Outcomes After Repair of Chronic Bucket-Handle Tears of Medial Meniscus

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**Purpose:** The purpose of this study was to determine the outcomes after repair of chronic bucket-handle medial meniscal tears by use of magnetic resonance imaging, clinical examination, and patient-reported outcomes. **Methods:** A retrospective review of patients with chronic bucket-handle medial meniscal tears that had been repaired with meniscal sutures was undertaken. The following criteria for inclusion were adopted: minimum tear length of 2 cm and chronic medial meniscal tear identified at the time of arthroscopy. The tears were susceptible to dislocation with probing. Data collected included demographic, clinical, radiologic, and surgical data. Postoperative healing was assessed with the clinical criteria of Barrett et al. The International Knee Documentation Committee rating, Lysholm score, and Tegner activity level were determined, and postoperative magnetic resonance imaging was used to evaluate healing in accordance with the criteria of Henning et al. **Results:** Twenty-four patients fulfilled the inclusion criteria. The mean time from injury to surgery was 10 months (range, 2 to 60 months). Sixteen patients underwent anterior cruciate ligament reconstruction, 1 patient underwent posterior cruciate ligament reconstruction, and 6 patients underwent meniscus repair only. A median of 5 sutures (range, 3 to 6 sutures) were used for repair. Four cases (all of which had undergone meniscus repair only) required revision. Complete healing was achieved in 83% of cases according to the criteria of Barrett et al. The mean follow-up time was 48 months (range, 24 to 112 months). An International Knee Documentation Committee rating of A or B was achieved in the 20 patients who did not require revision. The median Lysholm score was 95 (range, 92 to 100). The median Tegner activity level before injury was 7, and it remained unchanged after surgery in all cases. **Conclusions:** This study showed that repair of chronic bucket-handle meniscal tears can lead to good clinical outcomes and a relatively low (17%) failure rate. In addition, repairs of isolated meniscal tears had a significantly higher risk of failure than repairs performed in conjunction with anterior cruciate ligament reconstruction. **Level of Evidence:** Level IV, therapeutic case series.
arthroscopy is a common definition of failure and poor outcome.

Previously, better outcomes have been reported for acute injuries compared with chronic meniscal injuries. Nevertheless, recent studies have shown good clinical outcomes after chronic injury repair. The type of meniscal tear has also been associated with outcomes. Some bucket-handle tears, in particular those of the chronically dislocated or unstable variety, present the surgeon with a difficult challenge because of the complexity of their reduction and suture. However, because most injuries of this type are longitudinal and located in the periphery of the meniscus, they generally meet the requirements for repair, with good results being reported for repair.

The purpose of this study was to determine the outcomes after repair of chronic bucket-handle meniscal tears using MRI, clinical examination, and patient-reported outcomes. Our hypothesis was that patients would see positive outcomes and MRI would show healed repairs at 2 to 9 years' follow-up.

**Methods**

Patients were identified between 2005 and 2010 for this retrospective study. Our inclusion criteria were patients aged 45 years or younger, time from meniscal injury to surgery equal to or greater than 2 months, and meniscal injury diagnosed by preoperative MRI study. In addition, at arthroscopy, a bucket-handle tear of the medial meniscus at least 2 cm in length was required for inclusion in the study (Fig 1, Video 1 [available at www.arthroscopyjournal.org]). Cases in which meniscal tears were located outside of the red-on-red zone were excluded. At arthroscopy, meniscal injuries were repaired by refreshing both edges of the tear and performing inside-out suturing of the posterior two-thirds of the meniscus and outside-in suturing of the anterior third by use of a vertical mattress configuration in all cases. All suturing was carried out with a custom suture device (Sutureasy; Stryker Iberia S. L., Madrid, Spain) and No. 2 nonabsorbable suture (Ti-Cron; Covidien, Dublin, Ireland). After harvesting of the hamstring autograft, the sutures were passed in an inside-out manner. After completion of the anterior cruciate ligament (ACL) reconstruction, the sutures were tied with the knee in 30° of flexion. There were 17 cases of torn ACLs and 1 torn posterior cruciate ligament (PCL). One patient declined to undergo ACL reconstruction. All other ACL tears identified were reconstructed at the time of meniscus repair with autologous hamstring graft. The PCL tear was also reconstructed with hamstring autograft.

