



Meniscopectomy leads to good mid-term to long-term outcomes for children and adolescents with discoid lateral meniscus

Yau Hong Ng¹ · Si Heng Sharon Tan¹ · Andrew Kean Seng Lim¹ · James Hoipo Hui¹

Received: 15 May 2019 / Accepted: 28 February 2020 / Published online: 12 March 2020
© European Society of Sports Traumatology, Knee Surgery, Arthroscopy (ESSKA) 2020

Abstract

Purpose To date, there have been limited studies reporting the mid- to long-term outcomes of meniscopectomies for discoid lateral meniscus. The current study aims to evaluate the mid- to long-term outcomes of arthroscopic meniscopectomy for discoid lateral meniscus in children and adolescents.

Methods In the study, all patients under the age of 21 years who had undergone arthroscopic meniscopectomy with or without meniscal repair or partial meniscectomy for symptomatic lateral discoid meniscus were included. All patients were then followed up for a minimum of 5 years (median 84 months; range 68–110 months). The Lysholm scores and Ikeuchi scores were collected pre-operatively and at final follow-up and were compared.

Results A total of 24 knees were included in the study. The median duration of follow-up was 84.0 months (range 68–110 months). The Lysholm score improved from 53 (range 11–95) pre-operatively to 100.0 (range 60–100) at final follow-up ($p < 0.001$). Based on the Ikeuchi score pre-operatively, 15 knees were rated as poor (62.5%), 7 knees were rated as fair (29.2%), and 2 knees were rated as good (8.4%). The Ikeuchi score improved significantly at the final follow-up, such that 1 knee was rated as good (4.2%) and 23 knees were rated as excellent (95.8%) ($p < 0.001$). When analysing the effect of concomitant meniscal repair or partial meniscectomy on the outcomes at final follow-up, there was no apparent difference in the improvement in Lysholm score or Ikeuchi score when comparing between patients who had meniscopectomy alone and patients who had concomitant meniscal repair, as well as when comparing between patients who had meniscopectomy alone and patients who had concomitant partial meniscectomy.

Conclusion Meniscopectomy leads to good mid-term to long-term outcomes for children and adolescents with discoid lateral meniscus. Concomitant procedures such as meniscal repair or partial meniscectomy do not improve or worsen the mid- to long-term outcomes in these patients.

Level of evidence IV.

Keywords Discoid meniscus · Discoid lateral meniscus · Meniscopectomy · Meniscus saucerisation · Meniscus saucerization · Meniscus reshaping

Dr Yau Hong Ng and Dr Si Heng Sharon Tan are both co-first authors.

✉ Si Heng Sharon Tan
sharon_sh_tan@nuhs.edu.sg

¹ Department of Orthopaedic Surgery, University Orthopaedic, Hand and Reconstructive Microsurgery Cluster, National University Health System (NUHS), 1E Kent Ridge Road, NUHS Tower Block, Level 11, Singapore 119074, Singapore

Introduction

Discoid meniscus of the knee represents an abnormal morphological variation of the meniscus that typically covers a larger than usual area of the tibial plateau [14]. It is a relatively rare congenital condition, affecting predominantly the lateral meniscus [7, 20]. The incidence worldwide varies, and the incidence of discoid lateral meniscus is reportedly higher in Asians, with up to 20% incidence in Asians as compared to 0.4% in Caucasians [3, 7, 12, 18, 20].

Most discoid lateral menisci remain asymptomatic until adulthood [20]. However, owing to the shape of the discoid meniscus, the discoid meniscus is often subjected to shear

stresses during anteroposterior translation of the lateral femoral condyle, resulting in damage to the lateral meniscus due to repeated trauma or dysplasia [6]. These patients would then present earlier in childhood with symptomatic discoid meniscus, warranting treatment to relieve the symptoms and prevent further meniscal degeneration [20].

