



# Arthroscopic Saucerization of Discoid Lateral Meniscus, With Meniscus Repair as Indicated, Results in Excellent Outcomes in Pediatric Patients Younger Than 12 Years of Age

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**Purpose:** To evaluate the experiences and outcomes of arthroscopic partial meniscectomy in symptomatic non-Wrisberg discoid lateral meniscus in children younger than 12 years old at a single center. **Methods:** We retrospectively reviewed the medical records of all pediatric patients who were treated for non-Wrisberg discoid meniscus at our institute between 2013 and 2021. Patients were separated into 2 groups: Patients who underwent partial resection with saucerization (group A) or patients who underwent saucerization, tear repair, and fixation (group B). Clinical outcomes were compared between the 2 groups. **Results:** A total of 20 patients (22 knees) were treated for non-Wrisberg discoid meniscus and included in this study. Nine patients underwent partial resection with saucerization (group A) whereas 11 patients underwent saucerization, tear repair, and fixation (group B). The average follow-up was 3 years (range 2-10 years). The results showed that 17 of the 20 patients had excellent outcomes whereas the other 3 had good outcomes after a minimum follow-up of 2 years. The average Knee Injury and Osteoarthritis Outcome Score for Children score was 93. **Conclusions:** Arthroscopic saucerization of symptomatic non-Wrisberg discoid lateral meniscus, with additional repair as indicated results in excellent or good outcomes in children younger than 12 years of age. **Level of Evidence:** Level III, case-control study.

Non-Wrisberg discoid meniscus is an abnormal congenital variant of the fibrocartilaginous meniscus of the knee in which the meniscus is discoid in shape rather than semilunar in shape.<sup>1</sup> Most cases of discoid menisci involve the lateral meniscus; Davidson et al. reported female sex preponderance.<sup>2-4</sup> It is not uncommon for the lateral discoid meniscus to be present bilaterally.<sup>2-4</sup>

The classification of discoid meniscus consists of 3 types according to the Watanabe system<sup>5</sup> as follows: complete type, incomplete type, and the Wrisberg-

ligament type. The reported incidence of discoid meniscus in the literature is between 0.4% and 17%.<sup>6,7</sup> In the Caucasian population, it is less than 5%,<sup>8,9</sup> rising to 12.5% in the Korean population<sup>10</sup> and 17% in the Japanese population.<sup>11</sup> The cause for this prevalence dispersal is unknown.

Most cases of lateral discoid meniscus are undiagnosed, as the malformation may show few to no symptoms.<sup>4</sup> Surgical treatment consists of either partial or total meniscectomy, and reattachment to the tibia in the Wrisberg variant.<sup>12</sup> Typically, these procedures are performed between 9 and 12 years of age.<sup>4,13,14</sup>

For symptomatic discoid meniscus, nonoperative treatment may consist of immobilization, restricted activities, and exercises of the quadriceps muscles.<sup>4</sup> Indication for surgery is recommended only after failed nonoperative care for 3 to 6 months in symptomatic cases with persistent mechanical symptoms and/or pain.<sup>4</sup> Surgical options of the non-Wrisberg discoid meniscus include partial removal of the torn portion and restoration of the normal semilunar configuration of the meniscus and/or reattachment of meniscus or

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Received August 18, 2023; accepted February 16, 2024.

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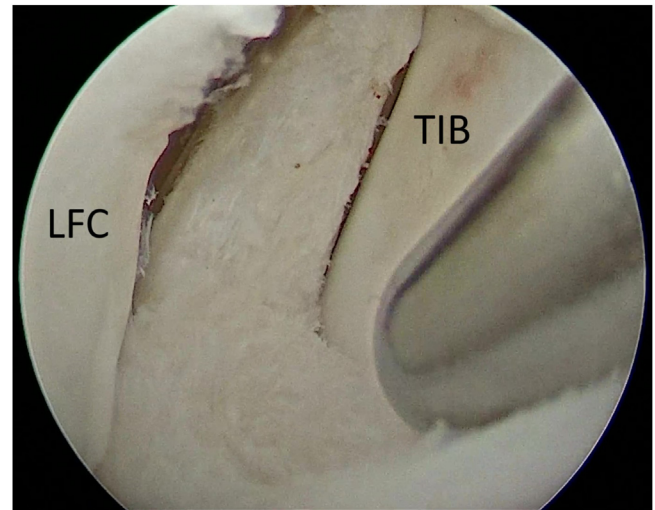
<https://doi.org/10.1016/j.asmr.2024.100915>

