



Decline in clinical scores at long-term follow-up of arthroscopically treated discoid lateral meniscus in children

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Abstract

Purpose The purpose of this study was to examine the long-term clinical outcomes of arthroscopic partial meniscectomy for the treatment of discoid lateral meniscus in children.

Methods A previous study identified 34 consecutive patients that underwent arthroscopic meniscal saucerization by one of the two surgeons between 1997 and 2002. Patients were asked to complete several outcomes questionnaires and were given the opportunity to receive a knee exam performed by their treating surgeon.

Results Of the 34 eligible patients, 21 agreed to participate. Seventeen patients (19 knees) had greater than 2-year follow-up, with an average follow-up of 11.0 years (range 3.4–16.6 years). Average age at the time of surgery was 9.3 years. Average IKDC, Kujala, and Lysholm scores at follow-up were 82.8 ± 28.9 , 86.6 ± 15.2 , and 83.7 ± 18.6 , respectively. In addition, median Marx and Tegner scores were 5 (range 0–14) and 6 (range 3–8), respectively. Stratifying the Lysholm scores revealed outcomes that were 45.4% “excellent”, 16.7% “good”, 25.0% “fair”, and 16.7% “poor”. In total, 36.8% (7 of 19) of knees underwent at least one subsequent surgical procedure. There were no significant associations between outcome scores and discoid type, meniscal stability, location of instability, or age at time of surgery.

Conclusions The results of the current study suggest that clinical outcome scores decline over time in patients treated arthroscopically for symptomatic discoid meniscus. Compared to our previous study with 2-year follow-up, there is an increased incidence of knee pain and mechanical/functional limitations. The overall modest, long-term results of this study illustrate the need for improved operative treatments for symptomatic discoid meniscus in children to prevent progressive, long-term clinical decline in these patients.

Keywords Discoid meniscus · Pediatric · Arthroscopic partial meniscectomy · Long-term follow-up

Introduction

The discoid lateral meniscus is a common anatomical anomaly first described by Young et al. in 1889 [27]. Its prevalence ranges from 0.4 to 16.6% and is more common in

Asian populations [1, 3, 6, 10, 16]. Classic symptoms of discoid lateral meniscus include pain, popping, snapping, and decreased knee extension, and tears are more common than in non-discoid menisci, as the increased thickness leads to abnormal shear forces across the knee joint [5, 9, 23]. These symptoms vary, however, and are contingent on the discoid type and the presence or absence of a tear [5, 6, 8, 11, 26]. There is great variability in meniscus morphology, stability, and peripheral attachment, and several methods exist for classifying discoid menisci [13]. Watanabe et al. classified discoid menisci based on the amount of coverage of the lateral tibial plateau and meniscal morphology [25]. Good et al. proposed a formal classification scheme that identifies a discoid lateral meniscus as complete or incomplete, stable or unstable, and if unstable, the location of instability [9].

Treatment of discoid meniscus depends on its type, the patient’s symptoms, and the patients’ age. In general, most

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children with discoid meniscus are asymptomatic and do not require treatment [12]. If a patient complains of pain, swelling, audible or palpable snap on extension, locking of the knee, or a decreased ability to participate in activities, then surgical intervention may be indicated. The traditional treatment of discoid lateral meniscus is open or arthroscopic total meniscectomy [4, 10, 18, 20, 23]. Long-term radiographic results, however, revealed early degenerative changes in 86–100% of patients [7, 15, 28]. With the advent of improved arthroscopic techniques, surgeons now typically favor meniscus-preserving procedures. The preferred treatment modality includes arthroscopic partial meniscectomy to reshape the meniscus (saucerization), in conjunction with repair, if indicated, for peripheral instability. Several studies have shown favorable short-term functional and radiographic outcomes for patients treated with partial meniscectomy and saucerization [9, 14, 18]. However, there is a paucity of long-term data derived from multiple modern, validated knee-specific outcomes tests that evaluate the efficacy of this procedure.

The purpose of this study was to examine the long-term clinical outcomes of arthroscopic partial meniscectomy for the treatment of symptomatic discoid lateral meniscus in children. The study hypotheses were that arthroscopic saucerization of a symptomatic discoid meniscus would yield good-to-excellent outcomes at long-term follow-up and that these children would have normal physical exam findings, as defined by the International Knee Documentation Committee (IKDC).