Till date, however, there is still no consensus on the ideal mode of treatment for discoid lateral meniscus [1]. In recent years, meniscus-preserving strategies are generally preferred for the treatment of discoid lateral meniscus due to the fear of developing knee osteoarthritis arthritis after meniscectomies [7, 16]. Meniscopectomy, which involves the removal of the central part of the meniscus to restore its standard crescent shape, is, therefore, currently considered the gold-standard treatment for discoid lateral meniscus [7, 20]. Yet, to date, there have been limited studies reporting the outcomes of meniscopectomies for discoid lateral meniscus [7, 20].

The current study then aims to evaluate the mid- to long-term outcomes of arthroscopic meniscopectomy for discoid lateral meniscus in children and adolescents. The hypothesis is that arthroscopic meniscopectomy results in good outcomes for discoid lateral meniscus in children and adolescents at mid-term to long-term follow-up.

Material and methods

The study was performed in accordance with the ethical standards of the institutional research committee. The National Healthcare Group Domain Specific Review Board (Singapore) has approved the study, with the study reference being 2015/00109.

In the 11-year study, all consecutive patients under the age of 21 years who had undergone arthroscopic meniscopectomy for symptomatic lateral discoid meniscus from 2002 to 2012 in a single institution were included. The indication for surgery was symptomatic lateral discoid meniscus, with the symptoms being knee pain, clicking, snapping, locking or instability, in a setting of a magnetic resonance imaging (MRI) confirmed discoid lateral meniscus.

Patients with neoplastic, infective or fractures of the knee who presented with an incidental finding of discoid lateral meniscus were excluded. Patients who had total meniscectomies performed for the discoid lateral meniscus (three patients) were also excluded. These three patients had type III discoid menisci with grossly unstable meniscal tears with hypermobile posterior horns, resulting in the need to undergo a subtotal or total meniscectomy. The complete lack of meniscocapsular attachments circumferentially, coupled with the highly degenerate and fragmented nature of the tears, precluded less radical procedures such as meniscal repair or partial meniscectomy. These three patients,

therefore, underwent subtotal or total meniscectomies and were excluded from the study. Following the inclusion and exclusion criteria, a total of 24 knees were included in the study.

Pre-operatively, patients were evaluated on an outpatient basis and noted to have knee symptoms, including knee pain, clicking, snapping, locking or instability. These patients were then assessed using MRI pre-operatively to confirm the presence of a discoid lateral meniscus, which is defined as the presence of a contiguous lateral meniscus on three consecutive 5-mm sagittal images [14]. Patients with symptomatic lateral discoid meniscus were then consented for meniscopectomy, with or without meniscal repair or partial meniscectomy.

The demographic information, pre-operative symptomatology and functional scores of the patient were then recorded and reported. The demographic parameters recorded included the age and gender of the patients, as well as the laterality of the affected knee. The pre-operative symptomatology, including the presence or absence of knee pain, clicking, snapping, locking, instability, joint line tenderness, effusion and limited range of motion were recorded. Patients were also evaluated pre-operatively for their Lysholm scores and Ikeuchi scores.

After obtaining informed consent, the patients then underwent arthroscopic meniscopectomy, with or without meniscal repair or partial meniscectomy by one of the two senior orthopaedic surgeons. Diagnostic arthroscopy was first performed with particular attention paid to the evaluation of the meniscus. The discoid lateral meniscus was classified intraoperatively according to the Watanabe classification. The Watanabe classification classifies discoid meniscus into complete (type I), incomplete (type II) or Wrisberg ligament-type (type III) menisci depending on the presence or absence of a normal posterior attachment and the degree of tibial plateau coverage [14]. A complete discoid meniscus (type I) refers to a discoid meniscus that fills the entire lateral compartment, has normal peripheral attachment and is stable to probing [14]. An incomplete discoid meniscus (type II) refers to a discoid meniscus that does not fill the entire lateral compartment, has normal peripheral attachment and is stable to probing [14]. A Wrisberg ligament-type discoid meniscus (type III) refers to a discoid meniscus that lacks posterior meniscal attachment, has Wrisberg ligament attachment and is hypermobile at the posterior horn [14]. The presence of any meniscal tear or associated knee pathologies was also noted intraoperatively.