total resection of the meniscus.<sup>15</sup> In this study, only partial meniscectomy and/or repair was conducted. Symptomatic discoid menisci traditionally have been treated with total meniscectomy<sup>7</sup>; reports at that time showed considerable symptomatic improvement.<sup>15-17</sup> However, more recent investigations have reported that total meniscectomy is associated with osteoarthritic changes on radiography as well as peripheral rim instability.<sup>10,11,16,18-20</sup> The purpose of our study was to evaluate the experience and outcomes of arthroscopic partial meniscectomy in symptomatic non-Wrisberg discoid lateral meniscus in children younger than 12 years old at a single center. Our hypothesis was that arthroscopic discoid meniscus partial meniscectomy with or without repair in children younger than the age of 12 years is safe and effective at minimum 2-year follow-up.

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## Methods

The clinical, radiologic, and operative records of all pediatric patients treated for meniscal disorders at our institute between 2013 and 2021 were reviewed retrospectively. Twenty patients were diagnosed with and subsequently treated for non-Wrisberg discoid meniscus at a single center by the senior surgeon. Two patients were diagnosed with bilateral discoid lateral menisci, 21 knees were classified as complete discoid menisci, and 1 knee was classified as incomplete discoid menisci. Two patients were diagnosed with discoid meniscus but refused surgery. Diagnosis was made based on patient history, supplemented by magnetic resonance imaging (MRI) findings supporting a diagnosis of discoid meniscus (a meniscal width that is greater than 1.5 cm).<sup>21</sup> The inclusion criteria of this study were based on the presence of symptoms such as pain, restriction of movement, and abnormalities in gait in patients younger than the age of 12 with imaging consistent with discoid meniscus. We excluded patients who had imaging significant for discoid meniscus but were otherwise asymptomatic or those who refused to undergo surgical treatment. Treatment consisted of partial meniscectomy with saucerization in 9 cases (group A) and partial meniscectomy with saucerization (to restore the normal semilunar shape of the meniscus) and repair of the peripheral tear using FAST-FIX sutures (Smith & Nephew, Andover, MA) in the other 11 cases (group B). Saucerization included using shaving and cutting techniques where we aimed to



**Fig 1.** View of the right knee joint from the anterolateral portal revealing a complete discoid meniscus with radial damage in the posterior horn, which was subsequently repaired and saucerized. Saucerization included using shaving and cutting techniques in which we aimed to keep 8 mm of the peripheral rim while recreating the normal semilunar shape of the meniscus. (LFC, lateral femoral condyle; TIB, tibial plateau.)

keep 8 mm of the peripheral rim while recreating the normal semilunar shape of the meniscus (Fig 1). All surgeries were performed by a senior surgeon (L.N./V.G.) at a single center. Ethical approval and parental consent were obtained for each patient.

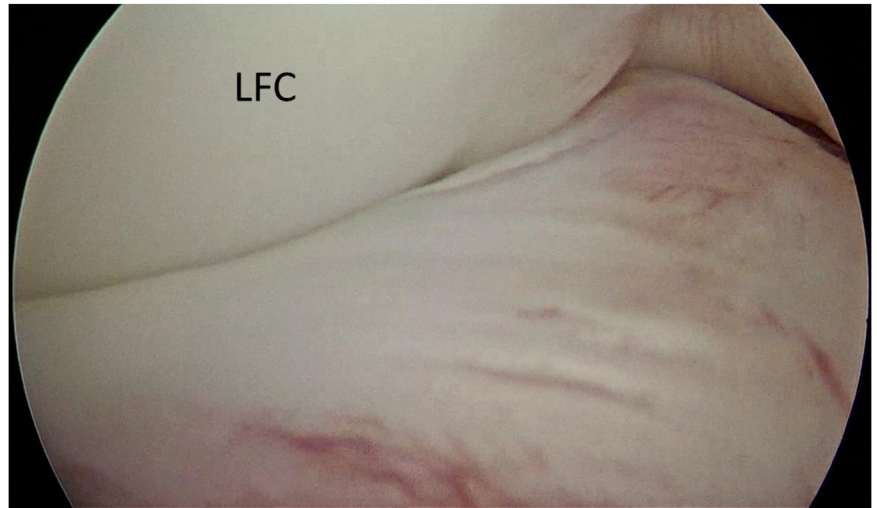
Each case of discoid meniscus was classified with the Watanabe classification<sup>5,22</sup> by MRI or at the time of surgery. Nonoperative treatment was initially prescribed for patients, ranging from 3 to 6 months, and included limited activity, immobilization and/or bracing, and subsequently physiotherapy to increase range of motion and knee strength.

