Combined Meniscal Saucerization and Repair Versus Subtotal Meniscectomy for Symptomatic Discoid Lateral Meniscal Tears in Children and Adolescents

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Background: Meniscal saucerization combined with repair of a symptomatic discoid lateral meniscus (DLM) has been expanding. However, the significance of meniscal saucerization with repair involving complex or degenerative tears remains uncertain.

Purpose/Hypothesis: The purpose of this study was to assess the radiological and clinical outcomes of saucerization with repair performed for symptomatic DLM tears in children and adolescents in comparison with a historical control cohort undergoing subtotal meniscectomy. It was hypothesized that saucerization with repair would lead to superior outcomes compared with subtotal meniscectomy.

Study Design: Cohort study; Level of evidence, 3.

Methods: This study group consisted of 27 knees in 21 patients who underwent saucerization with repair (SR group) between 2011 and 2018, while the historical control group included 22 knees in 20 patients who underwent subtotal meniscectomy (SM group) between 2005 and 2011. Patient age at the time of surgery ranged from 4 to 18 years (mean, 12.1 years). Clinical outcomes were assessed using the Lysholm score. The Tapper and Hoover classification based on Rosenberg view radiographs was adopted, and lateral joint space width was measured as a parameter for cartilage/meniscus preservation. Clinical and radiological results were evaluated preoperatively, 2 years postsurgery, and until the final follow-up.

Results: The mean follow-up period was 50.6 ± 17.0 months in the SR group and 62.3 ± 41.0 months in the SM group. Lysholm scores significantly improved postoperatively in both groups ($P < .001$). As for radiological evaluation, a progression in the Tapper and Hoover classification grade and a significant increase in lateral joint space width ($P < .001$) between the right and left sides were observed in both groups at 2 years postoperatively, with no significant differences between groups. Complications included postoperative retearing in 5 cases (18.5%) from the SR group, and osteochondritis dissecans (OCD) developed after surgery in 1 knee (4%) in the SR group and 6 knees in the SM group (27%), with a significantly higher incidence in the SM group ($P = .036$).

Conclusion: Both groups showed progressive postoperative radiographic degeneration, and clinical outcomes also improved in both groups. Based on the incidence of OCD development, saucerization with repair for complex DLM tears showed advantages over subtotal meniscectomy.

Keywords: knee; meniscus; discoid lateral meniscus; saucerization with repair; subtotal meniscectomy; osteochondritis dissecans; pediatric sports medicine

Discoid lateral meniscus (DLM) is a congenital anatomic abnormality of the lateral meniscus. Previous literature has reported that DLM occurs in 0.4% to 17% of the population, with a higher prevalence among Asian populations.[9,13] DLM is mechanically vulnerable because of its morphological and structural properties and is associated with a greater frequency of meniscal tears that present with related symptoms such as pain, clicking, and limited extension.[2,28]

With regard to the treatment of symptomatic DLM, nonoperative management leads to a fairly high failure

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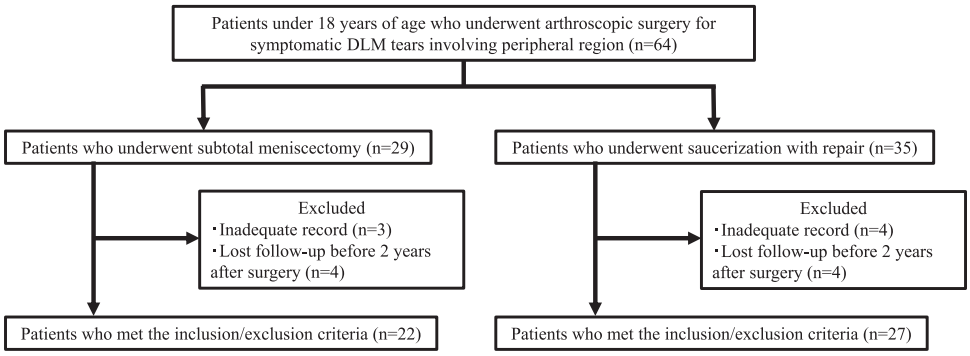

Figure 1. Flowchart of the patient selection process. DLM, discoid lateral meniscus.

rate[19] and surgery is indicated for those with prolonged or marked symptoms and functional impairment. Conventionally, total or subtotal meniscectomy has been a primary surgical option,[4,10,29,31] and there have been studies reporting satisfactory clinical outcomes.[4,10,29] However, postoperative progression of osteoarthritis secondary to the loss of meniscal function has been raised as a long-term problem.[17,20,31] In addition, changes in mechanical force transmission after discoid lateral meniscectomy may induce the development of osteochondritis dissecans (OCD) as another postoperative complication.[24,31]

To avoid these problems and preserve meniscal function, meniscal saucerization has emerged as an alternative to (sub-)total meniscectomy. There have been some studies comparing clinical and radiological outcomes of saucerization (with or without repair) versus (sub-)total meniscectomy of a symptomatic DLM.[3,4,19,37] Smuin et al[33] conducted a systematic review of these studies and stated better long-term results for the knee after saucerization. However, reported results vary from study to study, and the clinical significance of meniscal preservation in saucerization remains to be clarified.

