Arthroscopic Repair of Chronic Tears of the Anterior Horn of the Lateral Meniscus That Includes Covering the Lesion With an Infrapatellar Pedicle Fat Flap

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abstract

This study analyzed the efficacy and safety of arthroscopic outside-in repair of the anterior horn of the lateral meniscus that includes covering the lesion with an infrapatellar pedicle fat flap in patients with chronic tears. This retrospective study reviewed 87 patients with chronic tears of the anterior horn of the lateral meniscus who underwent arthroscopic outside-in repair, which included covering the lesion with an infrapatellar pedicle fat flap (group A, n=45) or not (group B, n=42). The 2 groups were similar in terms of age, sex, body mass index, and disease duration. Patient results were assessed with Tegner, Lysholm, and visual analog scale scores; healing criteria; magnetic resonance imaging; and complication rates. Mean follow-up was 38.2 months. Tegner and Lysholm scores improved postoperatively in both groups (all \( P < .01 \)) and were similar for the 2 groups (all \( P > .05 \)). Visual analog scale scores were reduced postoperatively in both groups (\( P < .01 \)) and similar for the 2 groups (\( P > .05 \)). Healing rates and complication rates did not differ between the 2 groups (all \( P > .05 \)), but healing on magnetic resonance imaging was better in group A than group B (\( P < .05 \)). The repair of chronic tears of the anterior horn of the lateral meniscus can lead to good clinical outcomes and a satisfactory success rate. Covering the repair site with an infrapatellar pedicle fat flap may improve meniscal healing and does not increase the complication rate. [Orthopedics. 201x; xx(x):xx-xx.]

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The menisci play a critical role in load transmission and shock absorption of the knee. Loss of meniscal tissue causes increased contact stress and leads to degenerative joint disease.\(^1\)\(^-\)\(^3\) Therefore, the focus of meniscal surgery is directed toward meniscal preservation. Meniscal repair is most likely to be successful for an acute longitudinal tear in the vascular periphery of the meniscus in a relatively young patient with a stable knee.\(^1\) Chronic meniscal tears have a lower healing rate compared with acute tears.\(^4\)

Meniscal tears in the anterior horn of the lateral meniscus are common in China, especially in discoid menisci. However, because patients who have these tears often present late with degenerative changes, meniscal repair is challenging. The infrapatellar fat near the anterior horn of the lateral meniscus has a rich blood supply and abundant fat tissue. In this study, chronic meniscal tears were repaired by covering the meniscal lesion with an infrapatellar...
pedicled fat flap. The authors hypothesized that the infrapatellar pedicled fat flap covering technique would augment the healing of chronic meniscal tears.

**MATERIALS AND METHODS**

**Study Design**

This study was approved by the local ethics committee, and informed consent was provided by each patient included. A total of 116 patients with chronic tears of the anterior horn of the lateral meniscus consecutively admitted to the authors’ institution between May 2010 and March 2015 were eligible for this study. Inclusion criteria were (1) preoperative magnetic resonance imaging showing vertical or complex tears of the anterior horn of the lateral nondiscoid meniscus, or longitudinal tears on the periphery of the anterior horn or complex tears extending from the inner part to the anterior horn of the lateral discoid meniscus; (2) positive findings on the McMurray test and the knee joint hyperextension test, and anterolateral joint-line tenderness and aggravation at full extension; (3) course of disease greater than 2 months; and (4) at arthroscopy, the repaired meniscal tears located at the red-red zone or red-white zone. Exclusion criteria were (1) greater than grade 1 Kellgren–Lawrence degenerative changes on knee radiograph (n=4); (2) irreparable tissue damage of the meniscus (n=20); (3) concomitant anterior cruciate ligament or posterior cruciate ligament reconstruction (n=5); or (4) concomitant meniscal repair of the posterior horn of the lateral or medial meniscus (n=0). Eighty-seven cases of chronic tears of the anterior horn of the lateral meniscus in which arthroscopic meniscal repair was performed were included in the study. In each case, an attempt was made to separate an inferior-based infrapatellar pedicled fat flap from the infrapatellar fat pad along the tear site. Pedicled fat flaps greater than 5 mm high, inferior-based infrapatellar pedicle fat flaps, could not be separated or had a height of less than 5 mm, only the meniscal lesion was sutured (group B, n=42). The height of the pedicle fat flap was determined by the size of the infrapatellar fat pad and was not associated with the quality of the meniscal tissue.