Ikeuchi's<sup>7</sup> classification was used to analyze the results. The classifications are excellent—full range of motion, no knee snapping and no pain; good—infrequent pain with exertion and full range of motion; fair—slight pain, knee snapping on motion and full range of knee motion; and poor—constant pain or recurrent locking of the knee, or both. We also used the Knee Injury and Osteoarthritis Outcome Score for Children (KOOS-Child)<sup>23,24</sup> scoring system to evaluate pre- and postoperative knee function.

## Surgical Technique

Patients were operated on under laryngeal anesthesia using the standard dual-portal technique with the standard 30° arthroscope. On arthroscopic examination, the meniscus was visualized and probed to determine the type of discoid meniscus, location, and type of potential tear (Fig 2). Meniscal stability was

**Fig 2.** View from the anterolateral portal revealing a complete discoid lateral meniscus. (LFC, lateral femoral condyle.)

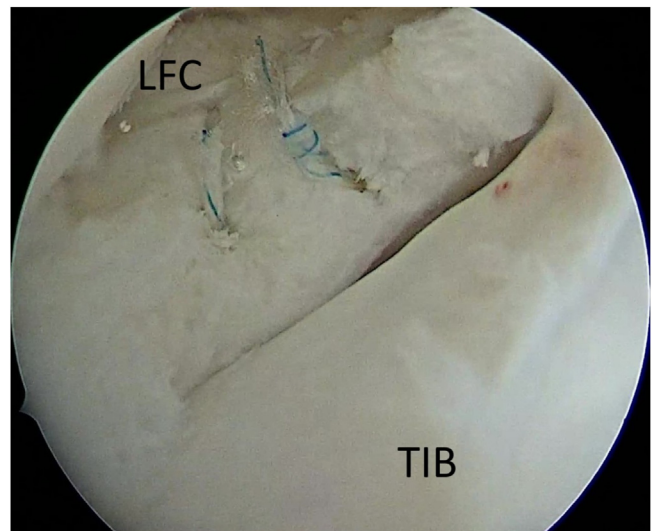


assessed and then partial central meniscectomy was performed, removing the discoid portion and any unstable/torn areas while trimming the meniscus down to a 6- to 8-mm remnant.<sup>16-20</sup> Saucerization involved using a 4.2-mm size shaver to smooth out the inner rim and recreate the natural semilunar meniscus shape.<sup>16,17</sup> In the group with longitudinal paracapsular tears of the posterior horn, meniscal paracapsular repair and reconstruction was performed using 2 to 3 Smith & Nephew “FAST-FIX” meniscal sutures (Fig 3).<sup>18-20</sup> For cases with a longitudinal tear near the anterior portion of the meniscus, a lateral incision was made to allow for improved visualization and subsequent repair.<sup>18,19</sup> The rehabilitation protocol was the same for both groups. Our rehabilitation protocol involved applying a cylinder splint and a brace, as well as an isometric exercise program followed by rest with gradual progression to full weight-bearing over several weeks.