Meniscopectomy was then performed. This involved the recreation of the normal semi-lunar morphology of the lateral meniscus by resection of the central “discoid” portion of the meniscus using an arthroscopic radiofrequency wand to perform a more precise meniscal cut, while avoiding damage to the underlying chondral surface. The meniscus was then

debrided down to a rim of 8 mm, based on the findings of Hayashi et al. which demonstrated a higher rate of meniscal rears with more than 8 mm of remnant meniscal width [11]. In the presence of a meniscal tear, meniscal repairs were attempted for cases with the goal of meniscal preservation, even for tears located in the red–white or white–white zones. Arthroscopic all-inside repair was the technique of choice for meniscal body tears and posterior horn bucket-handle tears; while, the outside–in technique was employed for the anterior horn tears if they were found non-amenable to an all-inside repair. Patients whose meniscal tears were not amenable to repair, usually due to the degenerate nature of the meniscus causing it to be impossible to pass sutures through for a stable and anatomical repair, underwent partial meniscectomy. These patients were typically discharged on the day of the surgery or 1 day after the surgery, depending on the patient's preference.

Patients were then followed up outpatient at 6 weeks, 3 months, 1 year, 2 years, then every 2nd year thereafter. Patients included in the study had a minimum of 5-year follow-up duration before the conclusion of the study. The post-operative Lysholm score and Ikeuchi scores were obtained at the final follow-up.

Statistical analysis

Statistical Package for the Social Sciences (SPSS) 23.0 was used for statistical analysis. Non-parametric statistical analyses were used due to the small sample size. When comparing between the pre-operative and post-operative scores, Wilcoxon signed rank test was used for Lysholm score, and marginal homogeneity exact test was used for Ikeuchi score. Statistical analysis to compare between the different surgical techniques was not performed in view of the small number of patients in each subgroup. A p -value of <0.05 was considered statistically significant.

As there was no previous similar study to calculate sample size, a post hoc power analysis was performed. With the significance level fixed at 5%, the statistical power of the study was 99.9%, given a sample size of 24 patients with an average pre-operative Lysholm score of 54.7 (standard deviation 19.0) and an average post-operative Lysholm score of 96.6 (standard deviation 8.3).

Results

Twenty-four knees were included in the study. This included nine women (37.5%) and fifteen men (62.5%). Twelve of these knees were bilateral from six patients. The median age of the patients was 14 years (range 8–21 years). The median duration of follow-up was 84 months (range 68–110 months).

The most common presenting complaint for symptomatic discoid lateral meniscus in children and adolescents was knee pain. Knee pain was reported in 21 knees (87.5%), clicking or snapping of the knee was reported in 17 knees (70.1%), locking was reported in 15 knees (62.5%), and instability was reported in 3 knees (12.5%). On examination, all knees had lateral joint line tenderness (100.0%), and 1 knee had a joint effusion (4.2%). None of the patients had a limited range of motion. The median pre-operative Lysholm score was 53 (range 11–95). Based on the Ikeuchi score pre-operatively, 15 knees were rated as poor (62.5%), 7 knees were rated as fair (29.2%), and 2 knees were rated as good (8.4%).

Intraoperatively, the discoid lateral meniscus was classified according to the Watanabe classification. The most common type of discoid lateral meniscus encountered was type II discoid meniscus, which was seen in 16 knees (66.7%). 7 knees had type I discoid meniscus (29.2%); while, 1 knee had type III discoid meniscus (4.2%). Five of the knees had no meniscal tears and, therefore, underwent meniscectomy alone without meniscal repair or partial meniscectomy (20.8%). Among the remaining cases with meniscal tears, meniscal repair was successfully performed before meniscectomy in 2 knees (8.3%). These 2 knees happened to be the only knees with peripheral meniscal tears involving the red–red zone. Both tears were horizontal cleavage-type tears involving the meniscal body, and both meniscal tears were stably repaired arthroscopically using the all-inside technique. The other 17 knees with meniscal tears were treated with partial meniscectomies (70.8%). Invariably, all knees that required partial meniscectomies were delayed presentations or referrals from other institutions after an extended period of failed conservative treatment. The most common underlying reason for irreparability was the degenerate nature of the meniscal tear, which made it impossible to pass sutures through for a stable and anatomical repair.

