Lateral Meniscal Tears in Young Patients

A Comparison of Meniscectomy and Surgical Repair

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Background: Meniscal tears are common in active patients, but treatment trends and surgical outcomes in young patients with lateral meniscal tears are lacking.

Purpose: To evaluate treatment trends, outcomes, and failure rates in young patients with lateral meniscal tears.

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

Methods: Patients aged ≤25 years treated surgically for isolated lateral meniscal tears from 2001 to 2017 were identified. Treatment trends were compared over time. International Knee Documentation Committee (IKDC) scores and failure rates were compared by treatment modality (meniscectomy vs meniscal repair). Failure was defined as reoperation, symptomatic osteoarthritis, or a severely abnormal IKDC score. Univariate regression analyses were performed to predict failure and IKDC scores based on treatment, type and location of tear, or extent of meniscectomy.

Results: Included were 217 patients (226 knees) with a mean age of 17.4 years (range, 7-25 years); of these patients, 144 knees (64%) were treated with meniscectomy and 82 knees (36%) with meniscal repair. Treatment with repair increased over time compared with meniscectomy (P < .001). At a minimum 2-year follow-up (mean, 6.1 ± 3.9 years), 107 patients (110 knees) had IKDC scores, and analysis indicated that although scores in both groups improved from pre- to postoperatively (repair: from 69.5 ± 13.3 to 97.4 ± 4.3; meniscectomy: from 75.7 ± 9.0 to 97.3 ± 3.9; P < .001 for both), improvement in IKDC score was greater after repair (27.9 ± 13.9) versus meniscectomy (21.6 ± 9.4) (P = .005). Included in the failure analysis were 184 patients (192 knees) at a mean follow-up of 8.4 ± 4.4 years. The rates of reoperation, symptomatic osteoarthritis, and failure were not significantly different between the meniscectomy and repair groups.

Conclusion: An increase was seen in the rate of isolated lateral meniscal tear repair in young patients. IKDC score improvement was greater after repair than meniscectomy, although postoperative IKDC scores were similar. Symptomatic arthritis, reoperation, and failure rates were similar between groups; however, there was a trend for increased arthritis symptoms in patients treated with meniscectomy, especially total meniscectomy. Treatment modality, type and location of tear, and amount of meniscus removed were not predictive of final IKDC scores or failure.

Keywords: lateral meniscus; meniscal repair; meniscectomy

The lateral meniscus contributes to load transmission across the femorotibial joint and functions to improve joint stability by increasing joint congruency.20 Meniscal tears occur at an incidence of 8.27 per 1000 person-years.12 The rate of isolated lateral meniscal tears in young adults is not reported in the literature. Although there is a paucity of literature directly investigating lateral meniscus tears, previous studies3,15 have shown that the degree and pattern of tear, as well as method of treatment, can have profound impacts on the longevity of the knee and patient outcomes, with total or subtotal meniscectomy leading to early arthrosis. Tear patterns are generally classified as simple or complex based on single or multiple planes of tearing, respectively, and simple patterns can be further subdivided by specific tear pattern.7 Treatment of meniscal tears varies from nonoperative management to partial or total meniscectomy or meniscal repair.8

Long-term sequelae of isolated meniscal tears include knee pain and articular cartilage degeneration. Partial meniscal resection can lead to higher rates of subsequent arthritis when compared with meniscal repair.23 Radial, root,15 and complex tear patterns treated with total or near-total meniscectomy result in loss of hoop stress resistance and rapid knee degeneration.3,17 Repair has recently become more common, according to a survey of practice trends. Treatment selection clearly affects results18; however, surgical outcomes in young patients with isolated lateral meniscal tears are lacking.

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We describe our experience with lateral meniscal tears in young patients, including (1) surgical treatment trends for both meniscectomy and meniscal repair, (2) midterm patient-reported outcomes (PRO; International Knee Documentation Committee [IKDC] score), and (3) failure rates and risk factors for failure. We hypothesized that repair has increased over time; PRO scores are higher with repair; radiographic evidence of symptomatic joint degeneration is decreased in patients who undergo repair; and midterm failure (reoperation, osteoarthritis [OA], or severely abnormal IKDC score) is higher in patients who undergo total meniscectomy.

**METHODS**

**Patients**

After receiving study approval from our institutional review board, we reviewed the records of all patients aged 25 years and younger who underwent surgical treatment of lateral meniscal tears from 2001 to 2017. Patients with concomitant knee ligament tears or previous knee surgery were excluded. A total of 217 patients (226 knees) were identified and included (Figure 1). Pre- and postoperative notes were reviewed to identify patient and injury characteristics. Operative notes were reviewed to determine tear

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Ethical approval for this study was obtained from Mayo Clinic (application No. 15-000601).
pattern/type, chondral injury, and treatment details. Electronic medical records were searched for reoperations, postoperative imaging, and patient outcome scores at final follow-up.

