previous study was never proven in radiological imaging.

Both cases in our study presented as a no shift-type meniscus on routine MRI despite the loud popping sound that occurred when the knee was moved from deep flexion to full extension. Two-position-MRI was efficient for confirming meniscal instability with an antero-central shift on deep flexion for Case 1 and a postero-central shift on full extension for Case 2.

Partial meniscectomy to reshape the meniscus (saucerization) while preserving at least 6–8 mm of the peripheral portion for the discoid lateral meniscus may be the preferred method for treatment compared with subtotal meniscectomy.<sup>8</sup> In cases with

peripheral instability of the meniscus, meniscal repair was necessary for any detached or unstable lesions for meniscal stabilization.<sup>7,9</sup> Saucerization and meniscal repair for instability contributed to the good results observed in our cases, similar to previous studies.<sup>2,3,8,10</sup> Nevertheless, although no recurrence of snapping or onset of osteochondritis dissecans has yet been observed, careful follow-up is necessary.

#### Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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