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Success of Meniscal Repair at ACL Reconstruction

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Abstract

Background—Meniscal repair is performed in an attempt to prevent posttraumatic arthritis resulting from meniscal dysfunction after meniscal tears. The socioeconomic implications of premature arthritis are significant in the young patient population. Investigations and techniques focusing on meniscus preservation and healing are now at the forefront of orthopaedic sports medicine.

Hypothesis—Concomitant meniscal repair with ACL reconstruction is a durable and successful procedure at two year follow-up.

Study Design—Case Series; Level of evidence, 4.

Methods—All unilateral primary ACL reconstructions entered in 2002 in a prospective cohort who had meniscal repair at the time of ACLR were evaluated. Validated patient oriented outcome instruments were completed preoperatively and then again at the two-year postoperative time point. Reoperation after the index procedure was also documented and confirmed by operative reports.

Results—437 unilateral primary ACL reconstructions were performed with 86 concomitant meniscal repairs (57 medial, 29 lateral) in 84 patients during the study period. Patient follow-up was obtained on 94% (81/86) of the meniscal repairs, allowing confirmation of meniscal repair success (defined as no repeat arthroscopic procedure) or failure. The overall success rate for meniscal repairs was 96% (76/79 patients) at two-year follow-up.

Conclusions—Meniscal repair is a successful procedure in conjunction with ACL reconstruction. When confronted with a “repairable” meniscal tear at the time of ACL reconstruction, orthopaedic surgeons can expect an estimated >90% clinical success rate at two-year follow-up using a variety of methods as shown in our study.

Key Terms

meniscal repair; clinical medicine; ACL reconstruction

INTRODUCTION

The incidence of meniscal tears in the acute setting have been documented to be as high as 61 per 100,000 and approximately 850,000 meniscal procedures are performed yearly in the United States.² However, many of meniscal tears in adolescents and young adults occur concurrently with anterior cruciate ligament (ACL) tears. The goal of meniscal repair is to prevent the sequelae of meniscal dysfunction, i.e. posttraumatic osteoarthritis.⁶ The socioeconomic implications of posttraumatic arthritis are significant in a 30 to 45-year-old patient population in their prime working years. Thus, investigations and techniques focusing on meniscus preservation and healing are now at the forefront of orthopaedic sports medicine.

To properly assess timeliness and generalizability regarding the outcomes of meniscal repair with ACL reconstruction, a multicenter approach is the preferred study design. For example, a single surgeon in the busiest, most efficient practice would amass 100 to 150 ACL reconstructions yearly and from that number only a small portion (~20%) would undergo meniscal repair. Secondly, a multicenter study can demonstrate the reproducibility of success of repair across sites and among surgeons. Thus, collaboration provides increased sample size and allows for the formation of relevant conclusions before current operative techniques become outdated.

Case series (Level 4) and comparative outcomes studies (Level 3) of meniscal repair have demonstrated variability in success.⁸ At this time only five prospective studies have been published comparing all-inside to inside-out meniscal repairs.^{1, 3, 4, 7, 9} The most recent systematic review of meniscal repair literature reveals a failure rate of 0% to 43.5%.⁸ The primary outcome variable in 80% (26/32) of all-inside meniscal repair studies was “clinical failure”, defined as re-operation for repair failure. The only conclusion to be had from this review was that prospective long-term studies are important to elucidating the failure rates of all-inside meniscal repairs. The aim of the present prospective longitudinal cohort study was to determine the success of primarily all-inside meniscal repairs with ACL reconstruction with re-operation for failure as our primary endpoint two years after meniscal repair and ACL reconstruction.

MATERIALS AND METHODS

The MOON (Multi-center Orthopaedic Outcomes Network) group is an NIH funded prospective longitudinal cohort of ACL reconstruction. After IRB approval from all centers, the group began enrolling all ACL reconstruction patients at six sites. A prospective longitudinal cohort design was established to determine the prognosis as well as the predictors of outcomes after ACL reconstruction. The general study design requires that subjects preoperatively complete a 13-page form that includes the mechanism of injury, a series of validated patient-oriented outcome questionnaires (KOOS, WOMAC, Marx, SF-36, IKDC), sports participation history, co-morbidities, demographics, prior surgery on either knee, and any current therapies (i.e. glucosamine, bracing, NSAIDs). The surgeon completes

a detailed operative assessment and treatment of meniscus and articular cartilage injuries. The details of each patient's ACL reconstruction and rehabilitation milestones are recorded. This form has been previously described and interrater agreement previously established with regard to meniscal pathology.^{1, 3, 7, 9, 10} The postoperative rehabilitation protocol and surgical technique used, including graft selection, surgical approach, and method of graft fixation, was left to the discretion of each surgeon.