Materials and methods

After obtaining Institutional Review Board approval, the radiographic and medical records of 34 consecutive patients (36 knees) who underwent arthroscopic saucerization for symptomatic discoid meniscus by two surgeons at our tertiary care center between 1997 and 2005 were reviewed. Patients were deemed symptomatic if they experienced pain, popping, snapping, and/or decreased extension at the knee and imaging consistent with a discoid meniscus. Patients were included in the study if they underwent arthroscopic discoid lateral meniscus surgery between 1998 and 2002. Twenty-eight such patients were identified, and eight additional patients who underwent arthroscopic discoid meniscus surgery between 2004 and 2005 were identified and included in this analysis. Patients were excluded if they were unwilling or unable to complete the outcomes questionnaires, or if they were greater than 21 years of age at the time of surgery. The arthroscopic saucerization technique with or without repair has been described previously [9]. The mean age at the time of surgery was 10.6 years (range 3–20 years). There

were a total of 23 females and 11 males. Of the 36 knees, 9 were left knees, 23 were right knees, and 2 were bilateral.

Data collected included sex, age at time of surgery, laterality, discoid type, presence of meniscal instability, location of instability (if applicable), presence of a tear, and length of clinical follow-up. Chondral changes were not analyzed prior to surgery. Meniscus instability was diagnosed if it was possible to evert the meniscus with a probe after saucerization, or if it was possible to translate the anterior aspect of the meniscus to the posterior half of the tibial plateau. Patients were asked to complete five outcome questionnaires (International Knee Documentation Committee (IKDC) Subjective Knee Evaluation, Kujala Scoring Questionnaire, Lysholm Knee Scoring Scale, Marx Activity Rating Scale, and Tegner Activity Scale) at the most recent follow-up.

Patients were also given the opportunity to receive a knee exam performed by one of the two surgeons who operated on the patients in this study. The exam was documented as per the IKDC knee examination protocol. Associations between outcome score and discoid type, meniscal stability, location of instability, and age at time of surgery were identified.

IRB approval to conduct this research was obtained from Hospital for Special Surgery, ID#2014-186.

Statistical methods

Data management and statistical analyses were performed using SAS[®] 9.3 (SAS Institute, Inc., Cary, NC, USA). Two-tailed student's *t* tests were used to compare means for all independent continuous variables. Two-tailed Fisher's exact tests and Chi-square tests were used for analysis of binary and categorical variables between the two groups. For all variables, a *p* value of less than 0.05 was considered significant.

Results

Classification of discoid meniscus

Of the 34 eligible patients (23 female, 11 male), 21 agreed to participate in the study. The average length of follow-up was 9.4 years, ranging from 1 month to 16.6 years. We defined clinical follow-up as the interval from the date of surgery to either the patient's most recent clinic visit or to the date on which the patient completed the outcomes questionnaires. Seventeen patients (19 knees) had clinical follow-up greater than 2 years. For these 17 patients, the mean length of clinical follow-up was 11.0 years (range 3.4–16.6). Arthroscopic assessment of discoid meniscus morphology revealed nine complete discoid menisci, seven incomplete discoid menisci, and three complete (Wrisberg-type) menisci. Assessment of meniscal stability revealed 15 unstable menisci and four

stable menisci. Nine of these menisci demonstrated anterior instability, four menisci showed posterior instability, and two menisci possessed both anterior and posterior instability. Thirteen of the 19 menisci demonstrated a tear during arthroscopic evaluation.

Patient reported outcomes and clinical follow-up

A total of 11 patients completed the outcomes questionnaires, which revealed average IKDC, Kujala, and Lysholm scores of 82.8 ± 28.9 , 86.6 ± 15.2 , and 83.7 ± 18.6 , respectively. In addition, median Marx and Tegner scores were 5 (range 0–14) and 6 (range 3–8), respectively. Stratifying the Lysholm scores revealed results that were 41.7% excellent, 16.7% good, 25.0% fair, and 16.7% poor. Four of the five patients who received a knee examination received an IKDC Knee Examination score of A (normal), and one patient received a score of B (nearly normal). There were no statistically significant correlation between discoid type and IKDC ($r=0.28$, $p=n.s.$), Marx ($r=-0.58$, $p=n.s.$) or Lysholm ($r=0.25$, $p=n.s.$) outcome scores. Neither discoid type, meniscal stability (as determined by arthroscopy) nor presence of a meniscal tear was significantly associated with outcome scores (Table 1).

