

Second-Look Arthroscopic Evaluation of Bucket-Handle Meniscus Tear Repairs With Anterior Cruciate Ligament Reconstruction: 67 Consecutive Cases

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Purpose: To evaluate arthroscopic second-look bucket-handle meniscus tear (BHMT) repairs using different suturing techniques. **Methods:** Between May 2002 and September 2006, 122 consecutive cases underwent arthroscopic repair surgery, including 40 males and 24 females (63 with concurrent anterior cruciate ligament [ACL] injury and 1 isolated BHMT) having 67 (60 medial and 7 lateral) repairs available for second-look arthroscopy evaluation. Inclusion criteria for reparability included reducible tears involving red-red and red-white zone without obvious additional complex tears and tissue degeneration, and concurrent ACL injury and/or isolated BHMT. Patients were excluded if they had combined ligaments injuries other than ACL. The arthroscopic suturing techniques, classified according to different involvement of meniscus zones, consisted of typical inside-out and all-inside suture repair with suture hook. **Results:** In a series of 64 second-look cases with 67 repairs, which showed healing after an average of 26 months (range, 14 to 66 mos), 55 repairs (82.1%) were completely healed (and clinically asymptomatic) in 53 cases; 5 cases (5 repairs; 7.5%) had joint line tenderness (incompletely healed and clinically asymptomatic); and 7 repairs (6 medial, and 1 lateral; 10.4%) failed, with recurrent locking or catching in 4 cases (and clinically asymptomatic in 2 cases). The overall success rate, including completely healed and incompletely healed cases, was 89.6%. Four failures occurred in failed ACL-reconstructed knees. **Conclusions:** For large bucket-handle meniscus tears involving red-red and red-white zones, an arthroscopic hybrid suture technique with ACL reconstruction achieves high anatomic healing results, with an overall meniscal healing rate of 89.6%, including 82.1% completely healed and 7.5% incompletely healed. The failure rate was 10.4% in the average 26-month follow-up period. **Level of Evidence:** Level IV, therapeutic case series. **Key Words:** Bucket-handle meniscal tear—Knee arthroscopy—Meniscal repair.

The importance of preserving meniscal function is well recognized, and the poor long-term outcomes after meniscectomy are well documented.^{1,2} As a result, a torn meniscus should be repaired if possible. Because bucket-handle meniscus tears (BHMTs) are

commonly long, peripheral tears primarily involving large portions of the meniscus, without proper surgical repair, meniscectomy can result in total or subtotal loss of meniscal function. Therefore, the repair of BHMTs is of great clinical importance.

Several studies have reported the success rate of meniscus repair to be anywhere from 70% to 90%.³⁻¹⁷ Factors that have been documented to significantly influence success rates include rim width, anterior cruciate ligament (ACL) laxity, concomitant ACL reconstruction, tear length, whether the tear is acute or chronic, and whether the medial or lateral meniscus is involved. Among these factors, rim width appears to be the most important. Concomitant ACL laxity is also an important factor in meniscal healing.

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Despite promising results reported for the repair of meniscal tears located in the vascular region, efforts to repair meniscus in the white-white zone have been generally agreed upon as poor.^{15,18,19} There are, however, few large clinical studies regarding the results of BHMT repair in the literature.^{3,4,18,20-22} O'Shea and Shelbourne¹⁸ reported on 59 patients who underwent staged procedures of BHMT repair (and were followed-up with repeated arthroscopy surgery for an average of 77 ± 58 days by ACL reconstruction) and reported a success rate of 89%. In 1999, Albrecht-Olsen et al.⁴ reported the results of a randomized study of 68 patients treated with either the arrow or inside-out repair.

The purpose of our study was to evaluate a large series of BHMT repairs by second-look arthroscopy to define the true structural integrity healing and its relationship to clinical incidence.

METHODS

Subjects

Between May 2002 and September 2006, 122 consecutive cases underwent arthroscopic BHMT repair surgery (Fig 1). The indications for BHMT repair were: (1) displaced BHMT when probing, (2) reducible inner fragment for chronic cases, (3) red-red and red-white zone without obvious additional complex tears and tissue degeneration, and (4) isolated BHMT and BHMT with concomitant ACL injuries.