Since this present study focused on meniscal repairs at the time of ACL reconstruction, specific surgeon variable data included left versus right knee (side), medial versus lateral meniscus, length of tear, type of tear, location of tear (anterior versus posterior and peripheral versus middle versus inner one-third), type and number of devices used, surgical approach, and method of meniscal repair.

Our inclusion criteria were all meniscal repairs concurrent with an ACL reconstruction enrolled by a participating site from 01/01/02 to 12/31/02. This cohort is a subgroup of the entire ACL reconstruction cohort entered in a large database. Two-year patient follow-up was prospectively obtained with the patient completing the same outcome questionnaire they originally completed preoperatively. This questionnaire documented any additional surgeries subsequent to the initial ACL reconstruction performed in 2002. Further, all patients were queried by telephone regarding any additional knee surgeries. Operative notes of 2002 ACL reconstructions and follow-up surgeries (if applicable) were obtained to confirm that each patient's meniscal repair had in fact failed.

Statistical analysis was performed with free open source R statistical software (www.r-project.org).

RESULTS

From 01/01/02 to 12/31/02, 437 unilateral primary ACL reconstructions were performed with 86 concomitant meniscal repairs (57 medial, 29 lateral) in 84 patients. Two patients had simultaneous repairs performed in both the medial and lateral menisci within the same knee. The average age of the entire 2002 ACLR cohort was 27 years (SD 11 range 11–63) with 56% males. Average age for the patients with meniscal repair was 25 years (SD 25 range 11–59) with 46 (55%) males. Initial surgeon questionnaires documented that the majority of these meniscal tears were located in the peripheral third of the menisci (83% in the medial meniscus; 48% in the lateral meniscus), in the posterior region (Table 1).

Table 2 provides a breakdown of the type of meniscal tears documented in the cohort. Longitudinal tears were the most common type of tear seen for both the medial and lateral menisci (81% - medial meniscus; 69% - lateral meniscus). In the lateral meniscus region, bucket-handle tears and oblique tears occurred with similar frequencies (13.8%), while bucket-handle tears occurred more often than oblique tears in the medial meniscus (12.3% versus 7%, respectively).

In addition to the repairs reported here, 104 patients underwent medial meniscectomy in the ACLR cohort. 29 patients had undergone medial meniscectomy at a previous operation before their ACL reconstruction. One hundred thirty-six patients underwent lateral meniscectomy and 17 had undergone lateral meniscectomy before their ACL reconstruction.

The average tear length for medial meniscal tears seen in this cohort was 17.1 mm (SD, 7.6 mm; range, 10 to 45 mm), while the average tear length for a lateral meniscal tear was 16.7 mm (SD, 6.7 mm; range, 10 to 45 mm). In addition, the number of sutures and devices needed to repair these menisci were similar. An average of three sutures/devices/implants was needed to repair either side of the meniscus (Table 3).

Figure 1 outlines the initial, follow-up, and success rates for the medial and lateral meniscal repairs, the surgical approach (all-inside versus inside-out) used, and the types of all-inside meniscal repair devices used (“devices” versus nonabsorbable suture). The majority of meniscal repairs were performed using the all-inside technique (79% [68/86]). Likewise, the majority of meniscal repairs were medial (66% [57/86]). For either meniscus the group primarily performed all-inside repair. For the medial meniscus 75% (43/57) and the lateral meniscus 86% (25/29) were repaired by all-inside technique. However, the type of all-inside meniscal repair chosen, either “absorbable devices” or nonabsorbable suture devices, differed in the cohort. For the medial meniscus 72% (31/43) of repairs were absorbable devices whereas in the lateral meniscus only 52% (13/25) were absorbable devices.

Figure 2 outlines patient follow-up and additional surgical procedures captured within the meniscal repair cohort. Patient follow-up was obtained on 94% (81/86) of the meniscal repairs, allowing confirmation of meniscus success (defined as no repeat arthroscopic procedure) or repair failure. The five patients lost to follow-up included four all-inside repairs (three for medial meniscus and one for lateral meniscus) and one inside-out medial meniscal repair.