A rehabilitation protocol similar to that used by De Haven was followed. This included 2 weeks of immobilization with the knee locked in extension and non-weight bearing. After 2 weeks, the patients were allowed partial weight bearing with 2 crutches. They were then allowed to wean from 2 crutches to 1 crutch. Knee flexion was limited to 90° for 4 to 6 weeks. The patient was allowed to return to normal sports activity after 4 to 6 months. For patients who underwent ligament reconstruction, normal activity was not resumed until at least 6 months.

At follow-up, all patients who met the inclusion criteria for the study were evaluated by MRI, clinical examination, and patient-reported outcomes. The clinical criteria of Barrett et al. were used to assess definitive healing after meniscus repair. Tears were considered to have healed when none of the following symptoms were found on examination: pain at the medial joint line, joint effusion, locking, or pain during meniscal provocation tests. For this study, failure was defined as the presence of at least 1 of the symptoms in the clinical criteria of Barrett et al. and the need for revision surgery. All patients underwent postoperative MRI studies (these were specifically obtained as part of this study and are not obtained routinely in our current practice). Healing was assessed by use of the criteria of Henning et al. These criteria are based on both sagittal and coronal serial sections and are defined as follows: completely healed, 90% to 100% of the meniscus height; partially healed, 50% to 89%; and unhealed, less than 50%.

Patient-reported outcomes were assessed with the International Knee Documentation Committee (IKDC) rating, Lysholm score, and Tegner activity level. All of these scores have been validated for use in cases of meniscal injury. Outcome data were collected for all patients who did not require revision arthroscopy.

Correlation between continuous variables was assessed by use of the Spearman ρ. Comparisons between continuous variables and binary categories were performed with the Mann-Whitney U test. For comparisons between
categorical variables, the Fisher exact test was used. Statistical analysis was performed with R-Commander (R Development Core Team [2011], http://www.r-project.org).

Results

Twenty-four patients met the inclusion criteria. The mean patient age was 22.8 years (range, 15 to 40 years), and there were 5 female and 19 male patients. All patients were available for follow-up monitoring. The meniscal injury was sports related in 18 cases, involved road accidents in 4, and occurred as a result of domestic accidents in 2. The bucket-handle tear was located in the posterior horn of the meniscus in 6 cases, whereas it involved the entire length of the meniscus in 18. No tears were found isolated in the anterior horn or middle third of the medial meniscus. Tears were able to be subluxated or were scarred to neighboring tissues when examined at arthroscopic surgery, but all were reducible and with limited deformity. The mean time between injury and surgery was 10 months (range, 2 to 60 months). A median of 5 sutures (range, 3 to 6 sutures) were used for suture repair. Eighteen cases had ligament tears, all of which were reconstructed except in the patient who refused treatment of the ligament tear. Isolated meniscal tears were present in 6 cases (25%). Sixteen patients underwent ACL reconstruction, 1 underwent PCL reconstruction, and 7 underwent meniscus repair only. Revision arthroscopy was required in 4 patients who underwent meniscus repair only. The time to failure was 6, 12, 17, and 24 months. One revision case had an ACL injury that was not operated on because of the express refusal of the patient. All meniscus repair failures occurred in patients without ACL reconstruction. Isolated meniscus repairs were 21.3 times (95% confidence interval, 1.3 to 757.2 times) more likely to fail than tears with ACL injuries identified at arthroscopy.

In accordance with the criteria of Barrett et al., complete healing was achieved in 20 of 24 cases (83%) (Table 1). On MRI, according to the criteria of Henning et al., 17 cases had healed menisci (Fig 2) whereas 7 meniscus repairs were not healed (Fig 3). The Barrett criteria and the MRI criteria for healing were significantly associated ($P = .003$). In 4 cases (17%) treatment failed and revision arthroscopy with meniscectomy was required. The mean follow-up period was 48 months (range, 24 to 112 months) for the remaining 20 patients. After surgery, 11 patients achieved a subjective IKDC rating of A and 9 attained a rating of B. The median Lysholm scale score was 95 (range, 92 to 100). The median Tegner activity level before injury was 7 (range, 4 to 9). The median Tegner activity level at follow-up was 7 ($P < .001$). No correlation was found between patient-reported outcomes (Lysholm score, Tegner activity level, IKDC rating) and the chronicity or length of the tear (Table 2). No complications, other than failure, were seen.