We excluded multiple ligament injuries other than ACL and medial collateral ligaments that were treated conservatively or surgically. We also excluded cases with BHMTs in the white-white zone. However, we did not exclude patients who received partial meniscectomy at their avascular zone tear before repairing the remaining peripheral two-thirds of meniscus, nor did we exclude double longitudinal BHMTs.

Among 122 cases, 64 patients who received second-look arthroscopic evaluation surgery comprised the current study group. For the other 58 patients who were not available for second-look arthroscopy, 28 patients were lost to follow-up and 30 patients (22 asymptomatic, 1 with repeated locking, and 7 with joint line tenderness) refused to undergo further surgery. The study group included 40 men and 24 women whose mean age at the time of meniscal repair was 25 years (range, 14 to 47 years). The mean interval from injury (mostly from ACL injury time) to the time repairs were made was 26 months (range, 7 days to 19 years and 7 months). Fifteen cases underwent acute stage repairs

(within 12 weeks after injury), and 49 cases with 52 meniscus underwent repairs for a chronic condition.

The mechanisms of injury were mainly sports-related in 51 patients (80%), with 21 patients (33%) experiencing basketball injuries, 15 (23%) with soccer injuries, 15 (23%) with skiing injuries, 8 (13%) with bicycling injuries (including falling down), and 5 (8%) being injured in other daily activities.

Fifty-eight medial and 9 lateral menisci were repaired. A single meniscus was repaired in 61 knees, and bilateral tears were repaired in 3 knees. To locate the tear(s), we used the 3 circumferential zone classification system, which divides the meniscus into a red-red zone (consisting of the capsular-meniscus junction and outer one-third), a red-white zone (the middle one-third), and a white-white zone (the innermost one-third). Forty-five tears involved the red-red zone and 22 involved the red-white zone.

Of the 64 cases, 63 were ACL concomitant cases, and among them, 62 cases underwent meniscus repair and simultaneous one-incision ACL surgery (61 reconstruction, 1 with thermal shrinkage). One case underwent second-stage ACL reconstruction because of skeletal immaturity. The only isolated BHMT patient underwent meniscus repair. For 62 cases of ACL reconstruction, 3 patients received hamstring autografts, 10 patients received bone-patellar tendon-bone (BPTB) allografts, and 49 patients received BPTB autografts.

Surgical Technique

In this study, arthroscopic meniscus repair techniques consisted of inside-out and 2 different all-inside suture repair techniques according to the involved sides and zones. After identifying an appropriate tear, a rasp or shaver was used to stimulate the tissue along the length of the tear and the meniscal rim adjacent to it. The preferred technique for the proceeding meniscus repair depended on the region of the tear.

The anterior and middle one-third portion of the medial meniscus and the anterior popliteal tendon portion of the lateral meniscus were repaired using a standard inside-out technique that has been previously described.^{15,19,23} All of the inside-out repairs were performed with multiple nonabsorbable No. 2-0 Ethibond sutures (Ethicon, Somerville, NJ) that stacked vertically in both the superior and inferior surface and were placed at 2- to 4-mm intervals to ensure repair strength.

The posterior one-third portion of the medial meniscus was repaired using all-inside suture technique through 2 posteromedial portals.²⁴ A 45° suture hook (Suture Hook CorkScrew; Linvatec, Largo, FL) pre-