At most recent clinical follow-up, symptomatic patients reported pain (9/19 knees) and/or clicking or locking sensation (2/19 knees). While one patient demonstrated knee range of motion of 0° – 90° , all other patients had full range of motion.

Subsequent surgical procedures

In total, 20.6% (7 of 34) of eligible patients underwent a subsequent surgical procedure on the affected knee. Two patients underwent subsequent arthroscopic partial meniscectomies, one patient underwent an arthroscopic knee debridement procedure followed by a meniscal allograft

transplantation, one patient underwent arthroscopic meniscectomy, one patient underwent arthroscopic repair of a tear on the affected meniscus, one patient underwent arthroscopic removal of a subcutaneous stitch and repair of a complex tear of the posterior horn, and one patient underwent repair of a chipped patella post-dislocation.

One patient with particularly unfavorable outcome scores underwent two subsequent procedures after their discoid lateral meniscus repair: an arthroscopic debridement (7-year post-partial meniscectomy) and a meniscal allograft transplantation (9-year post-partial meniscectomy) on the affected knee. On initial presentation, this patient had a complete discoid meniscus (Wrisberg-type) with a horizontal tear and posterior instability. At their most recent clinical follow-up (15.6-year post-op), this patient reported pain with activity (especially jumping) and demonstrated radiographic signs consistent with degenerative joint disease (Fig. 1). This patient also reported significant difficulty achieving more than 90 degrees of knee flexion, despite 7 years earlier demonstrating full knee range of motion.

One other patient had lost full range of motion by the time of their final follow-up. Six years after the index operation, this patient's MRI showed chronic lateral femoral condyle erosion, with mild cartilage thinning and sclerosis of the lateral femoral condyle (Figs. 2, 3).

Discussion

Short-term outcomes of pediatric patients treated arthroscopically for symptomatic discoid lateral meniscus are generally favorable [19, 22, 24]. Long-term outcomes on these patients, on the other hand, are sparse. This is attributable partly to the fact that at the age of what constitutes long-term follow-up, this population is typically mobile and difficult to contact, and existing contact data are often unreliable [17]. The purpose of this study was to examine the long-term

Table 1 Association between discoid type, meniscal stability, and presence of meniscal tear versus outcome scores

	IKDC ($n=11$)		Marx ($n=11$)		Lysholm ($n=11$)		Tegner ($n=8$)		Kujala ($n=8$)	
	Mean	p value	Mean	p value	Mean	p value	Mean	p value	Mean	p value
Discoid type		n.s		n.s		n.s		n.s		n.s
Complete	82.3		4.6		81.8		5.5		82.0	
Incomplete	94.3		6.0		99.3		5.5		97.0	
Wrisberg	72.4		5.0		71.3		6.0		85.5	
Meniscal stability		n.s		n.s		n.s		n.s		n.s
Stable	100.0		4.0		100.0		6.0		100.0	
Unstable	81.2		5.0		82.1		5.6		84.7	
Presence of meniscal tear		n.s		n.s		n.s		n.s		n.s
Yes	84.5		3.8		84.4		5.4		93.4	
No	78.6		9.7		82.0		6.0		75.3	



Fig. 1 10-year post-operative radiographs showing degenerative bony changes, including flattening of the lateral femoral condyle and a lateral mild osteophyte



Fig. 2 Pre-operative proton density sagittal MRI demonstrating lateral discoid meniscus of the left knee



Fig. 3 6-year post-operative proton density sagittal MRI demonstrating mild cartilage thinning and sclerosis of the lateral femoral condyle

clinical outcomes of arthroscopic partial meniscectomy for the treatment of symptomatic discoid lateral meniscus in children, with the hypothesis that this treatment would yield good-to-excellent clinical and functional outcomes at long-term follow-up.

Several studies have assessed the long-term outcomes of patients treated arthroscopically for discoid lateral meniscus. Okazaki et al. found good clinical outcomes at a mean follow-up of 16.0 years, although the study was not limited to pediatric patients [17]. Stilli et al. reported better clinical results in younger children (2–7 years) and in patients that received subtotal versus partial meniscectomy [21]. Recently, Ahn et al. concluded that partial meniscectomy with or without meniscal repair was associated with less progression of degenerative changes when compared to subtotal meniscectomy, with significant improvement in clinical and functional assessments from pre-operative to latest follow-up [2].

