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## Case Report

# MR- arthrography: anatomic variant from link between lateral meniscus and anterior and posterior cruciate ligaments. A case report and review of the literature ☆☆☆★★★

Christian Ossola, MD<sup>a,c,\*</sup>, Marta Duvia, MD<sup>a,c</sup>, Carmine Naccari Carlizzi, MD<sup>b</sup>, Eugenio Annibale Genovese, MD<sup>b,c</sup>

<sup>a</sup> Diagnostic and Interventional Radiology Department, Circolo Hospital, Varese, Italy

<sup>b</sup> Columbus Clinic Center, Milano, Italy

<sup>c</sup> Insubria University, Varese, Italy

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## ABSTRACT

Menisci congenital anomalies are rare morphologic abnormalities including accessory meniscus, discoid meniscus, double-layered meniscus, hypoplastic meniscus and ring-shaped meniscus (RSM). In a 35 year-old male patient, MR arthrography showed a bridging accessory bundle connecting the anterior cruciate ligament and posterior cruciate ligament with the posterior horn of the lateral meniscus. Arthroscopic examination showed a fan-like obstacle embracing the posterior horn of the lateral meniscus. It would be important to correctly identify this anatomical variant, because the bundle connecting the external meniscus to the ligaments of the central pivot can be misinterpreted as a meniscal fragment.

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**Abbreviations:** RSM, ring-shaped meniscus; MRI, magnetic resonance imaging; ACL, anterior cruciate ligament; PCL, posterior cruciate ligament.

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\* Corresponding author.

E-mail address: [c.ossola7@gmail.com](mailto:c.ossola7@gmail.com) (C. Ossola).

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## Background

The menisci act as shock absorbers and are important stabilizers of the knee joint [1].

The menisci in human embryos develop from an intermediate mesodermal blastema, which has thick-plate shape, and are fully defined approximately eight weeks after conception [2–4].

The lateral meniscus is an incomplete oval-shaped structure more mobile than the medial meniscus, as it lacks capsular attachments [3].

Congenital anomalies of the menisci are rare morphologic abnormalities including accessory meniscus, discoid meniscus, double-layered meniscus, hypoplastic meniscus and ring-shaped meniscus (RSM), which is usually limited to the lateral meniscus [5–13].

We present a case report of an anatomical variant of the lateral meniscus.

## Case presentation

A 33 year-old male was referred to our department due to a 2 month history of right knee pain after a weight-bearing valgus stress injury occurred during exercise.

Magnetic resonance imaging (MRI) revealed a "double posterior cruciate ligament", without morphological lesions of the lateral meniscus, with anomalous appearance at tibial insertion.

A differential diagnosis between meniscal tibial attachment lesion and anatomical variant was considered. Subsequently an MRI-arthrography was performed showing an accessory "bridging" bundle that connected both the anterior cruciate ligament (ACL) and the posterior cruciate ligament (PCL) with the lateral meniscus posterior horn (Fig. 1A-D, Fig. 2A-F, Fig. 3A-C).

Arthroscopic examination confirmed the anatomical variant previously detected by MRI. In particular, the posteromedial approach showed a barrier from the posterior cruciate ligament, embracing the posterior horn of the lateral meniscus (Fig. 4).

The structure was like a reparative scar due to a damage to the posterior cruciate ligament. The anamnestic data excluded the reparative finding.

## Discussion and literature review

Each meniscus can be anatomically divided in three parts: anterior horn, body and posterior horn. The function of both anterior and posterior horns is to secure the menisci to the tibial plateau; these are critical structures for their biomechanical function [14,15].

Meniscal variants are frequently identified on routine MRI and most commonly involve the lateral meniscus [16].

The discoid meniscus is the most frequent meniscal variant and has been subclassified into the modified Watanabe



**Fig. 1 – (A-D).** a: MRI. Sagittal DP fat saturation weighted image. MR pattern of double PCL (white arrows). (B) MRI. Coronal DP fat saturation weighted image. Abnormal insertion of the lateral meniscus posterior horn (empty arrow). (C) MR arthrography. Sagittal GE T1 fat saturation weighted image. Accessory "bridging" bundle that connected the ACL with lateral meniscus posterior horn (thin white arrow). (D) MR arthrography. Coronal SE T1 weighted image. Abnormal bridge connection between lateral meniscus posterior horn and PCL (curved arrow).

classification as complete discoid meniscus, incomplete discoid meniscus, Wrisberg type meniscus and the RSM [17,18]. Through a literature review, there's a number of variants of intermeniscal ligaments, including the anterior and posterior (transverse) ligaments and the oblique intermeniscal ligament [17].