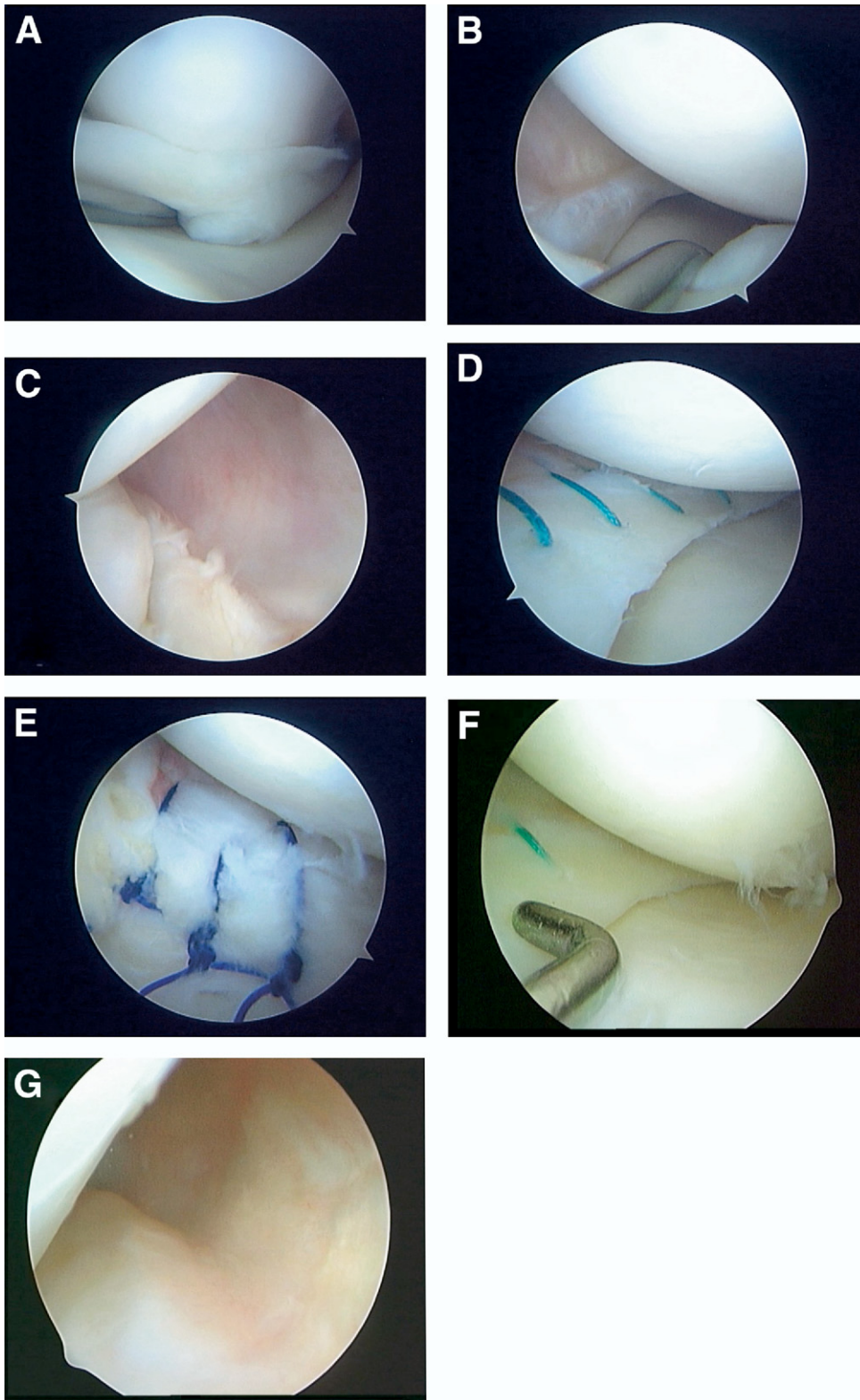


FIGURE 1. (A) A medial bucket-handle meniscus tear locked in the intercondylar notch. (B) The bucket-handle meniscal tear involved in the middle third of the medial meniscus. (C) Transcondylar arthroscopy view revealed the posterior portion of medial meniscus ("ramp area") involved. (D) Typical inside-out suture repair for middle third portion of the medial meniscus. (E) All-inside suture repair for posterior third of the medial meniscus through 2 posteromedial portals. Arthroscope viewed from the higher posteromedial portal. (F) Second-look arthroscopy showing complete healing. (G) Second-look arthroscopy transcondylar arthroscope showing complete healing of the repaired posterior third of the medial meniscus.

loaded with absorbable No. 0 polydioxanone-II sutures (Ethicon) was inserted through the lower posteromedial portal and proceeded to the procedure of all-inside suture repair with the arthroscope viewing from the higher posteromedial portal.

The posterior popliteal tendon portion of lateral meniscus was repaired using a transanteromedial portal technique for all-inside suture.²⁵ With the knee in the figure-four position, a suture hook was introduced into the joint through the regular anteromedial arthroscopic portal and reached the posterior horn of the lateral meniscus while using the arthroscope to view through the anterolateral portal. Usually, 2 to 4 absorbable sutures are needed to finish the posterior popliteus area repair. To facilitate the procedure, repair usually begins at the root area of the lateral meniscus and proceeds to the popliteus area.