### Results

Twenty of our patients (9 boys, 11 girls) were treated for discoid meniscus, 2 bilaterally, totaling 22 knees in all. Eleven of those patients were diagnosed with a suspected discoid meniscal tear on MRI based on the presence of a linear hyperintensity extending to either the superior or inferior meniscal surface. The average age was 8 years 4 months (ranging from 3 years, 2 months to 11 years, 6 months) at time of surgery. Minimum follow-up was 2 years, with an average of 3 years and ranged from 2 to 10 years. All 22 knees involved the lateral meniscus. All 22 knees had good-to-excellent results and an average KOOS-Child score of 93 at a minimum of 2 year follow-up. There was a total of 19 excellent (86%) and 3 good (14%) results at the time of the most recent follow up (Figs 4 and 5) (Table 1). Postoperative

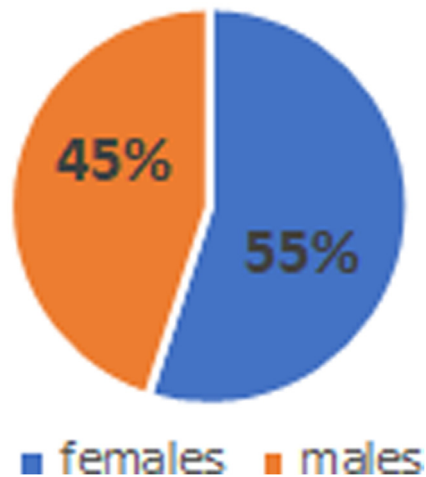
radiographs were not significant for any osteoarthritic changes for all patients according to the Kellgren and Lawrence classification system<sup>25</sup> (Fig 6). Nonoperative treatment was unsuccessful in all 20 cases and no patients were lost to follow-up. There were 2 patients (10%) who had bilateral knee involvement and 1 patient (5%) had a trauma, 1 year after surgery and tore the initially repaired meniscus, was not reparable and required partial resection. All cases were good to excellent at 2 years’ follow-up. Both groups performed comparatively (good-to-excellent outcomes).



**Fig 3.** View from the anterolateral portal. The upper and lower layers of the meniscus were debrided to expose bleeding. A longitudinal paracapsular tear of the posterior horn of meniscus was then revealed and repaired with 2 to 3 Smith & Nephew “FAST-FIX” meniscal sutures. (LFC, lateral femoral condyle; TIB, tibial plateau.)



## Cases by Sex



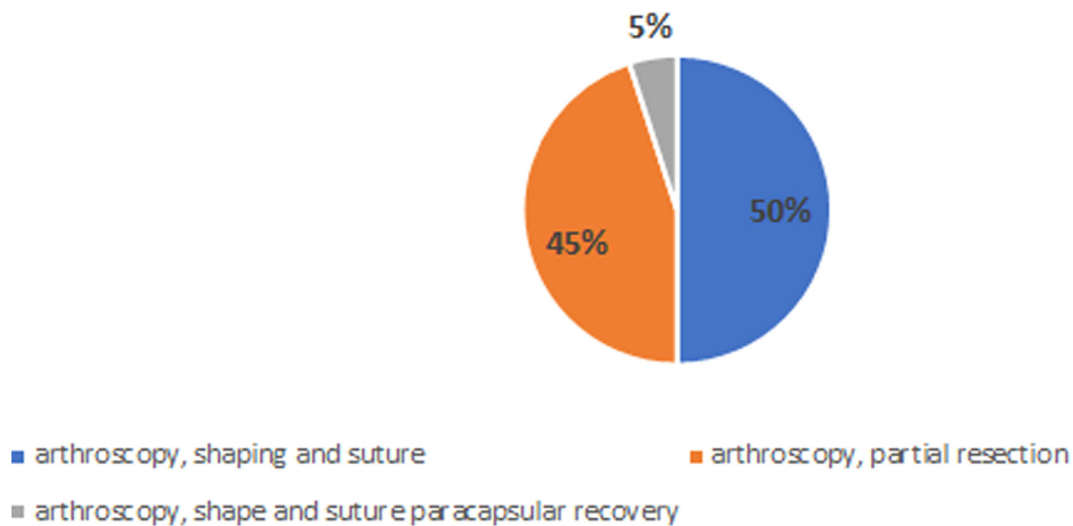
**Fig 4.** Cases distributed by sex.