At the time of the final follow-up, the median post-operative Lysholm score was 100 (range 60–100). There was a statistically significant improvement in the Lysholm score post-operatively as compared to pre-operatively ($p < 0.001$) (Table 1). Based on the Ikeuchi score at the final follow-up, 1 knee was rated as good (4.2%), and 23 knees were rated as excellent (95.8%). Similarly, there was statistically significant improvement in the Ikeuchi score post-operatively as compared to pre-operatively ($p < 0.001$) (Table 1).

When analysing the effect of concomitant meniscal repair or partial meniscectomy on the outcomes at final follow-up, there was no apparent difference in the improvement in Lysholm score or Ikeuchi score when comparing between patients who had meniscectomy alone and patients who had concomitant meniscal repair, as well as when comparing between patients who had meniscectomy alone and patients who had concomitant partial meniscectomy (Table 2).

Table 1 Comparison of the pre-operative and post-operative Lysholm score and Ikeuchi score

Functional scores	Pre-operative (N=24)		Post-operative (N=24)		p-value
	Median	Range	Median	Range	
Lysholm score	53.0	11.0–95.0	100.0	60.0–100.0	<0.001
	Frequency	Percentage	Frequency	Percentage	
Ikeuchi score					<0.001
Excellent	0	0.0	23	95.8	
Good	2	8.4	1	4.2	
Fair	7	29.2	0	0.0	
Poor	15	62.5	0	0.0	

Table 2 Comparison of the post-operative Lysholm score and Ikeuchi score between patients who had meniscoplasty alone, meniscoplasty with meniscal repair and meniscoplasty with partial meniscectomy

Functional scores	Meniscoplasty alone (N=5)		Meniscoplasty + meniscal repair (N=2)		Meniscoplasty + partial meniscectomy (N=17)	
	Median	Range	Median	Range	Median	Range
Lysholm score	100.0	60.0–100.0	100.0	NA	100.0	91.0–100.0
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Ikeuchi score						
Excellent	4	80.0	2	100.0	17	100.0
Good	1	20.0	0	0.0	0	0.0
Fair	0	0.0	0	0.0	0	0.0
Poor	0	0.0	0	0.0	0	0.0

However, no statistical analysis to compare between the different surgical techniques was performed in view of the small number of patients in each subgroup.

There were no immediate- or long-term complications noted before the conclusion of the study, such as infection, recurrent effusion, severe bleeding, arthrofibrosis or instability of the knee. There were no re-arthroscopies before the conclusion of the study.

Discussion

The principal finding of the study is that meniscoplasty leads to good mid- to long-term outcomes for children and adolescents with discoid lateral meniscus. Additionally, concomitant procedures such as meniscal repair or partial meniscectomy do not improve or worsen the mid- to long-term outcomes in these patients.

These findings are similar to the other series that have been published in the current literature [2, 4–10, 13, 15, 17, 19–22]. Indeed, multiple studies have demonstrated good outcomes with meniscoplasty for discoid lateral meniscus

[2, 4–10, 13, 15, 17, 19–22]. However, most of these studies have a short follow-up period, with only one other study having more than 5 years of follow-up for all patients included in their studies [7]. In that study, Chedal-Bornu et al. similarly reported good functional scores in 14 knees, including both paediatric and adult knees, that have undergone arthroscopic meniscoplasty for lateral discoid meniscus tears [7].

In contrast to the study by Chedal-Bornu et al., however, the current study focuses on the mid- to long-term outcomes of children and adolescents who had arthroscopic meniscoplasty for discoid lateral meniscus. This is because discoid lateral meniscus is a congenital condition, which can be symptomatic in children and adolescents; therefore, further evaluation regarding the mid- to long-term outcomes of the surgical management of discoid lateral meniscus in children is warranted [6, 7, 20]. Here, in the current study, it can then be identified that arthroscopic meniscoplasty can indeed similarly lead to good mid- to long-term outcomes in children and adolescents, with improved Lysholm scores and Ikeuchi scores at a minimum of 5-year follow-up.