After completion of the meniscus repair, arthroscopically assisted ACL reconstructions were carried out using BPTB autografts or allografts with metal interference screw fixation in 60 cases, autogenous hamstring tendon graft in 3 cases, and ACL shrinkage in 1 case.

All of the surgeries were performed by the same senior surgeon (H.F.).

Postoperative Rehabilitation Protocol

The knee was immobilized in a full extension brace, and crutches were used for 4 to 6 weeks postoperatively to protect the ACL graft and repaired meniscus. Range of motion exercises began immediately after removal of the drainage, with the goals of achieving 90° of knee flexion within 4 weeks. Partial weight bearing was allowed to begin after 4 weeks and gradually increased to full weight bearing by the sixth postoperative week. Squatting was not allowed until 12 weeks postoperatively. Sports activity was restricted for 6 to 10 months postoperatively.

Second-Look Arthroscopy Evaluation

Among the 122 consecutive cases, 64 cases with 67 repairs were available for second-look arthroscopy. The indications for second-look arthroscopy were: (1) patients who are asymptomatic but wanted to remove ACL graft metal interference screws (52 patients); (2) patients who are symptomatic (11 patients, including recurrent locking in 4, extension deficit in 4, 1 staged ACL reconstruction, 1 irritating suture cyst, and 1 with patellofemoral pain); and (3) second-stage ACL reconstruction (1 patient).

In this study, we followed the meniscal healing arthroscopic evaluation criteria recommended by Morgan.¹⁴ According to that criteria, meniscus repair at second-look arthroscopy were graded as healed, incompletely healed, or failed. A healed repair showed no defects or areas of hypermobility upon probing at the repair site. An incompletely healed repair had a partial defect of <50% of the original repair length or height that was stable to probing. A failed repair had either an unstable meniscus fragment secondary to rerupture at the original repair site or a second tear in the meniscal substance in an area different from the original repair site with a healed peripheral repair.

All of the second-look arthroscopic surgeries were performed by the same surgeon who did the initial meniscus repairs. For meniscus assessment, 2 regular anteromedial and anterolateral arthroscopic portals were used. In cases of all-inside suture repairs for the posterior horn of medial meniscus, the posteromedial portal was used.

Clinical Assessment

At second-look arthroscopy, clinical parameters²⁶ indicative of meniscal unhealing status including recurrent effusion, locking or catching, and localized joint line tenderness; positive McMurray tests were also recorded and correlated with the arthroscopic meniscal findings. During the follow-up examinations, Lysholm scores were obtained as subjective measurements. Objective measurements were obtained during follow-up with the International Knee Documentation Committee (IKDC) knee examination form.²⁷

The stability of ACL-reconstructed knees was measured using a KT-1000 arthrometer (MEDmetric, San Diego, CA), and the measured displacement of side-to-side differences at the standard of 134 N (30 lbs) were categorized into 3 groups: <2 mm, 3 to 5mm, and >5 mm.

We routinely performed magnetic resonance imaging (MRI) scans preoperatively and every year postoperatively. Preoperative and follow-up clinical assessments were completed by an orthopedic surgeon not involved in the surgical procedures. All patients' data were entered prospectively into a computer database (Microsoft Access; Microsoft, Redmond, WA) that was for analysis with the approval of the in-hospital institutional review board.

RESULTS

Sixty-four cases with 67 repairs were available for second-look arthroscopic evaluation on an average of

26 months (mean, 25 mo; range, 14 to 66 mo) post-operatively.

Second-Look Arthroscopy

Among the 67 repairs, 55 (82.1%) were completely healed (asymptomatic in 51 and joint line tenderness in 4), 4 (7.5%) were incompletely healed and asymptomatic, and 7 (10.4%) failed with recurrent locking or catching in 5 and asymptomatic in 2. The overall success rate, including completely healed and incompletely healed, was 89.6% (Fig 1D-G).

Of the 5 incompletely healed repairs, 1 occurred in the popliteal hiatus area of the lateral meniscus and 4 occurred in the medial meniscus, with 2 in the posterior one-third portion ("ramp area"), 2 in the junction of posterior and middle one-third area, and 1 underwent repeated repair with 1 using suture and 1 using meniscal fixator at the second-look surgery.