### Discussion

The most important finding based on our results is that arthroscopic discoid lateral meniscus partial meniscectomy with or without repair shows good-to-excellent outcomes, is highly safe, and supports a standard of treatment going forward, especially when operated on younger patients.<sup>9,24</sup> The primary characteristic for diagnosis of discoid meniscus is a history of snapping or clicking in the knee<sup>7</sup>; yet, recent studies have reported pain being the more common complaint preoperatively.<sup>2,13,26</sup> Numerous studies have indicated that plain radiographs are not useful in establishing the diagnosis; however, arthrography and arthroscopy are

supportive.<sup>3,26-30</sup> MRI also proved to be helpful for diagnosis, with the added benefit of an increased sensitivity in sensing meniscal tears.<sup>31-33</sup> Assessment of the shape and stability of a symptomatic discoid meniscus should be the foundation for determining treatment and assessed using arthroscopic evaluation. Partial meniscectomy—with or without tear repair—and preservation of the peripheral rim done arthroscopically should be the treatment of choice for persistently symptomatic non-Wrisberg discoid menisci in children.<sup>12,22,23</sup> In addition, it is important to note that partial meniscectomy with suturing has been suggested to have fewer complications (such as decreased incidence of mediolateral instability and joint laxity) and better outcomes than total meniscectomy.<sup>10,11</sup> We decided to use the KOOS-Child self-questionnaire due to its simple language that allows children to easily understand the questions with minimal assistance from their guardian, along with that we also found the content to be easily translated to Georgian language without loss of context. The main limiting factor in arthroscopic discoid meniscus repair is high technical demand required for a successful surgery.<sup>24</sup> Surgical repair of the posterior capsular attachment of the posterior horn of the meniscus can be used as treatment and may play an important role in protecting the re-rupture due to abnormal shear forces.<sup>34-36</sup> In addition, a potential complication of saucerization and partial resection is osteochondritis dissecans of the lateral femoral condyle<sup>31</sup>; future larger-scale trials should be conducted. Our study indicates that discoid lateral meniscus more commonly affects female patients more than male patients and more often presents symptomatically at a younger age (the average age for

## Cases by Surgery Type



**Fig 5.** Cases distributed by surgery type.

**Table 1.** Patients Sex, Age, Date of Surgery, and Follow-Up Status

Case No.	Sex	Age (y + mo)	Date of Surgery	Type of Surgery	Tear Present?	Tear Pattern	Number of Stitches	1 Month Follow-Up	Most Recent Follow-Up
1	Female	7+4	2020	Arthroscopy, shaping and suture	Yes	Peripheral	2	Excellent	Excellent (3 years)
2	Female	6+3	2020	Arthroscopy, shaping and suture	Yes	Peripheral	2	Excellent	Excellent (3 years)
3	Female	11+5	2020	Arthroscopy, partial resection	No	N/A	N/A	Good	Good (3 years)
4	Female	6+7	2019	Arthroscopy, shape and suture	Yes	Radial	3	Excellent	Good (3 years)
5	Female	7+7	2020	Arthroscopy, shape and suture	Yes	Longitudinal	3	Excellent	Excellent (2 years)
6	Female	10+1	2020	Arthroscopy, shape and suture	Yes	Radial	2	Excellent	Excellent (2 years)
7	Female	10+12	2019	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (4 years)
8	Female	9+4	2018	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (4 years)
9	Female	11+9	2014	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (8 years)
10	Male	11+3	2019	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (4 years)
11	Male	11+4 11+7	2019	Arthroscopy, shaping and suture for the right knee and arthroscopy, partial resection for the left knee after 3 months	Yes No	Peripheral N/A	3 N/A	Good	Excellent (4 years)
12	Female	3+1	2021	Arthroscopy, shape and suture paracapsular recovery	Yes	Radial	3	Excellent	Excellent (2 years)
13	Male	10+7	2018	Arthroscopy, shape and suture	Yes	Longitudinal	3	Excellent	Excellent (4 years)
14	Male	11+9	2018	Arthroscopy, shape and suture	Yes	Peripheral	2	Excellent	Excellent (5 years)
15	Male	8+12	2018	Arthroscopy, shape and suture	Yes.	Simple	2	Excellent	Excellent (5 years)
16	Male	9+2	2013	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (10 years)
17	Male	9+2	2018	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (5 years)
18	Male	10+11	2015	Arthroscopy, partial resection	No	N/A	N/A	Excellent	Excellent (7 years)
19	Female	11+3 11+7	2019	Arthroscopy, shape and suture for both knees, 4 months apart	Yes	Peripheral Longitudinal	3 3	Poor	Good (4 years)
20	Male	6+1	2019	Arthroscopy, partial resection	No	N/A	N/A	Good	Excellent (3 years)

N/A, not available.