Most symptomatic DLM tears exhibit a complex tear type, which involves peripheral tears and rim instability.[6] In such cases, (sub-)total meniscectomy has been the conventional surgical option, but in recent years, a combination of meniscal saucerization and repair has been advocated to preserve meniscal function.[1,3,8,30,32,37,39,40] Unstable (inferior) leaves of horizontal or degenerative tears, which were subject to resection in previous relevant studies,[34] are now being expanded in our current practice to include previously "unsalvageable" tears as well as indications for repair. However, the significance and clinical outcomes of meniscal saucerization with repair for symptomatic DLM tears including complex or degenerative tears still remain uncertain.

In our practice, the primary surgical option for symptomatic DLM changed from meniscectomy to saucerization in 2011. The purpose of this study was to assess the radiological and clinical outcomes of saucerization with repair performed for symptomatic DLM tears in children and adolescents compared with a historical control cohort that underwent subtotal meniscectomy. It was hypothesized that compared with subtotal meniscectomy, saucerization with repair would yield superior clinical and radiological results.

METHODS

Study Population and Design

A consecutive series of patients with symptomatic DLM injuries who underwent surgery at a single institution between April 2005 and December 2018 were eligible for the study. Inclusion criteria were limited to patients who were 18 years of age or younger at the time of surgery and had meniscal tears involving the peripheral region or those with peripheral instability who underwent subtotal meniscectomy between 2005 and 2011 and saucerization with repair between 2011 and 2018. Exclusion criteria were a concomitant surgical procedure to the index knee, combined injury to the cruciate ligament, inadequate documentation, and patients lost to follow-up before 2 years postoperatively (Figure 1).

This study was approved by our institutional review board (No. 4028) and written informed consent was obtained from all patients and families.

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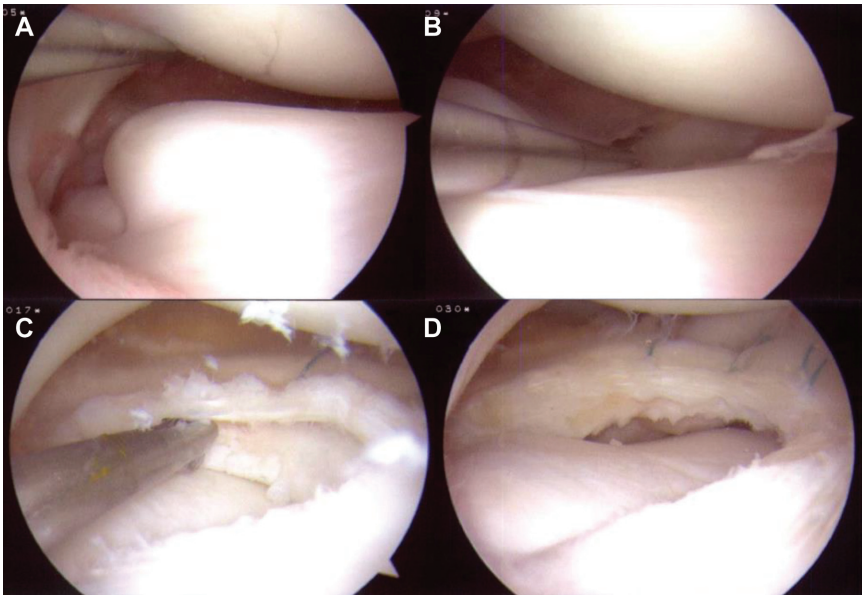

Figure 2. Intraoperative photographs obtained in a 12-year-old boy. (A) Complete discoid lateral meniscus of the left knee. (B) Peripheral tear at the posterolateral area. (C) Probing of the horizontal tear after saucerization. (D) Postoperative view after saucerization with repair.

Surgical Options and Procedures

All surgeries were performed by 1 of the 2 senior surgeons (S.Y. and H.N.). Surgery was indicated if persistent mechanical pain or meniscus-related symptoms persisted despite 3 months of nonoperative treatment.