Among the 7 failed repairs (1 lateral, 6 medial), 4 (57%) repairs in 3 cases occurred with concurrent ACL insufficiency (2 with ACL graft failure and 1 with thermal shrinkage failure) and underwent subsequent meniscectomy with 1 concurrent ACL reconstruction for the thermal shrinkage failure case. The other 2 ACL graft failure patients refused to undergo ACL revision surgery and underwent meniscectomy.

Of the 63 ACL surgery cases (62 reconstruction, 1 thermal shrinkage treatment), 3 (5%) failed, including 2 in reconstructed knees and 1 in the thermal shrink-

age knee. Those failed ACLs were probed and showed poor tension.

Clinical Assessment

Of the 67 repairs with 64 patients who underwent second-look arthroscopy, comprehensive clinical assessments were performed. The results showed that among the 67 repairs, 58 (86.6%) were asymptomatic (completely healed in 51, incompletely healed in 5, and failed in 2), 4 (6%) had joint line tenderness on the medial side but second-look arthroscopy showed that they were completely healed, and 5 (7.4%) had recurrent locking or catching with a positive McMurray test.

At the final follow-up, the average Lyshom knee score was 91.5 (range, 73 to 100), and the International Knee Documentation Committee objective scores were A (normal) in 30 cases, B (nearly normal) in 27 cases, C (abnormal) in 7 cases, and D (severely abnormal) in 0 cases. KT-1000 arthrometry showed that displacement of side-to-side difference was 1.8 mm on average, with 61 cases <2 mm, 3 to 5 mm in 1 case, and >5 mm in 2 cases.

Effect of Factors

The results of the statistical analysis of the 5 factors on the outcome of BHMT repair are given in Table 1. Patients with chronic BHMT had a lower failure rate

TABLE 1. Effects of 5 Factors on the Outcome of Second-Look Arthroscopic Findings

Factor	Success			Total
	Completely Healed (%)	Incompletely Healed (%)	Failed (%)	
Time from injury				67
≤12 wks	12 (80)	1 (6.67)	2 (13.3)	15
>12 wks	43 (82.7)	4 (7.7)	5 (9.6)	52
Meniscus side				67
Medial	48 (82.8)	4 (6.9)	6 (10.3)	58
Lateral	7 (77.8)	1 (11.1)	1 (11.1)	9
Location of tear				67
Red-red	35 (77.8)	5 (11.1)	5 (11.1)	45
Red-white	20 (90.9)	0 (0)	2 (9.1)	22
Knee stability (side-to-side difference)				67
≤2 mm	55 (87.3)	5 (7.9)	3 (4.8)	63
3-5 mm	0 (0)	0 (0)	1 (100)	1
≥5 mm	0 (0)	0 (0)	3 (100)	3
Repair technique				67
Inside-out only	20 (83.3)	0 (0)	4 (16.7)	24
Inside-out + all-inside	32 (80)	5 (12.5)	3 (7.5)	40
All-inside only	3 (100)	0 (0)	0 (0)	3

NOTE. The effects of 5 factors were analyzed using the χ^2 test for significance ($P < .05$).

than those with acute tears. Five failures (9.6%) occurred in the chronic group (>12 wks from injury to repair) compared with 2 (13.3%) in the acute group (≤ 12 wks from injury to repair). This difference in the failure rate was not statistically significant ($\chi^2 = 0.172$; $P < .05$).

Patients with medial BHMT have a similar failure rate with lateral tears. Six medial BHMTs (10.3%) failed, but only 1 (11.1%) lateral BHMT repair failed. Again, this difference was not statistically significant ($\chi^2 = 0.005$; $P < .05$).

Although a higher failure rate (11.1%) was observed in patients with red-red zone BHMT than those in red-white zone (9.2%), this increase was not statistically significant ($\chi^2 = 0.064$; $P < .05$). Evidence of suture techniques used to repair each BHMT did not have a significant effect on outcome of the repair ($\chi^2 = 1.714$; $P < .05$). Knee stability at the time of BHMT repair did have a significant effect on the outcome of the repairs ($\chi^2 = 36.436$; $P < .05$). Of the 63 repairs with successful concurrent ACL reconstruction (KT-1000 ≤ 2 mm), 3 failed (4.8%). However, a 100% failure rate was found in repairs with failed ACL grafts (3 of 3; KT-1000 > 5 mm) or failed thermal shrinking of the ACL (1 of 1; KT-1000 ≥ 3 to < 5 mm). This difference was statistically significant ($P < .05$).