Treatment Trends

All 217 patients (226 knees) were included in the treatment-trend analysis. Surgical treatment modality (meniscal repair vs meniscectomy) was obtained from operative notes along with tear pattern, size, location, amount of meniscus removed (meniscectomy group), and repair technique. Indications for repair technique were surgeon-dependent and included all-inside, outside-in, inside-out, and hybrid techniques. Treatment modality was compared on an annual basis throughout the study period.

Outcomes

Patients with IKDC scores at a minimum of 2 years after surgery were included in the outcome analysis. IKDC scores were obtained preoperatively and at final follow-up. These scores have been validated for use in patients treated for meniscal injury.5,24 IKDC scores were compared based on treatment modality. Outcomes after meniscal repair were compared with outcomes after removal of >25% of the meniscus and total meniscectomy.

Failure Rates

Patients were included in the failure analysis if they underwent reoperation for the lateral compartment, had symptomatic OA at any point after their primary lateral meniscal operation, or had a minimum 2-year follow-up.

RESULTS

Comprehensive patient characteristics are listed in Table 1. Of the 217 patients, 158 were male, with a mean age of 17.4 years (range, 7-25 years). A total of 138 patients (64%; 144 knees) were treated with meniscectomy, and 79 patients (36%; 82 knees) were treated with repair. Tear pattern and location are shown in Tables 2 and 3, respectively. Outcomes of the meniscectomy group by amount of meniscus removed are shown in Table 4.
Postoperative IKDC score

Overall 17 (23) 59 (82) 24 (33)

Treatment for radial tears (P < .001). The mean pre-operative improvement in IKDC score was greater in the repair group compared with the meniscectomy group (27.9 ± 13.9 vs 21.6 ± 9.4; P = .005). Postoperative IKDC scores in the repair group were similar to the IKDC scores for the subtotal/total meniscectomy group (97.5 ± 3.5; P = .899) and the group with >25% of the meniscus removed (97.3 ± 3.9, P = .918). Univariate regression analyses for prediction of IKDC did not reach significance when treatment type (P = .930), location of tear (P = .698), tear type (P = .949), and amount of meniscus removed (P = .555) were used as predictors in separate models.

Failure Rates

In total, 184 patients were included in the failure analysis. Of those, 181 had a clinical follow-up of at least 2 years (mean, 8.4 ± 4.4 years). Seven patients underwent reoperation before 2 years. In total, 22 patients (18%) underwent reoperation in the meniscectomy group compared with 15 patients (23%) in the repair group (P = .380). With regard to reoperation of the lateral compartment in the meniscectomy group, 12 patients underwent repeat meniscectomy, 2 underwent meniscal repair, 4 underwent chondroplasty, 2 received a combination of chondroplasty and repeat meniscectomy, 1 patient was treated with an osteochondral autograft transfer, and 1 patient received a femoral condyle osteochondral allograft and meniscal allograft. For reoperation in the repair group, 1 underwent open debridement for postoperative infection, 5 received a repeat repair, 8 underwent meniscectomy, and 1 patient had a subsequent chondroplasty.

Postoperative radiographs more than 2 years after surgery were available for 75 patients (34.6% of total cohort); an additional 7 patients had symptomatic OA before 2 years. Seventeen patients (32%) in the meniscectomy group had symptomatic OA compared with 5 patients (16%) in the repair group (P = .109). Compared with the repair group, 4 patients (50%) in the subtotal/total meniscectomy group

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**TABLE 3**

| Anatomic Position       | Meniscectomy | Repair |
|-------------------------|--------------|--------|
| Body                    | 78 (54.2)    | 24 (29.3) |
| Posterior horn          | 32 (22.2)    | 34 (41.5) |
| Multiple locations      | 18 (12.5)    | 19 (23.2) |
| Anterior horn           | 16 (11.1)    | 5 (6.1)  |

*Data are reported as No. of knees (%).

**TABLE 4**

| Amount Removed | Overall | Postoperative IKDC score | Lateral compartment reoperation | Symptomatic OA |
|----------------|---------|--------------------------|--------------------------------|---------------|
| >75%           | 17 (23) | 97.5 (13)                 | 17 (3)                        | 50 (4)        |
| 25%-75%        | 59 (82) | 97.2 (44)                 | 19 (14)                       | 27 (8)        |
| <25%           | 24 (33) | 97.2 (15)                 | 17 (5)                        | 36 (5)        |

*Data are reported as percent (No. of knees) unless otherwise indicated. IKDC, International Knee Documentation Committee; OA, osteoarthritis.