A short-term follow-up study involving patients included in this long-term study demonstrated favorable results at a mean of 37.4 months of follow-up [9]. All patients exhibited full range of knee motion, and of the 4 patients who exhibited symptoms of catching or snapping, none experienced a limitation in activities. Within the entire study population, no patients reported a deficit in activities of daily living or mobility. Upon radiographic follow-up, no patient exhibited evidence of degenerative joint disease. These short-term

results are in contrast with the outcome scores generated at the final follow-up, as our long-term follow-up study demonstrates that patient outcomes appear to decline over time. While patients did not complete the quantitative outcome scores at short-term follow-up, the results obtained from this study are worse than aforementioned short-term studies that did utilize outcome scores. The previous studies have correlated patient age with clinical outcome [17, 21], although the results of the current study do not support this correlation.

Patients who returned for an in-person follow-up scored well in accordance with the IKDC Knee Examination (average score of A). This finding is in contrast with the generally less favorable subjective knee outcome scores, as generated by the outcomes questionnaires. Among those who returned for an in-person follow-up, the average IKDC ($p=0.51$), Marx ($p=0.63$), Lysholm ($p=0.83$), and Kujala ($p=0.74$) scores were not statistically different from the scores of those who did not return for an in-person follow-up. This difference might be attributed to the fact that patients may be more likely to report unhappiness on a survey, as opposed to their surgeon.

There were several limitations to the current study. Given the long-term design of the study and the demographic of the patient population, a significant number of patients were lost to follow-up. Of the 34 patients who qualified for the study, only 21 patients agreed to participate (38% lost to follow-up). Second, this is a retrospective study and lacks a control. A prospective, randomized study would better elucidate the role of surgery in preventing degenerative joint disease and improving clinical outcomes. Another limitation of the study is that not all patients obtained post-operative imaging. As such, it is difficult to fully characterize the long-term effects of this procedure radiographically. Finally, a power analysis was not conducted to assess the statistical power of this study.

While numerous studies have demonstrated good-to-excellent short-term outcomes after arthroscopic treatment of discoid meniscus, this study adds to the poorly characterized long-term outcomes on these patients. At an average follow-up of nearly 11 years, the data of the current study suggest that clinical outcome scores decline over time. Compared to our previous study with 2-year follow-up, there is an increased rate of knee pain, mechanical symptoms, and functional limitations. Despite excellent post-operative IKDC examination scores, approximately 40% of our patient cohort demonstrated relatively low Lysholm scores (fair and poor). The optimal treatment protocol for these patients has not yet been fully revealed. Clinically, the results of the current study may be helpful in counselling patients about expected long-term outcomes after surgical management of discoid meniscus. These results also necessitate further refinement of arthroscopic techniques coupled with larger-scale follow-up studies to improve patient outcomes. Finally,

a radiographic analysis of patients treated surgically for discoid lateral meniscus is warranted to better characterize the long-term effects of this surgery.

Conclusions

The results of the current study suggest that clinical outcome scores decline over time in patients treated arthroscopically for symptomatic discoid meniscus. Compared to our previous study with 2-year follow-up, there is an increased incidence of knee pain and mechanical/functional limitations, although pre-operative risk factors, including concomitant injuries or discoid injury type, were not significantly associated with long-term outcome. The overall modest, long-term results of this study illustrate the need for improved operative treatments for symptomatic discoid meniscus in children to prevent progressive, long-term clinical decline in these patients.

Compliance with ethical standards

Conflict of interest None of the authors received payments or services, either directly or indirectly (i.e., via his or her institution), from a third party in support of any aspect of this work. None of the authors, or their institution(s), have had any financial relationship, in the 36 months prior to submission of this work, with any entity in the biomedical arena that could be perceived to influence or have the potential to influence what is written in this work. In addition, no author has had any other relationships, or has engaged in any other activities, that could be perceived to influence or have the potential to influence what is written in this work.

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Ethical approval The study was approved by the Ethical committee of the institution.

Informed consent Patients were informed, and they consented to conduct the study.

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