**Fig 6.** Postoperative anteroposterior radiograph of the left knee showing no significant osteoarthritic changes.

female patients was 8.2 years, whereas the average age for male patients was 9.4 years), as is consistent with previous studies.<sup>4,37-39</sup>

### Limitations

The main limiting factors of this study was the smaller sample size and shorter follow-up time, in some cases. Another limiting factor was the fact that this was a retrospective study, not a randomized study, without a control group. In addition, several variables were not obtainable postoperatively such as postoperative MRIs, body mass index, and alignment. Due to the lack of a centralized MRI storage system in our country, patients were asked to bring their preoperative MRI discs on most recent follow-up; however, due to the nature of the longer follow-up times, the patients have either lost them or forgot to get them.

### Conclusions

Arthroscopic saucerization of symptomatic non-Wrisberg discoid lateral meniscus, with additional repair as indicated, results in excellent or good outcomes in children younger than 12 years of age.

### Disclosure

All authors (G.A.R., L.N., V.G., M.A.M., T.T., I.K., M.Z.) report no conflicts of interest in the authorship and publication of this article. Full ICMJE author

disclosure forms are available for this article online, as supplementary material.

### References

1. Young RB. The external semilunar cartilage as a complete disc. Cleland J, MacKay JY, Young RB, eds. *Memoirs and memoranda in anatomy*, 1 London: Williams and Norgate, 1889;179;1, 1889.
2. Watson-Jones R. Specimen of internal semilunar cartilage as a complete disc. *Proc R Soc Med* 1930;23:588.
3. Cave EF, Staples OS. Congenital discoid meniscus of cause of internal derangement of the knee. *Am J Surg* 1941;54:371-376.
4. Davidson D, Letts M, Glasgow R. Discoid meniscus in children: Treatment and outcome. *Can J Surg* 2003;46:350-358.
5. Watanabe M, Takeda S, Ikeuchi H. *Atlas of arthroscopy*, 3rd ed. Tokyo: Igaku-Shoin, 1979;75-130.
6. Barthel T, Pesch R, Lippert MJ, Lutz G. Arthroskopische Behandlung des lateralen Scheibenmeniskus. *Arthroskopie* 1995;8:12-18 [in German].
7. Ikeuchi H. Arthroscopic treatment of the discoid lateral meniscus: technique and long-term results. *Clin Orthop* 1982;167:19-28.
8. Clark CR, Ogden JA. Development of the menisci of the human knee joint. Morphologic changes and their potential role in childhood meniscal injuries. *J Bone Joint Surg Am* 1983;65:538-547.
9. Nathan PA, Cole SC. Discoid meniscus: A clinical and pathological study. *Clin Orthop* 1969;64:107-113.
10. Kim SJ, Kim DW, Min BH. Discoid lateral meniscus associated with anomalous insertion of the medial meniscus. *Clin Orthop* 1995;315:234-237.
11. Hede A, Larsen E, Sandberg H. Partial versus total meniscectomy. A prospective, randomised study with long-term follow-up. *J Bone Joint Surg Br* 1992;74:118-121.
12. Ozeki N, Koga H, Nakamura T, et al. Surgical repair of symptomatic Wrisberg variant discoid lateral meniscus with pull-out repair and capsulodesis. *Arthrosc Tech* 2021;11:e61-e68.
13. Barnes CL, McCarthy RE, Vanderschelden JL, McConnell JR, Nusbickel FR. Discoid lateral meniscus in a young child: Case report and review of the literature. *J Pediatr Orthop* 1988;8:707-709.
14. Chen YC. Arthroscopic meniscectomy of the discoid meniscus. *Arthroscopy* 1988;4:131-135.
15. Okazaki K, Miura H, Matsuda S, Hashizume M, Iwamoto Y. Arthroscopic resection of the discoid lateral meniscus: long-term follow-up for 16 years. *Arthroscopy* 2006;22:967-971.