With the exception of location of tear (P = .918), amount of meniscus removed (P = .555) and meniscectomy type (P = .930), other variables did not reach significance when entered into association analyses for prediction of IKDC score.

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**Treatment Trends**

All 217 patients (226 knees) were included in the treatment-trend analysis. Treatment rates for meniscal repair increased over time compared with meniscectomy, with 63% of lateral meniscal tears from 2013 to 2017 treated with repair compared with 23% from 2001 to 2004 (P < .001). In total, 54.9% of menisci treated with repair occurred from 2013 to 2017 compared with 15.9% of repairs taking place from 2001 to 2004. Overall trends are represented in Figure 2. Subgroup analysis of specific tear types over time showed a statistically significant trend in treatment for radial tears (P < .001), complex tears (P < .001), and horizontal cleavage tears (P = .049). The earliest repair of complex and horizontal cleavage tears occurred between 2013 and 2017, and only 1 radial tear was repaired before the 2013 to 2017 period. Treatment trends for bucket-handle, oblique-flap, and vertical-longitudinal tears were not different over time.

**Outcomes**

In total, 107 patients (49.3%) had an IKDC score at a minimum of 2 years (mean, 6.1 ± 3.9 years). Of those patients, 71 (73 knees) underwent meniscectomy, and 36 (37 knees) underwent repair. The mean preoperative IKDC score in the meniscectomy group was 75.7 ± 9.0, and it increased to 97.3 ± 3.9 postoperatively (P < .001). In the repair group, the mean preoperative IKDC score was 69.5 ± 13.3, and it increased to 97.4 ± 4.3 postoperatively (P < .001). The mean pre- to postoperative improvement in IKDC score was greater in the repair group compared with the meniscectomy group (27.9 ± 13.9 vs 21.6 ± 9.4; P = .005). Postoperative IKDC scores in the repair group were similar to the IKDC scores for the subtotal/total meniscectomy group (97.5 ± 3.5; P = .899) and the group with >25% of the meniscus removed (97.3 ± 3.9, P = .918). Univariate regression analyses for prediction of IKDC did not reach significance when treatment type (P = .930), location of tear (P = .698), tear type (P = .949), and amount of meniscus removed (P = .555) were used as predictors in separate models.
had symptomatic OA ($P = .065$), and 12 patients (32%) in the group with >25% of the meniscus removed had symptomatic OA. No patient in either the repair or meniscectomy group had an IKDC score <75.4.

Overall, 34 patients (27%) in the meniscectomy group and 18 patients (27%) in the repair group were deemed treatment failures ($P = .966$) (Table 5). The rate of failure in the repair group was not significantly different from the rates of failure in the subtotal/total meniscectomy group (39%, $P = .399$) or the group with >25% of the meniscus removed (26%, $P = .776$). Logistic regression analyses to predict failure did not reach significance when treatment type ($P = .305$), location of tear ($P = .854$), tear type ($P = .415$), and amount of meniscus removed ($P = .134$) were used as predictors in separate models.

**DISCUSSION**

Treatment outcomes of lateral meniscal tears in the young patient are limited in the current literature. Our results demonstrate satisfactory treatment outcomes at midterm follow-up with both repair and meniscectomy, with repair becoming more common in recent years at our institution. Rates of symptomatic OA, reoperation, and failure were similar between groups. However, there is a trend of increased symptomatic OA in patients treated with meniscectomy, especially total meniscectomy. We report an overall clinical success rate of 73% in patients with a lateral meniscal tear who undergo meniscectomy or lateral meniscal repair. Clinical success was defined as no reoperation for the lateral compartment, no symptomatic OA, and postoperative IKDC score ≥75.4.

The study results indicate that over time, a larger proportion of lateral meniscal tears in this young population were treated with repair rather than meniscectomy. This is represented in Figure 2, with more than half of repairs taking place between 2013 and 2017 compared with the 12 preceding years. Conversely, there was a trend of performing fewer meniscectomies, with close to 30% of all meniscectomies being performed between 2001 and 2004, with decreasing percentages annually. Subgroup analysis also showed that horizontal cleavage along with more difficult tear patterns, such as complex (multiplanar) and radial tears, were being repaired more frequently. Treatment trends for bucket-handle, oblique-flap, and vertical-longitudinal tears did not change over time.