Arthroscopic surgery was performed under general anesthesia. First, the type of DLM (location, type of tear, and presence of concomitant intra-articular lesions) was confirmed by arthroscopic examination and determined based on the Watanabe classification.[38] When a meniscal tear or instability at the meniscocapsular region was identified, a subtotal meniscectomy was performed between 2005 and 2011, but since 2011, saucerization with meniscal repair has been the primary surgical option for all types of tears, including complex and degenerative tears. Subtotal meniscectomy was defined as a meniscectomy in which the remaining peripheral meniscus was <3 mm wide.[16,17] During the saucerization with repair procedure, first, the central portion of the meniscus was resected and the peripheral portion was truncated from 6 mm to 8 mm in width.[3] If there was significant displacement at the peripheral tear site, a temporary reduction with 1 or 2 sutures was performed by meniscal repair before resection. After partial central meniscectomy, careful arthroscopic evaluation for meniscal instability and presence of tears was repeated by probing the remaining rim and body of the DLM. Even if horizontal or complex tears were present in the remaining meniscal substance, the tear site was repaired as a whole, while only a portion with severe damage and degeneration was minimally resected. After debriding the edge of the meniscus and capsule at the repair site using a rasp, the torn ends were approximated with multiple sutures using an inside-out technique with zone-specific cannula (Smith & Nephew) used for the central and posterior regions. Sutures were placed vertically, approximately 4 mm apart, with one end directed inferiorly and the other superiorly. This suture configuration effectively closed the gap between apposing edges of the tear. Through use of the Meniscal Mender system (Smith & Nephew), anterior segment tears were repaired using an outside-in technique with vertical, braided, nonabsorbable sutures (Figure 2). In the repair of the combined intrasubstance (horizontal) and degenerative tears, an autogenous fibrin clot was prepared intraoperatively and implanted into the repair site as biological augmentation.[26]

Postoperative Rehabilitation

After subtotal meniscectomy, range of motion exercises were initiated immediately after surgery, and full weightbearing was allowed the following day as tolerated by the patient. Return to sports activities was permitted at 2 to 3 months postsurgery.

In cases of saucerization with repair, the operated knee was immobilized with a brace and weightbearing was prohibited for 3 weeks. Partial weightbearing with crutches supporting half of the patient's body weight began in the third week postoperatively and progressed to full weightbearing by the fourth week. Return to sports activities was permitted 6 months postoperatively.

Evaluation

Preoperative clinical and radiological evaluations were performed immediately before surgery, and comprehensive

TABLE 1
Patient Data[a]

	Subtotal Meniscectomy (n = 22)	Saucerization With Repair (n = 27)	*P*
Male/female	12/10 (55/45)	16/11 (59/41)	.740
Age at operation, y	11.9 ± 3.4 (4-18)	12.2 ± 2.8 (4-17)	.685
Complete/incomplete	20/2 (91/9)	23/4 (85/15)	.543
Right/left/bilateral	12/6/2 (60/30/10)	8/7/6 (38/33/29)	.240
Open/closed physis	21/1 (95/5)	25/2 (93/7)	.677
Follow-up, mo	62.3 ± 41.0 (24-164)	50.6 ± 17.0 (25-96)	.793
Predominant tear type, n	8/8/6	15/2/10	.043
Peripheral/horizontal/complex tear, %	36/36/28	56/7/37	

[a]Data are presented as n (%) or mean ± SD (range) unless otherwise indicated.

postoperative evaluations were performed 2 years postoperatively, with subsequent periodic (yearly) follow-ups.

Clinical results were assessed using the Lysholm knee score as an outcome measure. Radiological evaluation was conducted with posteroanterior weightbearing radiographs using the Rosenberg view. The Tapper and Hoover classification was applied to assess postoperative degenerative changes, and lateral joint space width (LJSW) was measured as a parameter of the combined thickness of the cartilage and meniscus. Sequential changes in the Tapper and Hoover classification grade and left-right difference in LJSW were examined by comparing the pre- and postoperative results. The Tapper and Hoover classification used to determine grade was as follows: grade 0, normal radiographs; grade 1, squaring of the tibial margin; grade 2, flattening of the femoral condyle, squaring and sclerosis of the tibial plateau; grade 3, narrowing of the joint space and hypertrophic changes; and grade 4, a more severe degree of all these changes.[36] In the assessment of postoperative LJSW changes, 8 patients (subtotal: 2, repair: 6) who underwent bilateral surgery were excluded from the analysis because a side-to-side comparison was not feasible for those knees.

During the follow-up period, information regarding surgical failures and complications such as decreased range of motion of the knee joint, retear of the repaired meniscus, development of OCD, and additional surgery was extracted from the patient records until the final follow-up. Revision meniscal surgery was indicated for persistently symptomatic retear. Regarding the treatment of postoperative OCD lesions, nonoperative treatment with activity restriction was applied for the first 3 months, and surgical treatment such as drilling, internal fixation, and autologous osteochondral transplantation was indicated for those with failed nonoperative treatment.[21]

Statistical Analysis

All statistical analyses were performed using JMP (Version 15; SAS Institute Inc). The normality of the data distribution was assessed using the Shapiro-Wilk test. Based on the results of the data distribution evaluation, differences among demographic parameters were analyzed using the Mann-Whitney *U* test, and those among categorical variables were analyzed using the chi-square test. The pre- and postoperative values of the Lysholm score and radiographic parameters were compared using a paired *t* test. The Fisher exact test was used for statistical analysis of the incidence of postoperative complications and the Tapper and Hoover classification. Statistical significance was assumed with a P value $<.05$.