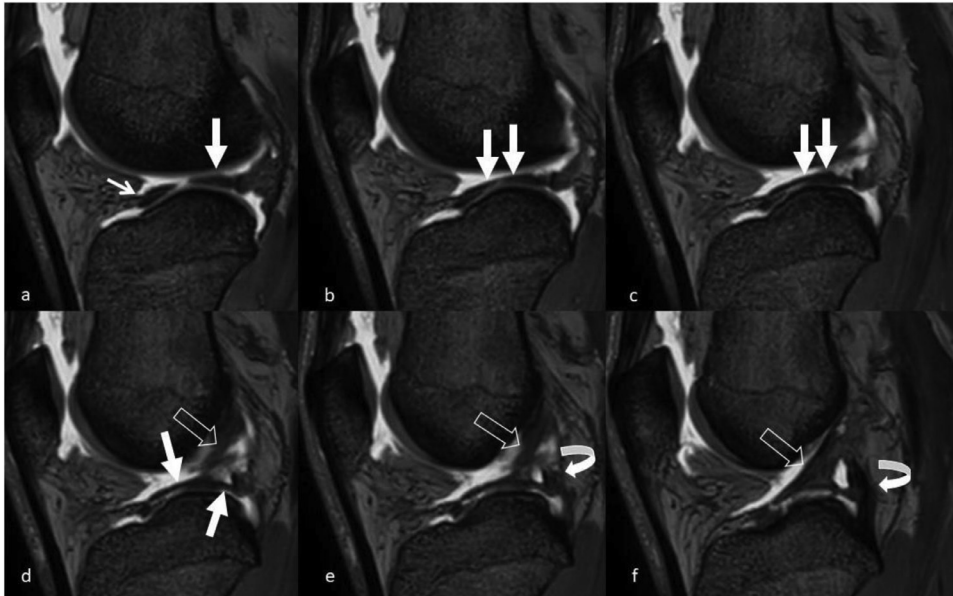
Iqbal et al reported a series of RSMs in six patients including a description of two cases of medial RSM and a case of bilateral lateral RSM [17].

Fujikawa et al report a case of ring-shaped lateral meniscus with a small vertical tear of the posterior part and two cases of patients with lateral meniscal malformations of the knee that were found incidentally. MRI of both cases showed a fragment-like meniscus structure located in the intercondylar notch, very similar to the "fragment in the intercondylar notch sign" observed in displaced bucket-handle tears. Arthroscopic examinations revealed a ring-shaped lateral meniscus in one case, and "flipped-over" lateral meniscus in the other. In the latter, a similar lateral meniscal malformation was observed contralaterally at MRI-arthrography [19].

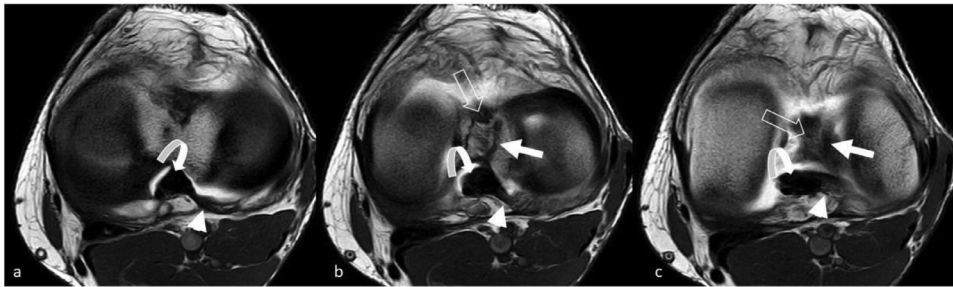
Esteves C et al report a case of a 25 year-old girl with progressive knee pain whose MRI demonstrates a ring-shaped lateral meniscus and an hypoplastic anterior cruciate ligament [20].

Sadigursky D et al report a case of a 36 year-old Hispanic man presenting several symptoms, including knee pain, locking and effusion.

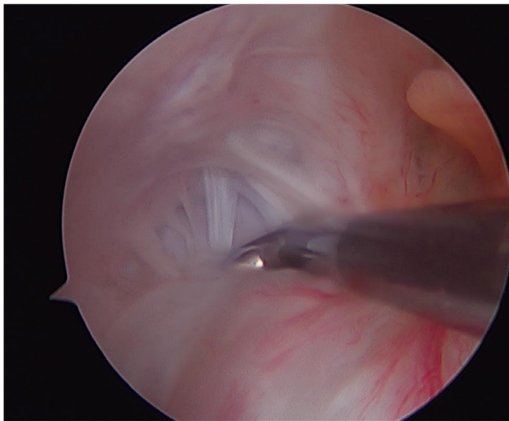
MRI showed anatomical abnormality of the menisci corresponding to the junction of the posterior horns of the menisci



**Fig. 2 – (A-F): MR arthrography. Sagittal GE T1 fat saturation weighed image, from the lateral compartment to the medial compartment. An accessory "bridging" bundle like MR pattern of double PCL (white arrows) that connected ACL (empty arrow) and the PCL (curved arrow) with the lateral meniscus posterior horn. Lateral meniscus anterior horn (thin white arrow)**



**Fig. 3 – (A-C) MR arthrography. axial SE T1 weighed image at the level of the meniscal plane and intercondylar space. Abnormal bridge connection between lateral meniscus posterior horn (arrowhead) and PCL (curved arrow). "bridging" bundle (white arrow) that connected the ACL (empty arrow) with PCL (curved arrow)**



**Fig. 4 – Arthroscopy. The postero-medial approach showed a posterior cruciate ligament barrier embracing the posterior horn of the lateral meniscus**

in tandem with the insertion of the posterior meniscus fibers in the anterior cruciate ligament [21].