Parker et al\textsuperscript{18} described practice patterns of American Board of Orthopaedic Surgery members from 2004 to 2012 and also showed a 37% increase in meniscal repair over this 9-year time period as well as a 17% decrease in meniscectomy procedures. Their study did not separate medial or lateral meniscal tears. Abrams et al\textsuperscript{1} reviewed the PearlDiver Patient Record Database, which represents 9% of patients in the United States who are younger than 65 years of age. They showed a doubling in the incidence of meniscal repairs from 2005 and 2011 but also showed a 14% increase in the incidence of meniscectomy over this same time period. The same trend seems to be occurring outside of the United States as well, with 7.2% of patients in Japan undergoing meniscal repair in 2007 compared with 25.9% in 2014 and the 92.8% meniscectomy rate in 2007 falling to 73.3% in 2014. Most patients undergoing meniscal repair in this study were 10 to 19 years of age.\textsuperscript{15} Jacquet et al\textsuperscript{11} reported similar trends in France, with a 21.4% reduction in meniscectomy procedures from 2005 and 2017 and a 32.0% increase in repair over this same time period. Our data align with the literature showing increased rates of repair, and to our knowledge, this is the first time this is reported specifically regarding the lateral compartment.

In this study, we found a statistically significant improvement from preoperative to postoperative IKDC scores in both the meniscectomy and repair groups. On average, scores increased by 21.6 points in the meniscectomy group compared with an increase of 27.9 points in the repair group. Postoperative IKDC scores did not differ between repair and meniscectomy; however, the repair group started with a lower preoperative IKDC score. No patients in either group had an IKDC score <75.4 at the final follow-up. In these patients, tear location, type, and amount of meniscectomy were not predictive of IKDC scores.

Paxton et al\textsuperscript{19} conducted a systematic review comparing partial meniscectomy to repair and showed higher Lysholm scores and less radiographic degeneration in patients who underwent repair compared with partial meniscectomy.\textsuperscript{19} Krych et al\textsuperscript{14} reviewed the results of isolated meniscal tears in skeletally immature patients younger than 18 years treated with meniscal repair. At an average follow-up of 5.8 years (range, 2.5 months-13.8 years), they reported an IKDC score of 89.4 and that complex tears and a rim width >3 mm were risk factors for failure. Salata et al\textsuperscript{22} conducted a systematic review of patients with meniscectomy and found an association between total meniscectomy and lateral meniscectomy and poor clinical outcomes. The mean follow-up of their included studies ranged from 7.8 to 21 years,\textsuperscript{8,9,21} compared with our shorter time period of 6.1 years.
We found a 27% failure rate in patients treated with lateral meniscectomy (34 patients) and a 27% failure rate in patients treated with lateral meniscal repair (18 patients). Our reoperation rates in the meniscectomy group and repair group were similar, at 18% for the meniscectomy group and 23% for the repair group, which did not reach statistical significance. More patients in the meniscectomy group had symptomatic OA compared with patients who underwent repair, showing rates of 32% and 16%, respectively; however, this also did not reach statistical significance. Our rate of failure was increased in the >75% (subtotal/total) meniscectomy group at 39% failure, but not in patients with >25% of their meniscus resected (26% failure).

Conversely, Paxton et al. reported a lower reoperation rate with partial meniscectomy, which was 3.9% compared with 20.7% in the repair group at long-term follow-up. The reoperation rate of partial lateral meniscectomy was higher than the reoperation rate of partial medial meniscectomy. Also, repairs of the lateral meniscus had a slightly lower reoperation rate than repairs of the medial meniscus. Our study includes patients with near-total and total lateral meniscectomy, which likely explains our higher reoperation rate in our meniscectomy cohort. In the previously discussed study by Krych et al. evaluating meniscal repair in young patients, they reported a success rate of 80% for simple tears, 68% for bucket-handle tears, and 13% for complex tears. Our success rate of repair in the lateral compartment (73%) was comparable to their study based on our tear complexity distribution.

Limitations

This retrospective study has multiple limitations, including inconsistent radiographic follow-up and the lack of postoperative magnetic resonance imaging or second-look arthroscopy to capture repair failures or advancement in lateral compartment degeneration. Long-leg radiographs were not evaluated; therefore, the contribution of limb alignment was not included. Data on red-red, red-white, and white-white zones of meniscus were not consistently recorded in operative reports. Additionally, midterm length of follow-up may not have allowed adequate time for joint degeneration. Lastly, functional scores were obtained for only a portion of patients.

This study has multiple strengths, as the first report assessing surgical management exclusively of the lateral meniscus in a young population. The patient numbers are also a strength, given the infrequency of meniscal repairs in this young population.

CONCLUSION

The rate of isolated lateral meniscal tear repair in young patients at our institution has increased. IKDC score improvement is greater after repair than meniscectomy, although postoperative IKDC scores are similar. Symptomatic arthritis, reoperation, and failure rates were similar between groups; however, there was a trend for increased arthritis symptoms in patients treated with meniscectomy, especially total meniscectomy. Treatment modality, type and location of tear, and amount of meniscus removed were not predictive of final IKDC scores or failure.

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