RESULTS

Patient Data

Initially, a consecutive series of 64 knees in 54 patients were eligible for inclusion in this study. However, as shown in Figure 1, 15 knees were subsequently excluded from the analysis, bringing the final study population to 41 individuals and 49 knees. Subtotal meniscectomy was performed on 22 knees in 20 patients (SM group) and saucerization with repair on 27 knees in 21 patients (SR group). Although every attempt was made to repair any type of tear since 2011, there was 1 knee with a severely complex degenerative tear extending to the peripheral region that was deemed unsalvageable and underwent subtotal meniscectomy. The patient data for each procedure group are shown in Table 1.

Clinical and Radiological Outcomes

Lysholm scores improved significantly after both procedures ($P < .001$). In a comparison of the 2 groups, the overall score at 2 years postoperatively was significantly greater in the SR group (mean, 96.5 vs 93.3; $P = .036$) (Table 2).

The results of the Tapper and Hoover classification are shown in Figure 3. The majority (90%) of knees did not exhibit any changes before surgery. During the postoperative 2 years, no appreciable change in the radiological grade was noted for 55% of cases in the SM group and 40% in the SR group. Postoperative progression $\geq$2 grades was observed in 9% of the SM group and 7% of the SR group. Statistical analysis showed no significant differences between groups.

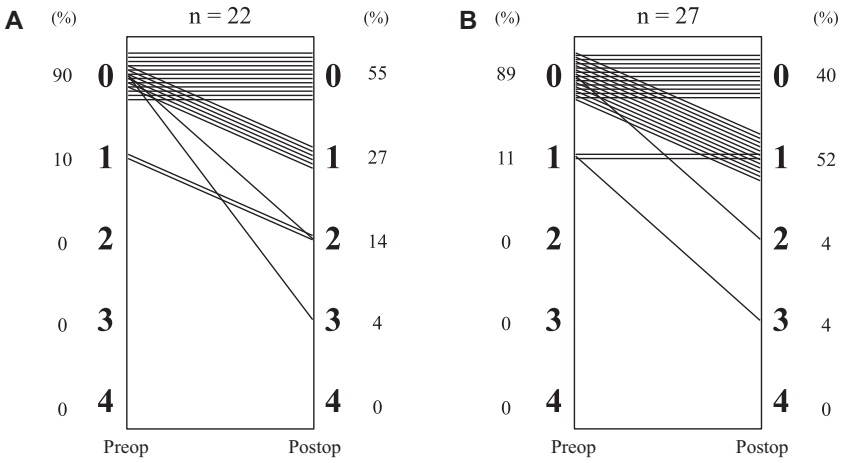

Figure 3. Postoperative change in Tapper and Hoover classification grade, shown as a line plot with each line representing a single patient. Numbers on the preoperative (preop) and postoperative (postop) axes indicate Tapper and Hoover classification grades at the preoperative and postoperative evaluations, respectively. (A) Subtotal meniscectomy. (B) Saucerization with repair.

TABLE 2
Comparison of the Lysholm Scores Between Groups and Time Points[a]

	Subtotal Meniscectomy	Saucerization With Repair	*P*
Preoperative	79.1 ± 6.8	76.0 ± 7.3	.151
Postoperative	93.3 ± 4.2	96.5 ± 4.0	.036
P	<.001	<.001	

[a]Data are presented as mean ± SD.

TABLE 3
Comparison of LJSW Between Groups and Time Points[a]

	Subtotal Meniscectomy	Saucerization With Repair	*P*
LJSW, mm			
Preop	7.65 ± 2.2	7.30 ± 1.9	.574
Postop	4.91 ± 1.4	5.08 ± 1.5	.692
P value	**<.001**	**<.001**	
Side-to-side difference in LJSW, mm[b]			
Preop	0.39 ± 2.2	0.03 ± 2.0	.608
Postop	1.71 ± 1.6	1.44 ± 1.5	.641
P value	**.022**	**.003**	

[a]Data are presented as mean ± SD. Bold *P* values indicate statistical significance. LJSW, lateral joint space width; postop, postoperative; preop, preoperative.

[b]In the comparison of postoperative LJSW side-to-side difference, 8 patients (subtotal: 2; repair: 6) who underwent bilateral surgeries were excluded.

In the LJSW measurement of the operated knee, the values taken at the 2-year follow-up were significantly lower in both groups compared with their respective preoperative values ($P < .001$). As for the side-to-side difference in LJSW, significant increases in the calculated values were noted at 2 years postoperatively in both treatment groups with no significant intergroup difference (Table 3).