Complications

In this study group of 67 repairs, there were 7 complications (10.4%), consisting of 4 knee extension deficits between 5° and 10° that resolved with secondary arthroscopic scar tissue resection and notchplasty, 1 symptomatic meniscal suture-irritating cyst in the medial capsule that required resection, 1 local superficial infection in the medial safety incision that healed after local wound care, 1 temporary tourniquet paralysis involving the perineal nerve postoperatively that resolved spontaneously after 6 months without any sequelae.

DISCUSSION

The results of this study showed high healing rates (89.6%) for BHMT repair with mostly concurrent ACL reconstruction which were verified by second-look arthroscopy. Although repairing nondegenerative vertical longitudinal tears in the outer one third of the vascularized area of the meniscus would be expected to achieve good results, this study's greatest strength is that it captures the experience of a relatively large series (67 repairs with an average 26 mos follow-up)

of patients who received second-look arthroscopic evaluation of BHMT healing status. Second-look arthroscopic surgery could provide an accurate evaluation of the anatomic integrity of the meniscus.

Our study's success rate of 89.6% compares favorably with previous research. O'Shea and Shelbourne¹⁸ reported on 59 patients who underwent staged procedures of BHMT repair (and were followed for an average of 77 ± 58 days by ACL reconstruction) and reported a success rate of 89%, which is comparable to our study. However, in Shelbourne's study,¹⁸ the complete healing rate was lower (55%) and the partial healing rate was higher (34%) than our study. The reason for these differences is that in his study group, 78% (43 of 55) repairs were in the white-white zone. However, of the 11 repairs in the red-white zone, 8 (72.7%) completely healed, a rate that is comparable to our results. Also, in our study group, we used a meticulous combined hybrid suture repair technique, by which the torn meniscus reapproximation and suture fixation strength improved; therefore, we achieved a higher complete healing rate.

There are several well-known techniques for repairing the meniscus: inside-out, outside-in, and all-inside meniscus fixator and suture. At present, it can be concluded that no single meniscal repair technique or device is superior in all situations. Inside-out methods will continue to be the treatment of choice when repairing complex tears and when faced with a middle one-third meniscus tear. However, possible complications currently exist to constrain its use. The all-inside suture technique is particularly useful in treating posterior horn tears, to limit the chance of neurovascular injury and improve tissue reapproximation.

For BHMTs, stable repairs with good tissue reapproximation techniques are mandatory. To meet this technique's demands, we combined the inside-out and all-inside suture methods, termed the hybrid method. For the middle one third of the medial meniscus and anterior popliteal tendon region of the lateral meniscus, the inside-out technique was used. Because of the potential neurovascular complications and less optimal repair with inside-out repairs, for posterior one third meniscus tears, 2 all-inside suture repair techniques were favored: the all-inside suture technique through posteromedial portals²⁴ for medial meniscus and an all-inside suture technique through the anteromedial portal²⁵ for the lateral side.

For medial BHMTs, we believe that the hybrid method is beneficial to improve complete meniscal healing, especially for the medial meniscus which is

susceptible to failure and incomplete healing. Morgan et al.¹⁴ reported a 92% failure rate for posterior medial meniscus tears and concluded that meniscal repair failure was strongly associated with original location in the posterior horn of the medial meniscus, and that incomplete healing was also associated with posterior horn repair of the medial meniscus. Ahn et al.²⁴ also reported incomplete healing, mainly at the posteromedial corner of the meniscus.

The all-inside suture technique through the antero-medial portal is useful for repairing lateral BHMTs. This technique ensures complete and proper apposition of the repaired meniscus and eliminates the potential risk of peroneal nerve injury. Unlike medial BHMTs, the main torn area of lateral BHMTs is located in the posterior one-third region, sometimes involving only the posterior popliteal tendon region. With 2 to 4 all-inside stitches, lateral BHMTs can be stabilized. Shelbourne and Dersam²² reported that for unstable lateral BHMTs, only the anterior popliteus portion needs to be repaired using an inside-out technique, while the posterior popliteus portion can be treated with trephination, believing that lateral meniscus tears that are located posterior to the popliteus have been shown to be asymptomatic or heal spontaneously. Although Shelbourne's technique eliminates neurovascular complications and saves surgical time, we still suggest that, for BHMTs, stable repairs with good tissue reapproximation techniques are mandatory.