In group A, there were 28 females and 17 males with a mean age of 31.9 years (range, 13-55 years) and a mean course of disease of 6.8 months (range, 2-36 months). Twenty-eight patients had a lateral discoid meniscus, and 17 patients had a nondiscoid meniscus. In group B, there were 26 females and 16 males with a mean age of 33.6 years (range, 14-54 years) and a mean course of disease of 6.3 months (range, 2-33 months). Twenty-six patients had a lateral discoid meniscus, and 16 patients had a nondiscoid meniscus. The 2 groups were similar in terms of age, sex, body mass index, and disease duration.

**Surgical Technique**

All procedures were performed under spinal or general anesthesia. Patients were placed in the supine position. Diagnostic arthroscopy was performed to determine the pathologic state of the meniscus and articular cartilage before the decision for meniscal repair was made. In patients with a lateral discoid meniscus, the inner part of the discoid meniscus was removed, and 6 to 8 mm of the surrounding edge was reserved to suture. Before repair of complex meniscal tears, unstable and degenerative components were trimmed to stable components. Synovial hyperplasia near the tear site was removed, and fat tissue was disclosed (Figure 1A).

In group A, an approximately 5-mm high, inferior-based infrapatellar pedicled fat flap was separated from the infrapatellar fat pad along the tear site (Figure 1B). The 1 needle hole outside-in technique previously described by Laupattarakasem et al was used to repair meniscal tears. An 18-gauge spinal needle was used to apply a No. 2 Ethibond suture (Ethicon, Somerville, New Jersey). The suture-loaded needle penetration.
ed the tear and exited the femoral surface of the inner meniscal segments (Figure 2A). The free suture end at the needle tip was drawn into the joint through the anterolateral portal using mosquito forceps. The needle was withdrawn from the joint until it was approximately 15 cm from the skin, while the suture remained loaded. The needle was reinserted into the previous needle hole and then transferred upward. The needle entered the joint above the fat flap and just sagittally to the former suture, with a suture loop at the needle tip (Figure 1C, Figure 2B). The former suture tip was introduced into the suture loop. The needle was completely withdrawn (Figure 2C). The 2 arms of the suture loop were pulled out, trapping the free end of the former suture outside the joint. The tear surface was covered by the infrapatellar pedicle fat flap using a probe; then, the suture was tied using a slipknot and several half stitches (Figure 1D, Figure 2D). Other stitches were placed anteriorly or posteriorly every 5 mm, accordingly. After suturing was complete, bleeding was stopped using a radiofrequency device (TriStar 50, ICW; ArthroCare Corporation, Sunnyvale, California).

In group B, the height of the separated infrapatellar pedicle fat flap was less than 5 mm. Therefore, the separated infrapatellar pedicle fat flap could not be used to cover the meniscal lesion, which was debrided. The chronic lateral meniscal tear was sutured using the 1 needle hole technique described for group A.

Postoperative Management

The postoperative protocol was the same for the 2 groups. Specialist knee physiotherapists supervised postoperative rehabilitation. Patients were allowed to transition from partial weight bearing to full weight bearing at 6 weeks postoperatively. Knee flexion was not restricted, but excessive extension was not permitted for the first 12 weeks postoperatively. Straight-leg raising exercises were continued for 3 to 6 months postoperatively depending on the progress of the individual patient.