Postoperative complications were as shown in Table 4. There were 5 cases in which symptoms recurred due to retearing of the repaired meniscus, requiring repeat arthroscopy. In 3 of these cases, repeat repair was attempted, and in 2 cases, meniscectomy was performed (Appendix Table A1). As for complications related to the index surgical procedure, a mild restriction on the range of motion was noted in 1 case but did not require revision surgery, while no other postoperative complications such as infection were found. With regard to the occurrence of OCD, 1 patient in each group presented with preoperative OCD lesions before surgery. After surgery, OCD occurred in 6 knees in the SM group and 1 knee in the SR group, with a significantly higher incidence in the SM group (27% vs 4%; $P = .036$). In addition, all patients in the SM group who developed OCD postoperatively required surgical treatment, while 1 patient in the SR group was able to be treated nonoperatively (Table 5).

DISCUSSION

This study compared clinical and radiological outcomes 2 years postoperatively between saucerization with repair and subtotal meniscectomy in the treatment of DLM tears involving the peripheral region. The most important study findings were that despite no significant differences in the rate of postoperative progression of radiographic degenerative changes between the 2 groups, meniscal saucerization with repair was associated with a significantly lower incidence of postoperative OCD (4% vs 27%). In addition, 2-year clinical outcomes assessed by the Lysholm score

TABLE 4
Postoperative Complications[a]

	Subtotal Meniscectomy (n = 22)	Saucerization With Repair (n = 27)	*P*
Retear	0 (0)	5 (19)	.056
Subsequent treatment of retear			
Repair	0 (0)	3 (11)	.242
Meniscectomy	0 (0)	2 (7)	.495
Postoperative OCD[b]	6 (27)	1 (4)	**.036**
Subsequent treatment of OCD			
Surgical treatment	6 (27)	0 (0)	.005
Nonoperative treatment	0 (0)	1 (4)	>.99
Restriction of range of motion	0 (0)	1 (4)	>.99

[a]Data are presented as n (%). Bold *P* value indicates statistical significance. OCD, osteochondritis dissecans.
[b]Two patients (subtotal: 1; repair: 1) with preoperative OCD were excluded.

TABLE 5
Clinical Features of Knees Developing OCD After Surgery[a]

Age, y	Sex	Watanabe Classification	Physis	Surgery	Location	Duration From Surgery, mo	Treatment	Outcome
9	M	Complete	Open	SM	LFC	34	(1) Drilling (2) OATS	Healed
4	M	Complete	Open	SM	LFC	47	Drilling	Healed
8	M	Complete	Open	SM	LFC	19	(1) Drilling (2) Internal fixation (3) OATS	Healed
7	M	Complete	Open	SM	LFC	36	Drilling	Healed
15	F	Complete	Open	SM	LFC	19	Drilling	Healed
12	F	Complete	Open	SM	LFC	10	(1) Drilling (2) OATS	Healed
7	M	Complete	Open	SR	LFC	21	Nonoperative treatment	Healed

[a]F, female; LFC, lateral femoral condyle; M, male; OATS, osteochondral autologous transplantation; OCD, osteochondritis dissecans; SM, subtotal meniscectomy; SR, saucerization with repair.

were significantly better in the SR group. These results suggest that saucerization with repair may be more advantageous than subtotal meniscectomy in terms of preserving meniscal function.

Previously, total meniscectomy was the primary surgical option for symptomatic DLM tears, with satisfactory outcomes reported in both short- and long-term follow-up studies.[11,31] However, in consideration of meniscal function preservation, partial meniscectomy with saucerization was proposed as an alternative.[5,18] Several studies have since compared the surgical outcomes between (sub-)total resection and partial resection (saucerization) of symptomatic DLM.[15,35] In these studies, the type of tear determined the surgical procedure, with complex or severely degenerative tears resulting in total meniscectomy. This issue raises concerns about selection bias. Smuin et al[33] conducted a systematic review of relevant studies and concluded that long-term data demonstrated improved patient-reported outcomes with saucerization over (sub-)total meniscectomy. However, they also stated that the heterogeneity of nonrandomized studies makes the analysis of the pooled data less reliable.

The predominant types of DLM tears are peripheral tears and intrasubstance horizontal or complex tears.[6] In the case of peripheral tear or peripheral rim instability, the gold standard in recent years has been arthroscopic meniscal saucerization with repair.[1,3,8,30,31,32,37,39,40] These studies compared the surgical outcomes of various surgical procedures, including saucerization alone, saucerization with repair, and (sub-)total meniscectomy. In general, there were no clear differences among the 3 techniques or notable improvements in the clinical scores attained after surgery. Previous studies reported that complex or degenerative tears and peripheral tears with substantial separation were once deemed irreparable, and meniscectomy was the selected method for surgical treatment. In addition, the inferior leaf of a horizontal tear and the degenerative fragment were resected before suture repair. At our institution, the current surgical option is to repair the remaining portion of the meniscus after partial central meniscectomy as a whole, including any horizontal or degenerative tears. In this study, the results of saucerization with repair were compared with those of the historical control group that underwent (sub-)total

meniscectomy for DLM tears involving the peripheral region. Therefore, the type of tears in the 2 treatment groups were comparable. To our knowledge, no previous study has compared the surgical outcomes of saucerization with repair and (sub-)total meniscectomy for symptomatic DLM tears that included complex tears with consistent indications.