Although surgical repair is usually recommended for nondegenerative red-red or white-red zone tears, reparability still varies according to the surgeon's preference. Some authors^{5,15,18,19} have shown that even in the white-white zone, meniscus salvage is still possible.⁵ Although we do agree that the repair of avascular zone BHMTs may give the patient several years of functional meniscus, concern for the patient's full comprehension and expense for the next possible meniscectomy is the reason we performed the assured repair.

Several short- to mid-term clinical studies using meniscus devices showed successful outcomes despite their weaknesses.^{4,28,29} For example, Albrecht-Olsen et al.⁴ reported the results of a randomized study of 68 patients treated for BHMTs with either the arrow or inside-out repair. Sixty-five of the patients had second-look arthroscopy at 3 to 4 months with no differences found with the rates of healing. In this present study, we repaired all of the BHMTs using hybrid suture techniques, believing that those repaired unstable large BHMTs are subjected to higher stress than

other tears, and that multiple sutures that have superior strength than meniscus devices are required.

In this study, all patients but 1 had concurrent ACL injuries. The 95% (61 of 64) success rate of ACL reconstruction at the time of BHMT contributed to the high healing rate of meniscus repair. Four of 7 (57%) failed repairs occurred with concurrent ACL surgery failure. The result revealed that meniscal repair failure was strongly associated with ACL deficiency. Ample evidence has shown an increased incidence of repair failure in an ACL-deficient knee compared with a stable joint.³⁰⁻³² Whereas the ACL reconstruction can be done at the time of BHMT repair as presented in this study or at a separate operation as shown by O'Shea and Shelbourne.¹⁸ With the results of this study, we believe that a same-stage operation would be beneficial to reduce the patient's rehabilitation period and their expense for treatment. The increased risk of extension deficit and stiffness, especially for the chronic locked knee preoperatively, could be reduced with advanced postoperative rehabilitation protocols. The reasons for the other 3 failure cases remain unknown. All of the these tears were located in the red-red zone without obvious degenerative changes, had postoperative KT-1000 measurements within 2 mm, and were of acute stage repair in 1 case and chronic stage in 2 cases.

MRI is considered to be a useful imaging technique for the diagnosis and postoperative evaluation of BHMT.^{33,34} Thoreux et al.³³ presented results that suggest good agreement (92.9%) between MRI and arthroscopy for predicting the reparability of BHMT. In the present series, we evaluated conventional MRI in all of the cases preoperatively and every year postoperatively. We found reproducible results of diagnosis for displaced BHMT and reparability prediction for medial meniscus; however, for undisplaced BHMT and lateral BHMT, the criteria are still insufficient. In our limited experience, oblique or vertical tear detected in 4 or more consecutive slides both in sagittal or coronal images should arouse suspicion for undisplaced BHMT.

There are several important points that we believe are essential to obtaining a successful outcome with BHMT repair. First, the appropriate candidate's meniscus must have good vascularity and tissue integrity to ensure its healing capacity and suture strength. Those with tears in the white-white zone or with degenerative changes must be carefully selected for repair. Second, our hybrid suture technique provides meticulous suture repair along the entire length of the BHMT and, therefore ensures suture stability. Three alternative suture meth-

ods available for different meniscus zones—especially the 2 all-inside suture techniques—are useful and safe for repairing the posterior horn of the medial and lateral meniscus. Third, the ACL plays an important role in the integrity of repaired BHMT and, once injured, must be successfully reconstructed.

The outlook of meniscal repair methods seems to be encouraging when one considers the involvement of tissue engineering and gene therapy.³⁵⁻³⁷ However, much has to be learned before these means gain widespread clinical application. At present, traditional repair methods are still the treatment of choice.

There were some limitations to our study. First, this study projected the results from 52.5% second-look arthroscopic cases onto the entire series of 122 cases. Second, second-look arthroscopy could not verify the interstitial component healing status, and the posteromedial region of medial meniscus is sometimes difficult to access for arthroscopic viewing, especially in tight knees. Third, the all-inside suture technique is time-consuming and technically demanding, which might make it less likely to be popularized with surgeons.

CONCLUSIONS

For large BHMTs, our arthroscopic hybrid suture technique in conjunction with ACL reconstruction achieves high-quality anatomic results with an overall meniscal healing rate of 89.6%.

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