Additionally, the current study identified that concomitant procedures such as meniscal repair or partial

meniscectomy do not appear to improve or worsen the mid- to long-term outcomes in these patients. While meniscus-preserving strategies are generally preferred for the treatment of discoid lateral meniscus due to the fear of developing knee osteoarthritis arthritis after meniscectomies, the current study identified that patients who had meniscopectomy alone, patients who had meniscopectomy with meniscal repair and patients who had meniscopectomy with partial meniscectomy fared similarly at 5- to 10-year follow-up. These findings are similarly echoed in another study by Carter et al. who performed a comparative study between patients who had meniscopectomy alone and patients who had meniscopectomy with meniscal repair and found that there was no significant difference in clinical outcomes and complication rates at an average of 15-month follow-up [7]. The current study then compared between patients who had meniscopectomy alone, meniscopectomy with meniscal repair and meniscopectomy with partial meniscectomy, and found that neither meniscal repair or partial meniscectomy improve or worsen clinical outcomes at a minimum of 5 years follow-up. This then prompts the need to review the clinical strategy of attempting meniscal repairs for all cases of meniscal tear in the setting of a discoid lateral meniscus especially when they are in the zone which is traditionally managed with meniscectomy than repair.

However, despite the novel findings in the current study, this study faces several limitations. Firstly, the study is limited by the small sample size. This limits the statistical comparison between the different surgical techniques used. Despite so, the sample size is already similar or larger than many other published studies on meniscopectomy for discoid lateral meniscus due to the low incidence of the condition [2, 4–10, 13, 15, 17, 19–22]. The post hoc power analysis also indicates that the number of patients included in the study was sufficient to validate the conclusions drawn from the study. Additionally, while this study represents one of the longer-term studies on the outcomes of lateral discoid meniscus, further follow-up of this group of patients or further longer-term studies are warranted to verify the long-term outcomes of these patients. This is especially in the setting of a recent publication by Haskel et al. which showed a decline in the functional outcome scores at long-term follow-up as compared to a short-term follow-up [10]. A longer-term follow-up would also allow us to better reconsider the decision whether to perform concomitant meniscal repairs or partial meniscectomies for meniscal tears in the setting of discoid lateral meniscus. Lastly, the study is also limited by the lack of a control group comprising of patients with discoid menisci that were managed non-surgically, and further studies that include patients with discoid menisci that were managed non-surgically can then shed further light on the difference in outcomes in the various groups.

Conclusion

Meniscopectomy leads to good mid-term to long-term outcomes for children and adolescents with discoid lateral meniscus. Concomitant procedures such as meniscal repair or partial meniscectomy do not improve or worsen the mid- to long-term outcomes in these patients.

Compliance with ethical standards

Conflict of Interest The authors declare that they have no conflict of interest.

Funding There is no funding source.

Ethical approval The study was performed in accordance with the ethical standards of the institutional research committee.