Clinical evaluation showed significant improvement in the postoperative Lysholm score in both groups, but the indications for meniscal repair, which had been considered irreparable in previous related studies, have since been expanded at our institution.[37,39,40] The Lysholm score at 2 years postoperatively was statistically superior in the SR group compared with the SM group; however, a difference of 3.2 on the Lysholm scale is of questionable clinical significance. Based on the results obtained, the clinical advantage of saucerization with repair remains unclear.

Regarding radiographic changes after DLM meniscectomy, several clinical follow-up studies have noted a high rate of postoperative osteoarthritic progression.[20,31] Räber et al[31] showed that 10 of 11 knees had osteoarthritic changes compared with the uninvolved, contralateral knee. Aglietti et al[1] reported the development of minor osteophytes and a joint space narrowing of <50% in the lateral compartment of 8 and 11 of 17 knees, respectively. Sabbag et al[32] reviewed a geographic database of surgically treated DLM and reported that progression to symptomatic lateral compartment degenerative change was identified in 50% of cases at 8 years postoperatively. In the present study, there were no significant differences in radiographic outcomes between the 2 groups as assessed by Tapper and Hoover classification system. The LJSW was adopted as another parameter for radiological assessment. Milewski et al[23] reported that the knees of children are likely to exhibit a narrower LJSW with age as the skeletal maturity and ossification near the joint space increase. Therefore, the side-to-side difference was measured and used in the analysis of this study, as opposed to the postoperative change in LJSW. The LJSW evaluation also showed no significant difference between the 2 groups. As a result, contrary to our hypothesis, the advantage of meniscal preservation by saucerization and repair was not confirmed by radiological evaluation. This finding may be attributed to progressive meniscal extrusion and a reduction in size after saucerization, as reported in some studies.[14,22,27]

OCD has been reported as a complication after DLM resection and may significantly affect clinical prognosis. There have been a few papers investigating the incidence and factors related to its occurrence.[11,12,24,25] Hashimoto et al[12] reported that 7.8% of 103 knees (mean age, 12.1 years) were complicated by OCD at a mean follow-up of 4.2 years after surgery for symptomatic DLM, and that subtotal meniscectomy and patient age of 11 years or younger at the time of surgery were considered high risk factors. Mochizuki et al[25] reported that postoperative OCD occurred in 19% of 18 patients (mean age, 12 years) with a mean follow-up of 23.7 months, and that younger age, subtotal meniscectomy, and a shorter meniscal width were predictive factors for postoperative OCD. In this study, postoperative OCD was found in 6 knees (27%) in the SM group and 1 knee (4%) in the SR group. All these lesions were located at the contact area from extension to mild flexion in the lateral femoral condyle. All knees that developed OCD after subtotal meniscectomy required surgical intervention after nonoperative treatment failed. As discussed in the case report by Stanitski and Bee,[34] overloading of the lateral femoral compartment after meniscectomy with a marked increase in peak local contact pressure and repetitive microtrauma over time may have induced postoperative OCD lesions. The difference in postoperative OCD incidence observed in this study suggests that saucerization with repair may be superior to subtotal meniscectomy in preserving meniscal function.

Limitations

There are some limitations in this study. First, this was a retrospective comparative study using historical control data with a relatively short follow-up period. As a result, the evolution of surgical technique and instrumentation during the study period was not taken into account in the analysis, and the time to final follow-up in the histological cohort (subtotal meniscectomy) was longer than that in the saucerization/repair group. In addition, the criteria for peripheral instability have been broadened with a better understanding of rim instability over the years,[6,40] which may explain the difference in the distribution of tear types between the 2 study cohorts (more peripheral tears in the more recent cohort). Second, the follow-up period was short and the study population in each group consisted of a small number of patients. This study may be too underpowered to detect differences in outcomes between the 2 treatment groups. There seems to be a need for further investigations with a longer follow-up period and larger sample size (using pooled data from multiple sites) to confirm the advantages of meniscal saucerization with repair in preserving meniscal function as well as the effect of meniscal surgery on progressive degeneration over time. Further studies with a longer follow-up period and larger sample size are needed to clarify the advantages of meniscal saucerization with repair in preserving meniscal function. Third, the Lysholm score was used in the clinical evaluation. Although the reliability and validity of the Lysholm score have been confirmed in the evaluation of patients with meniscal injury, unacceptable ceiling effects have also been shown in some domains of this scoring system.[7] Use of comprehensive patient-reported outcome measures such as the Knee injury and Osteoarthritis Outcome Score or International Knee Documentation Committee subjective scores may have been preferable; however, the data based on these scoring systems were not available for patients during the early study period.