Discussion

This study showed that repair of chronic bucket-handle medial meniscal tears resulted in a 17% failure rate and 83% of cases were healed at follow-up. Failures were more likely to occur in patients with isolated meniscus repair than in patients with ligament reconstruction. Patients in whom failure did not occur were able to return to their preoperative activity level and reported excellent functional outcomes. These results were seen in cases in which the injury proved difficult to reduce, with the meniscus scarred and involving adherence to neighboring structures (Video 1, available at www.arthroscopyjournal.org).

Although repairs of acute tears have naturally been reported to offer a better prognosis than those performed on chronic injuries, recent studies suggest that the repair of chronic meniscal tears can also yield good and even excellent results. Nevertheless, Table 1. Meniscus Healing as Assessed by Clinical Criteria of Barrett et al.26

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain at joint line</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Joint effusion</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Locking or pain during meniscal provocation tests</td>
<td>1</td>
<td>23</td>
</tr>
</tbody>
</table>

NOTE. For a tear to be considered healed, none of the symptoms can be positive.

Fig 2. (A) Coronal view of postoperative MRI of a completely healed repair of a chronically dislocated bucket-handle medial meniscal tear (arrow) in a patient who had a new traumatic injury 5 years after repair. The traumatic injury included possible ACL ligament injury and a lateral meniscal tear. (B) Second-look arthroscopy showed complete healing of the medial meniscus (arrows). The patient required second-look arthroscopy because of the new traumatic injury to the lateral side.
there is no clear limit to the evolution time that must elapse before surgery for a meniscal injury to be deemed “chronic.” The limit set by this study was 2 months, and the results obtained were positive. Moreover, because all of the injuries reviewed in this study were bucket-handle tears, they were more difficult to reduce and suture than standard chronic tears. In addition, we did not consider lateral meniscal tears as a control group because of the low number of such injuries found. This lower number of injuries to the lateral side of the knee correlates with previous studies about meniscal tear patterns and could be related to the chronicity of the ACL torn.

Numerous studies have reported the results of meniscus repair. A recent meta-analysis noted that most patients reported Lysholm scores of 90 or greater and IKDC ratings of normal to nearly normal. These same results were found in our study.

Repairs of meniscal tears associated with ACL injuries are known to offer better outcomes and prognoses than those performed with the ACL intact. This was corroborated by our study: patients with isolated tears had higher odds of meniscus repair failure than patients with an ACL injury and meniscal tear. All meniscal tears and associated ACL injuries were repaired at the same time to provide an adequate environment for healing. Augmentation techniques for isolated meniscal tear healing are being developed and used, but further research is necessary to find relevant evidence.

Limitations
This study is limited by the relatively low number of patients and the lack of a control group. A control group would be difficult to identify. With recent literature showing the damaging effects of removing substantial meniscal tissue, debridement of large bucket-handle tears may not be the treatment of choice. The complex bucket-handle tear is not commonly seen in the chronic injury stage, resulting in the low number of patients. Given its nature, the bucket-handle tear often dislocates into the joint, which results in treatment during the acute stage. It is difficult to address healing when not all patients underwent second-look arthroscopy. Although arthroscopy is the gold standard for healing, patient outcomes do provide a picture of the patient’s function. From this study, it is unclear how useful MRI criteria are for measuring meniscus healing, which correlates with previous studies. Another limitation is that this was a retrospective study; however, all data were collected prospectively to avoid bias. The Tegner activity level was documented as activity before injury. Although this does introduce recall bias to the data, our goal was to determine whether patients returned to their preinjury level. Most patients easily answered this question and did not have trouble recalling the level of activity; however, this is still a limitation.

Conclusions
This study showed that repair of chronic bucket-handle meniscal tears can lead to good clinical outcomes and a relatively low (17%) failure rate. In addition, repairs of isolated meniscal tears had a significantly higher risk of failure than repairs performed in conjunction with ACL reconstruction.

References

![Fig 3. Sagittal view of postoperative MRI of an unhealed repair of a chronically dislocated bucket-handle medial meniscal tear (arrow) after 2 years' follow-up. (I, inferior; S, superior.)](image-url)