Nine percent (7/79) of patients required additional arthroscopic procedures. These include three patients (4%) who required arthroscopic removal for failed meniscal repair, one for scar debridement, and three patients (4%) with either an ACL graft failure (n=2) or contralateral ACLR (n=1). The meniscus was noted to be healed at the time of repeat surgery in the three cases of ACL graft failure or scar debridement

The overall success rate for meniscal repairs was 96% (76/79 patients). The three repair failures were identified at two-year follow-up. Upon identification, both the initial meniscal repair and follow-up records were obtained to confirm that each patient’s meniscal repair had in fact failed.

DISCUSSION

The clinical success of overall meniscal repair as well as each specific method for either meniscus was >91%. The three failures were distributed with one each in medial meniscus device, medial meniscus inside-out, and lateral meniscus device. However, to determine if two methods are significantly different by 5% to 10%, one would require a total sample size of 500 to 1000 patients, respectively. The extremely low event rate for failure (n=3) precludes evaluation of predictors. Each potential predictor requires, in general, ten events. Thus, for the clinician choosing between these methods versus another method with 100% success, one would not be able to scientifically distinguish an observed <9% difference (100% – 91%) using clinical success as the primary outcome.

Five prospective studies (three RCTs [Level 1] and two cohorts [Level 2]) have compared all-inside techniques with inside-out meniscus repair.^{1, 3, 4, 7, 9} In the study by Albrecht-Olsen et al¹, the success rate for all-inside stints was 91% versus a 75% success rate with the inside-out suture technique. Spindler et al,⁹ in an ACL reconstruction population with medial meniscal repair, showed a near equal rate of success with all-inside absorbable devices and inside-out suture techniques at 89% and 88%, respectively. Bryant et al⁴ noted equal success with all inside and inside and out techniques at 78%. Similar results were shown by Barber et al,³ with all-inside stints yielding a 91% success rate and inside-out sutures a 100% success rate. Finally, Hantes et al⁷ showed all-inside repair to be successful in 65% of cases and the inside-out technique successful in 95%. Three studies, those of Albrecht-Olsen et al, Hantes et al, and Bryant et al, evaluated operative time between all-inside and inside-out meniscal repair. The all-inside technique was faster in all studies

yielding an average repair time of 14 minutes for all-inside and 18 minutes for inside-out repairs in the Hantes et al⁷ study and 30 versus 60 minutes in the Albrecht-Olsen¹ group and 24.8 minutes versus 41.9 minutes in the Bryant et al group.⁴ Analogous to these prospective comparative studies our clinical success between all-inside versus inside-out was within 10%, with the lowest success being 91%.

The strengths of this current study are the prospective study design, documented interrater agreement of surgeons for meniscal tears and treatment,⁵ generalizability among sites and surgeons, and 94% follow-up. The techniques used represent the most common forms of repair currently in clinical use.

The weaknesses of this study include, short-term follow-up of two years, relatively low sample size within each individual repair method, and the low failure rate which precludes analysis for predictors of outcome. These weaknesses will be addressed as the cohort matures both in length of follow-up and in number of patients enrolled. Reevaluation of the cohort is planned at six years, and additional enrollment is ongoing. Accumulating more patients will increase the sample size within each specific repair method allowing for multivariable analysis of factors contributing to success and failure. An additional weakness of this study is the lack of standardization of the post-operative rehabilitation protocol. In subsequent years of the cohort the rehabilitation protocol has been standardized to minimize variability.

Other weaknesses include difficulty in defining the age of the meniscal tears, acute versus chronic. Evaluation of this point was precluded by the patients' inability to characterize the timing of injury. An additional weakness is the definition of repair failure as reoperation. Unfortunately, currently it is very difficult to obtain repeat arthroscopy or MRIs secondary to cost in a cohort of this size. We acknowledge that some of these seeming clinical successes could be anatomic failures. A systematic review of all inside meniscal repair was recently published that helps to define outcome following meniscal repair. Lozano et al⁸ found that the standard measure of outcome in meniscal repair was a need for reoperation in 26 of 32 studies evaluating all-inside repair. Finally, our conclusions apply only to meniscal repairs at the time of ACL reconstruction, that fit the location, size, and configuration of these tears and the results cannot be extended to isolated meniscal repairs not done in conjunction with ACL reconstruction.

In summary, when confronted with a "repairable" meniscal tear at the time of an ACL reconstruction, orthopaedic surgeons can choose between several all-inside methods or inside-out repairs with an estimated >90% randomized clinical success rate at two-year follow-up. With the observed success rate, powering a clinical trial to significantly improve efficacy in this population is not practical based on sample size requirements. As the MOON database prospectively accumulates patients, conclusions regarding the best modality of meniscal repair may be able to be made. In the interim, prospective longitudinal studies are needed focusing on clinical success of meniscal repair in the absence of ACL reconstruction or with the ACL intact. We believe this information is beneficial for the surgeon counseling patients and their families regarding expected outcomes, benefits and risks of meniscal repair at the time of ACL reconstruction.