CONCLUSION

Although progression of the postoperative radiographic degeneration was noted in both groups in the surgical

management of DLM tears involving the peripheral region, the clinical outcomes were improved in both groups. Based on the 2-year clinical outcomes and the incidence of OCD development, saucerization with repair for complex DLM tears had advantages over subtotal meniscectomy.

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REFERENCES

1. Aglietti P, Bertini FA, Buzzi R, Beraldi R. Arthroscopic meniscectomy for discoid lateral meniscus in children and adolescents: 10-year follow-up. *Am J Knee Surg*. 1999;12(2):83-87.
2. Ahn JH, Choi SH, Lee YS, et al. Symptomatic torn discoid lateral meniscus in adults. *Knee Surg Sports Traumatol Arthrosc*. 2011;19(2):158-164.
3. 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(8):888-898.
4. 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):932-936.
5. Asik M, Sen C, Taser OF, Alturfan AK, Sozen YV. Discoid lateral meniscus: diagnosis and results of arthroscopic treatment. *Knee Surg Sports Traumatol Arthrosc*. 2003;11(2):99-104.
6. Bauwens PH, Vandergugten S, Fiquet C, Raux S, Cance N, Chotel F. Discoid lateral meniscus instability in children: part II. Repair first to minimise the saucerisation. *Knee Surg Sports Traumatol Arthrosc*. 2023;31(11):4816-4823.
7. Briggs KK, Kocher MS, Rodkey WG, Steadman JR. Reliability, validity, and responsiveness of the Lysholm knee score and Tegner activity scale for patients with meniscal injury of the knee. *J Bone Joint Surg Am*. 2006;88(4):698-705.
8. Carter CW, Hoellwarth J, Weiss JM. Clinical outcomes as a function of meniscal stability in the discoid meniscus: a preliminary report. *J Pediatr Orthop*. 2012;32(1):9-14.
9. Dickhaut SC, DeLee JC. The discoid lateral-meniscus syndrome. *J Bone Joint Surg Am*. 1982;64(7):1068-1073.
10. Habata T, Uematsu K, Kasanami R, et al. Long-term clinical and radiographic follow-up of total resection for discoid lateral meniscus. *Arthroscopy*. 2006;22(12):1339-1343.
11. Hagino T, Ochiai S, Senga S, et al. Arthroscopic treatment of symptomatic discoid meniscus in children. *Arch Orthop Trauma Surg*. 2017;137(1):89-94.
12. Hashimoto Y, Nishino K, Reid JB III, et al. Factors related to postoperative osteochondritis dissecans of the lateral femoral condyle after meniscal surgery in juvenile patients with a discoid lateral meniscus. *J Pediatr Orthop*. 2020;40(9):e853-e859.
13. Kato Y, Oshida M, Aizawa S, Saito A, Ryu J. Discoid lateral menisci in Japanese cadaver knees. *Mod Rheumatol*. 2004;14(2):154-159.
14. Kim SH, Lee JW, Kim KI, Lee SH. Can an injured discoid lateral meniscus be returned to the correct anatomic position and size of the native lateral meniscus after surgery? *Knee*. 2021;28:25-35.
15. Kim SJ, Chun YM, Jeong JH, Ryu SW, Oh KS, Lubis AM. Effects of arthroscopic meniscectomy on the long-term prognosis for the discoid lateral meniscus. *Knee Surg Sports Traumatol Arthrosc*. 2007;15(11):1315-1320.
16. Kim SJ, Lee SK, Kim SH, et al. Does decreased meniscal thickness affect surgical outcomes after medial meniscectomy? *Am J Sports Med*. 2015;43(4):937-944.
17. Lee DH, Kim TH, Kim JM, Bin SI. Results of subtotal/total or partial meniscectomy for discoid lateral meniscus in children. *Arthroscopy*. 2009;25(5):496-503.
18. Lins LAB, Feroe AG, Yang B, et al. Long-term minimum 15-year follow-up after lateral discoid meniscus rim preservation surgery in children and adolescents. *J Pediatr Orthop*. 2021;41(9):e810-e815.
19. Logan CA, Tepolt FA, Kocher SD, Feroe AG, Micheli LJ, Kocher MS. Symptomatic discoid meniscus in children and adolescents: a review of 470 cases. *J Pediatr Orthop*. 2021;41(8):496-501.
20. Manzione M, Pizzutillo PD, Peoples AB, Schweizer PA. Meniscectomy in children: a long-term follow-up study. *Am J Sports Med*. 1983;11(3):111-115.
21. Masquijo J, Kothari A. Juvenile osteochondritis dissecans (JOCD) of the knee: current concepts review. *EFORT Open Rev*. 2019;4(5):201-212.
22. Matsuo T, Kinugasa K, Sakata K, Ohori T, Mae T, Hamada M. Postoperative deformation and extrusion of the discoid lateral meniscus following a partial meniscectomy with repair. *Knee Surg Sports Traumatol Arthrosc*. 2017;25(2):390-396.
23. Milewski MD, Krochak R, Duarte AJ, et al. Do Age and Weightbearing Radiographs Affect Lateral Joint Space and Fibular Height Measurements in Patients With Discoid Lateral Meniscus? *Orthop J Sports Med*. 2018;6(3):2325967118760534.
24. Mizuta H, Nakamura E, Otsuka Y, Kudo S, Takagi K. Osteochondritis dissecans of the lateral femoral condyle following total resection of the discoid lateral meniscus. *Arthroscopy*. 2001;17(6):608-612.
25. Mochizuki T, Tanifuji O, Sato T, Watanabe S, Endo N. Predictive factors for developing osteochondritis dissecans after surgery for discoid lateral meniscus are younger age and shorter meniscal width. *Knee Surg Sports Traumatol Arthrosc*. 2021;29(1):100-108.
26. Nakayama H, Kanto R, Kambara S, Iseki T, Onishi S, Yoshiya S. Successful treatment of degenerative medial meniscal tears in well-aligned knees with fibrin clot implantation. *Knee Surg Sports Traumatol Arthrosc*. 2020;28(11):3466-3473.
27. Nishino K, Hashimoto Y, Tsumoto S, Yamasaki S, Nakamura H. Morphological changes in the residual meniscus after reshaping surgery for a discoid lateral meniscus. *Am J Sports Med*. 2021;49(12):3270-3278.
28. Ogut T, Kesmezacar H, Akgun I, Cansu E. Arthroscopic meniscectomy for discoid lateral meniscus in children and adolescents: 4.5 year follow-up. *J Pediatr Orthop B*. 2003;12(6):390-397.
29. 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(9):967-971.
30. 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):23-27.
31. Räber DA, Friederich NF, Hefti F. Discoid lateral meniscus in children. Long-term follow-up after total meniscectomy. *J Bone Joint Surg Am*. 1998;80(11):1579-1586.
32. Sabbag OD, Hevesi M, Sanders TL, et al. High rate of recurrent meniscal tear and lateral compartment osteoarthritis in patients treated for symptomatic lateral discoid meniscus: a population-based study. *Orthop J Sports Med*. 2019;7(7):2325967119856284.
33. Smuin DM, Swenson RD, Dhawan A. Saucerization versus complete resection of a symptomatic discoid lateral meniscus at short- and long-term follow-up: a systematic review. *Arthroscopy*. 2017;33(9):1733-1742.
34. Stanitski CL, Bee J. Juvenile osteochondritis dissecans of the lateral femoral condyle after lateral discoid meniscal surgery. *Am J Sports Med*. 2004;32(3):797-801.