16. Raber DA, Friederich NF, Hefti F. Discoid lateral meniscus in children: Long-term follow-up after total meniscectomy. *J Bone Joint Surg Am* 1998;80:1579-2586.
17. Hayashi LK, Yamaga H, Ida K, Miura T. Arthroscopic meniscectomy for discoid lateral meniscus in children. *J Bone Joint Surg Am* 1988;70:1495-1500.
18. Ahn JH, Lee SH, Yoo JC, Lee YS, Ha HC. 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* 2008;24:888-898.
19. Ahn JH, Kim KI, Wang JH, Jeon JW, Cho YC, Lee SH. Long-term results of arthroscopic reshaping for symptomatic discoid lateral meniscus in children. *Arthroscopy* 2015;867-873.
  20. Yoo WJ, Jang WY, Park MS, et al. Arthroscopic treatment for symptomatic discoid meniscus in children: Midterm outcomes and prognostic factors. *Arthroscopy* 2015;31:2327-2334.
  21. Yoo WJ, Lee K, Moon HJ, et al. Meniscal morphologic changes on magnetic resonance imaging are associated with symptomatic discoid lateral meniscal tear in children. *Arthroscopy* 2012;28:330-336.
  22. Tiftikçi U, Serbest S. Repair of isolated horizontal meniscal tears with all-inside suture materials using the overlock method: Outcome study with a minimum 2-year follow-up. *J Orthop Surg Res* 2016;11:131.
  23. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee injury and osteoarthritis outcome score (KOOS)—development of a self-administered outcome measure. *J Orthop Sports Phys Ther* 1998;28:88-96.
  24. Örtqvist M, Roos EM, Broström EW, Janarv PM, Iversen MD. Development of the Knee Injury and Osteoarthritis Outcome Score for children (KOOS-Child): Comprehensibility and content validity. *Acta Orthop* 2012;83:666-673.
  25. Schiphof D, Boers M, Bierma-Zeinstra SM. Differences in descriptions of Kellgren and Lawrence grades of knee osteoarthritis. *Ann Rheum Dis* 2008;67:1034-1036.
  26. Silverman JM, Mink JH, Deutsch AL. Discoid menisci of the knee: MR imaging appearance. *Radiology* 1989;173:351-354.
  27. Kaplan EB. Discoid lateral meniscus of the knee joint. *J Bone Joint Surg Am* 1957;39:77-80.
  28. Aichroth PM, Patel D, Marx C. Congenital discoid lateral meniscus in children: A follow-up study and evolution of management. *J Bone Joint Surg Br* 1991;73:932-936.
  29. Bellier G, DuPont JY, Larrain M, Caudron C, Carlouz H. Lateral discoid menisci in children. *Arthroscopy* 1989;5:52-56.
  30. Bramson RT, Staple TW. Double contrast knee arthrography in children. *AJR Am J Roentgenol* 1975;123:838-844.
  31. Hall FM. Arthrography of the discoid lateral meniscus. *AJR Am J Roentgenol* 1977;218:993-1002.
  32. Haveson SB, Rein BI. Lateral discoid meniscus of the knee: Arthrographic diagnosis. *AJR Am J Roentgenol* 1970;109:581-585.
  33. Blacksins MF, Greene B, Bothelho G. Bilateral discoid medial menisci diagnosed by magnetic resonance imaging: A case report. *Clin Orthop* 1992;285:214-216.
  34. Washington ER, Root L, Liener UC. Discoid lateral meniscus in children: Long-term follow-up after excision. *J Bone Joint Surg Am* 1995;77:1357-1361.
  35. Campbell AL, Pace JL, Mandelbaum BR. Discoid lateral meniscus. *Curr Rev Musculoskelet Med* 2023;16:154-161.
  36. 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;41:23-27.
  37. Woods GW, Whelan JM. Discoid meniscus. *Clin Sports Med* 1990;9:695-706.
  38. Kelly BT, Green DW. Discoid lateral meniscus in children. *Curr Opin Pediatr* 2002;14:54-61.
  39. Randhawa S, Tran E, Segovia NA, Ganley T, Tompkins M, Ellis H, et al. Epidemiological study of the discoid meniscus: Investigating demographic-based predictors in large-scale claims database. *Cureus* 2021;13:e20050.