References

1. Abdon P, Turner MS, Pettersson H, Lindstrand A, Stenström A, Swanson AJ (1990) A long-term follow-up study of total meniscectomy in children. *Clin Orthop Relat Res* 257:166–170
2. Atanda A Jr, Wallace M, Bober MB, Mackenzie W (2016) Arthroscopic treatment of discoid lateral meniscus tears in children with achondroplasia. *J Pediatr Orthop* 36(5):e55–58
3. Bin SI, Kim JC, Kim JM, Park SS, Han YK (2002) Correlation between type of discoid lateral menisci and tear pattern. *Knee Surg Sports Traumatol Arthrosc* 10:218–222
4. Carabajal M, Allende GJ, Masquijo JJ (2019) Mid-term results of arthroscopic remodelling combined with peripheral repair in children with unstable discoid meniscus. *Rev Esp Cir Ortop Traumatol*. <https://doi.org/10.1016/j.recot.2019.10.002>
5. Carter CW, Hoellwarth J, Weiss JM (2012) Clinical outcomes as a function of meniscal stability in the discoid meniscus: a preliminary report. *J Pediatr Orthop* 32(1):9–14
6. Chambers HG, Chambers RC (2019) The natural history of meniscus tears. *J Pediatr Orthop*. <https://doi.org/10.1097/BPO.0000000000001386>
7. Chedal-Bornu B, Morin V, Saragaglia D (2015) Meniscopectomy for lateral discoid meniscus tears: long-term results of 14 cases. *Orthop Traumatol Surg Res* 101(6):699–702
8. Good CR, Green DW, Griffith MH, Valen AW, Widmann RF, Rodeo SA (2007) Arthroscopic treatment of symptomatic discoid meniscus in children: classification, technique, and results. *Arthroscopy* 23(2):157–163
9. Hagino T, Ochiai S, Senga S, Yamashita T, Wako M, Ando T, Haro H (2017) Arthroscopic treatment of symptomatic discoid meniscus in children. *Arch Orthop Trauma Surg* 137(1):89–94
10. Haskel JD, Uppstrom TJ, Dare DM, Rodeo SA, Green DW (2018) Decline in clinical scores at long-term follow-up of arthroscopically treated discoid lateral meniscus in children. *Knee Surg Sports Traumatol Arthrosc* 26(10):2906–2911
11. Hayashi LK, Yamaga H, Ida K, Miura T (1988) Arthroscopic meniscectomy for discoid lateral meniscus in children. *J Bone Joint Surg Am* 70(10):1495–1500

12. Ikeuchi H (1982) Arthroscopic treatment of the discoid lateral meniscus. technique and long-term results. *Clin Orthop Relat Res* 167:19–28
13. Kose O, Celiktas M, Egerci OF, Guler F, Ozyurek S, Sarpel Y (2015) Prognostic factors affecting the outcome of arthroscopic saucerization in discoid lateral meniscus: a retrospective analysis of 48 cases. *Musculoskelet Surg* 99(2):165–170
14. Kushare I, Klingele K, Samora W (2015) Discoid meniscus: diagnosis and management. *Orthop Clin North Am* 46(4):533–540
15. Lee SW, Chun YM, Choi CH, Kim SJ, Jung M, Han JW, Kim SH (2016) Single-leaf partial meniscectomy in extensive horizontal tears of the discoid lateral meniscus: does decreased peripheral meniscal thickness affect outcomes? (Mean four-year follow-up). *Knee* 23(3):472–477
16. McDermott ID, Amis AA (2006) The consequences of meniscectomy. *J Bone Joint Surg Br* 88B(12):1549–1556
17. Ohnishi Y, Nakashima H, Suzuki H, Nakamura E, Sakai A, Uchida S (2018) Arthroscopic treatment for symptomatic lateral discoid meniscus: the effects of different ages, groups and procedures on surgical outcomes. *Knee* 25(6):1083–1090
18. Seong SC, Park MJ (1992) Analysis of the discoid meniscus in Koreans. *Orthopedics* 15:61–65
19. Vandermeer RD, Cunningham FK (1989) Arthroscopic treatment of the discoid lateral meniscus: results of long-term follow-up. *Arthroscopy* 5(2):101–109
20. Wasser L, Knörr J, Accadbled F, Abid A, Sales De Gauzy J (2011) Arthroscopic treatment of discoid meniscus in children: clinical and MRI results. *Orthop Traumatol Surg Res* 97(3):297–303
21. Wong T, Wang CJ (2011) Functional analysis on the treatment of torn discoid lateral meniscus. *Knee* 18(6):369–372
22. Yamasaki S, Hashimoto Y, Takigami J, Terai S, Takahashi S, Nakamura H (2017) Risk factors associated with knee joint degeneration after arthroscopic reshaping for juvenile discoid lateral meniscus. *Am J Sports Med* 45(3):570–577

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.