35. Stilli S, Marchesini Reggiani L, Marcheggiani Muccioli GM, Cappella M, Donzelli O. Arthroscopic treatment for symptomatic discoid lateral meniscus during childhood. *Knee Surg Sports Traumatol Arthrosc*. 2011;19(8):1337-1342.
36. Tapper EM, Hoover NW. Late results after meniscectomy. *J Bone Joint Surg Am*. 1969;51(3):517-526 passim.
37. Wasser L, Knorr J, Accadbled F, Abid A, Sales De Gauzy J. Arthroscopic treatment of discoid meniscus in children: clinical and MRI results. *Orthop Traumatol Surg Res*. 2011;97(3):297-303.
38. Watanabe M, Takeda S, Ikeuchi H. *Atlas of Arthroscopy*. 3rd ed. Igaku Shoin; 1978.
39. Wong T, Wang CJ. Functional analysis on the treatment of torn discoid lateral meniscus. *Knee*. 2011;18(6):369-372.
40. Yoo WJ, Jang WY, Park MS, et al. Arthroscopic treatment for symptomatic discoid meniscus in children: midterm outcomes and prognostic factors. *Arthroscopy*. 2015;31(12):2327-2334.

APPENDIX

APPENDIX TABLE A1
Clinical Features of Revision Surgery for Retear of the DLM After Meniscal SR[a]

Age, y	Sex	Watanabe Classification	Surgery	Cause of Meniscal Injury	Postoperative Period, mo	Tear Location	Original Tear Type	No. of Sutures at Initial Surgery	Treatment
14	M	Complete	SR	No trauma	3	A-MB-P	Peripheral	8	Meniscectomy
16	F	Complete	SR	No trauma	3	A-MB	Peripheral	7	Repair
4	F	Complete	SR	No trauma	89	A-MB-P	Peripheral	4	Meniscectomy
13	M	Complete	SR	No trauma	4	A-MB	Peripheral	4	Repair
12	M	Complete	SR	Trauma	5	P	Peripheral	5	Repair

[a]A, anterior horn; DLM, discoid lateral meniscus; F, female; M, male; MB, midbody; P, posterior horn; SM, subtotal meniscectomy; SR, saucerization with repair.