Follow-up

All patients were followed at 1, 2, 3, and 6 months and then annually postoperatively. Postoperative knee function was compared between the groups and with preoperative data. Knee function was estimated using the Tegner functional scale score, Lysholm score, and visual analog scale score. Meniscal healing and complications were compared between the 2 groups. Meniscal healing was evaluated using the criteria of Barrett et al6 and the criteria of Henning et al7 on magnetic resonance imaging at 6 months postoperatively.8

Statistical Analysis

Statistical analysis was performed using SPSS version 17.0 software for Windows (SPSS Inc, Chicago, Illinois). Postoperative Lysholm scores were evaluated using the Student’s t test. Tegner scale scores and visual analog scale scores were assessed using the nonparametric Wilcoxon signed-rank test. Meniscal healing and postoperative complications were analyzed with the chi-square test. P<.05 was considered statistically significant.

RESULTS

Patients were followed for a mean of 38.2 months (range, 24-64 months). As reported in Table 1, at the last follow-up, Tegner and Lysholm scores were significantly improved compared with preoperative values in both groups (P<.01) and were similar for the 2 groups (P>.05). Visual analog scale scores decreased significantly postoperatively in both groups but were similar for the 2 groups (P>.05).

In most of the patients, symptoms associated with meniscal tear improved after surgery until final follow-up. According to the criteria of Barrett et al,6 41 repairs in group A and 37 repairs in group B were considered clinically successful. The
healing rates according to Barrett et al criteria were similar between the 2 groups (P>.05). On magnetic resonance imaging at 6 months postoperatively, according to Henning et al criteria, 23 repairs had healed completely (Figures 1E-F), 18 had healed partially, and 4 were considered failures in group A. In group B, 20 repairs had healed completely, 10 had healed partially, and 12 were considered failures. On magnetic resonance imaging, healing appeared better in group A than in group B (Table 2).

In group A, 2 patients had a postoperative knee effusion, which was treated 2 to 3 times with knee puncture and pressure dressing. Two patients reported a “giving way” of the knee that resolved with quadriceps strengthening. In group B, 1 patient had a postoperative knee effusion and 1 patient had a postoperative articular hematoma, both of which were treated as in group A. Two patients reported a giving way of the knee because of atrophy of the quadriceps muscle; these patients were treated as in group A. The complication rate in group A was similar to that in group B (P>.05) (Table 2).

**DISCUSSION**

The lateral meniscus covers a greater area than the medial meniscus and may contribute more to load bearing in the lateral compartment than the medial meniscus in the medial compartment. However, radiographic results are worse and the incidence of osteoarthritis is higher following lateral meniscectomy compared with medial meniscectomy. Meniscal repair is the preferred treatment for tears of the anterior horn of the lateral meniscus.

The outside-in technique is particularly effective and easy to perform for meniscal tears located in the anterior horn. Meniscal tears may be securely sutured and covered by the infrapatellar pedicle fat flap using several outside-in interrupted vertical mattress sutures. The suture technique reported in this study was a needle hole procedure that required only 1 spinal needle and avoided the need for an additional incision. Its relative avoidance of cutaneous scars should enhance patient satisfaction and adherence in general.

Repair of acute meniscal tears may offer a better prognosis than repair of chronic injuries. Tengroothenhuysen et al reported a success rate of 83% for meniscal repairs performed within 6 weeks of injury, compared with 52% for late repairs. Indications for meniscal repair have broadened greatly in recent years; several studies have suggested that repairs of chronic meniscal tears result in good and even excellent outcomes. Popescu et al treated chronic meniscal tears with FasT-Fix (Smith & Nephew, Andover, Massachusetts) and achieved a meniscal healing rate of 84% and mean postoperative Lysholm and Tegner scores of 95 (range, 58-100) and 6 (range, 3-9), respectively. Espejo-Reina et al reported a meniscal healing rate of 83%, a mean postoperative International Knee Documentation Committee score of 95 (range, 92-100), and Tegner scores that returned to preinjury level following repair of chronic bucket-handle tears of the medial meniscus. Acute lateral meniscal tears usually occur less frequently in knees with intact ligaments. Symptoms associated with lateral meniscal tears in patients with no history of trauma often have a slow on-