The meniscal variation presented in this report is not described in any other study on meniscal abnormalities. Additional investigation of similar cases is required so that a suitable description can be added among the possible anatomical variations of the menisci.

### Conclusion

This is the first study about a meniscal anatomical variant with junction of the posterior horn with both ACL and PCL. The recognition of meniscal variants is important as they can be misinterpreted for more significant pathology on MRI. MR arthrography better defines and depicts intra-articular anatomic variants than MRI.

## Patient consent

Informed consent was obtained from all individual participants included in the study.

## REFERENCES

- [1] Noble J, Turner PG. The function, pathology, and surgery of the meniscus. *Clin Orthop Relat Res* 1986;210:62–8.
- [2] Dejour H, Neyret P. Que faire devant une lésion méniscale? [What should be done in a meniscal lesion?] *Rev Prat* 1989;39(28):2497–502.
- [3] Ohana N, Plotquin D, Atar D. Bilateral hypoplastic lateral meniscus. *Arthroscopy* 1995;11(6):740–2. doi:10.1016/0749-8063(95)90121-3.
- [4] Shahriaree H. O'Connor's textbook of arthroscopic surgery. Philadelphia: JB Lippincott 1992;2:40–3.
- [5] 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.
- [6] Aichroth PM, Patel DV, Marx CL. Congenital discoid lateral meniscus in children. A follow-up study and evolution of management. *J Bone Joint Surg Br* 1991;73(6):932–6. doi:10.1302/0301-620X.73B6.1955439.
- [7] Yamazaki K, Hirasawa Y, Kakinuma S. Two cases of the unusual abnormality of the lateral meniscus with accessory meniscus. *Arthroscopy [Japanese]* 1994;19:145–9.
- [8] Gebhardt MC, Rosenthal RK. Bilateral lateral discoid meniscus in identical twins. *J Bone Joint Surg Am* 1979;61(7):1110–11.
- [9] Kim SJ, Kim DW, Min BH. Discoid lateral meniscus associated with anomalous insertion of the medial meniscus. *Clin Orthop Relat Res* 1995;315(315):234–7.
- [10] Stern A, Hallel T. Medial discoid meniscus with cyst formation in a child. *J Pediatr Orthop* 1988;8(4):471–3. doi:10.1097/01241398-198807000-00018.
- [11] Suzuki S, Miura A, Hayashi H. Two cases of double-layer meniscus. *Arthroscopy [Japanese]* 1990;15:99–101.
- [12] Twyman RS, Ferris BD. Congenital hypoplasia of the medial meniscus: a report of two cases. *Arthroscopy* 1991;7(2):148–50. doi:10.1016/0749-8063(91)90100-c.
- [13] BASMAJIAN JV. A ring-shaped medial semilunar cartilage. *J Bone Joint Surg Br* 1952;34-B(4):638–9 34-B. doi:10.1302/0301-620X.34B4.638.
- [14] Noble J. Congenital absence of the anterior cruciate ligament associated with a ring meniscus. *J Bone Joint Surg Am* 1975;57(8):1165–6.
- [15] Moraes DE. Meniscus morphometric study in humans. *J Morphol Sci* 2010;27(2):62–6.
- [16] Fox AJ, Wanivenhaus F, Burge AJ, Warren RF, Rodeo SA. The human meniscus: a review of anatomy, function, injury, and advances in treatment. *Clin Anat* 2015;28(2):269–87. doi:10.1002/ca.22456.
- [17] Iqbal A, McLoughlin E, Botchu R, James SL. The ring-shaped meniscus: a case series demonstrating the variation of imaging appearances on MRI. *Skeletal Radiol* 2020;49(2):281–9. doi:10.1007/s00256-019-03277-y.
- [18] Monllau JC, León A, Cugat R, Ballester J. Ring-shaped lateral meniscus. *Arthroscopy* 1998;14(5):502–4. doi:10.1016/s0749-8063(98)70079-9.
- [19] Fujikawa A, Amma H, Ukegawa Y, Tamura T, Naoi Y. MR imaging of meniscal malformations of the knee mimicking displaced bucket-handle tear. *Skeletal Radiol* 2002;31(5):292–5. doi:10.1007/s00256-002-0490-3.
- [20] Esteves C, Castro R, Cadilha R, Raposo F, Melão L. Ring-shaped lateral meniscus with hypoplastic anterior cruciate ligament. *Skeletal Radiol* 2015;44(12):1813–18. doi:10.1007/s00256-015-2197-2.
- [21] Sadigursky D, Garcia LC, Martins RR, De Queiroz GC, Carneiro RJF, Colavolpe PO. Anatomical variant of the meniscus related to posterior junction: a case report. *J Med Case Rep* 2017;11(1):351 2017Published. doi:10.1186/s13256-017-1512-z.