### Table 1: Comparison of Clinical Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tegner score (Group A (n=45))</td>
<td>3.13±0.63</td>
<td>5.60±1.03b</td>
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<tr>
<td>Tegner score (Group B (n=42))</td>
<td>3.07±0.68</td>
<td>5.62±1.06b</td>
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<tr>
<td>Lysholm score (Group A (n=45))</td>
<td>53.27±7.76</td>
<td>92.18±7.22b</td>
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<tr>
<td>Lysholm score (Group B (n=42))</td>
<td>52.71±8.25</td>
<td>92.52±7.68b</td>
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<tr>
<td>Visual analog scale score (Group A (n=45))</td>
<td>3.24±0.72</td>
<td>0.98±1.37b</td>
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<tr>
<td>Visual analog scale score (Group B (n=42))</td>
<td>3.33±0.79</td>
<td>0.98±1.41b</td>
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</tbody>
</table>

*a*No significant difference between groups (P>.05).

*b*Significant difference compared with preoperative (P<.05).

### Table 2: Comparison of Healing Rate and Complication Rate

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Cases</th>
<th>Group A (n=45)</th>
<th>Group B (n=42)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success according to Barrett et al criteria</td>
<td>41</td>
<td>37</td>
<td>.733</td>
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<tr>
<td>Healing on magnetic resonance imaging</td>
<td>23</td>
<td>20</td>
<td>.041</td>
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<td>Complete healing</td>
<td>18</td>
<td>10</td>
<td>6 (range, 3-9)</td>
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<tr>
<td>Partial healing</td>
<td>4</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure</td>
<td>4</td>
<td>4</td>
<td>1.000</td>
<td></td>
</tr>
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</table>
set; therefore, surgery is delayed. The current study investigating repair of chronic meniscal tears also showed improved functional outcomes, and the meniscal healing rates were comparable to those following repair of acute meniscal injuries.4

In this study, the authors used an infrapatellar pedicle fat flap to cover the repair site as an augmentation technique to improve meniscal healing. The infrapatellar pedicle fat flap may enhance the rate of healing of the meniscal tear in multiple ways. First, the infrapatellar pedicle fat flap may increase the blood supply to the repair site, which is inferior and broad based.13 Similarly, a pedicle flap was shown to enhance revascularization and regeneration of the meniscus in allografted meniscal transplantation.14 Second, the infrapatellar pedicle fat flap may facilitate the transfer of cells such as fibroblasts and adipose stem cells to the repair site. Adipose stem cells derived from the infrapatellar fat pad have the potential for multidirectional differentiation and meniscal regeneration.15,16 Finally, the infrapatellar pedicle fat flap may act as a scaffold for the migration of cells.14,17

Notably, meniscal repairs performed concurrently with anterior cruciate ligament reconstruction have a higher healing rate than meniscal repairs only. This may result from increased release of growth factors because of intra-articular bleeding and fibrin clot formation during anterior cruciate ligament reconstruction.18,19 Dissection of the pedicle fat flap may have a similar role.

Separation of the infrapatellar pedicle fat flap has the potential to increase surgical trauma and intraoperative and postoperative bleeding. A radiofrequency device was used to prevent bleeding after meniscal suture. Postoperative pain and complication rates were similar in the 2 groups.

This study had 2 strengths. First, only chronic meniscal tear repairs, which have been addressed in only 3 previous reports, were described. Second, the authors covered the repair site using an infrapatellar pedicle fat flap, which is a safe and easy technique. This study had several limitations. First, the decision regarding whether to use an infrapatellar pedicle fat flap was subject to selection bias because this was not a randomized study. Second, evaluating repaired meniscal tears using clinical symptoms provides indirect evidence of successful healing. Third, long-term outcomes were not explored.

**Conclusion**

The repair of chronic tears of the anterior horn of the lateral meniscus can lead to good clinical outcomes. Covering the repair site with an infrapatellar pedicle fat flap may improve meniscal healing and does not increase the complication rate.

**REFERENCES**