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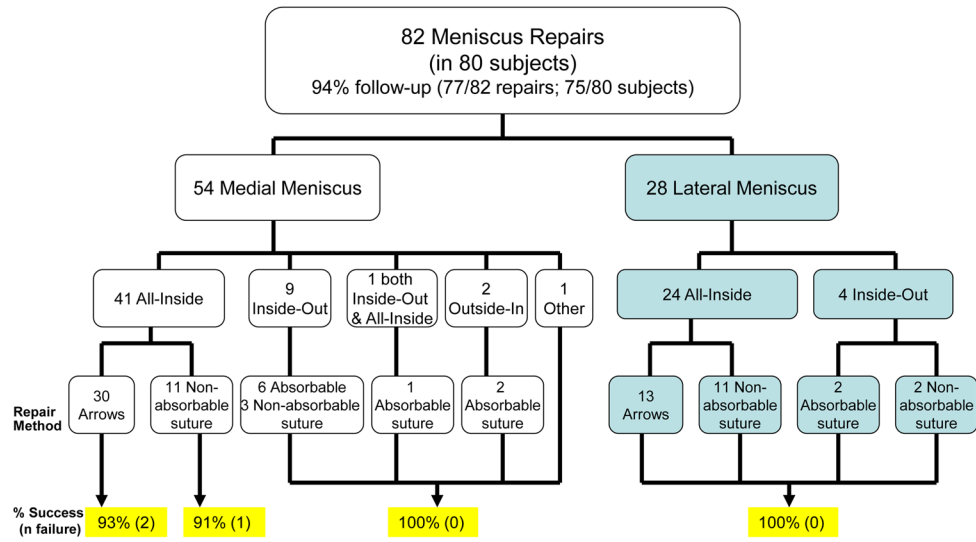


Figure 1.
MOON Meniscus Repair Cohort with ACL Reconstruction

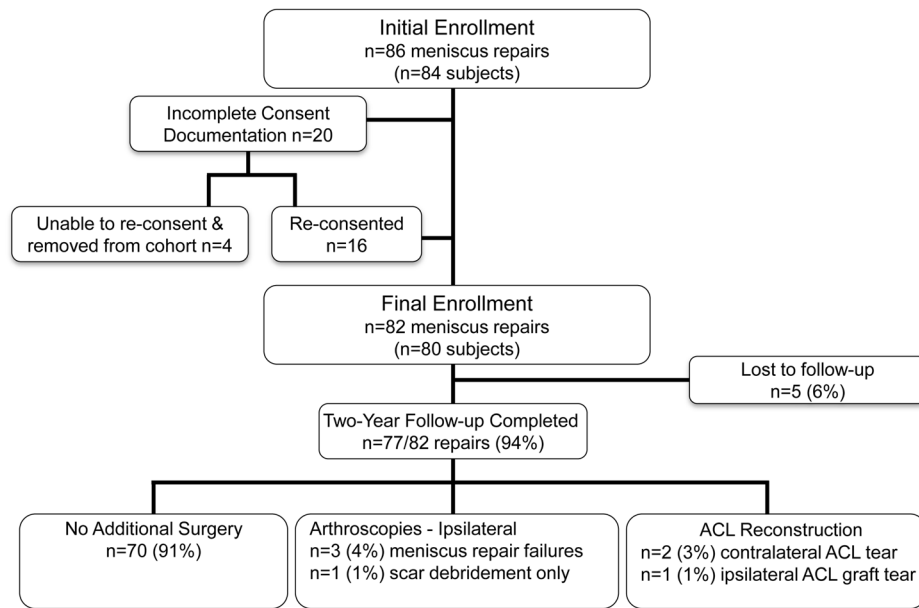


Figure 2.
Summary Data for Patient Follow-up and Additional Surgeries

Table 1

Repaired Meniscal Tears Stratified by Location

CENTRAL/PERIPHERAL	Medial Meniscus (n=57)	Lateral Meniscus (n=29)
Peripheral 1/3	82.5% (47/57)	48.3% (14/29)
Middle 1/3	5.3% (3/57)	20.7% (6/29)
Middle 1/3 + Peripheral 1/3	8.8% (5/57)	20.7% (6/29)
Central 1/3	0.0% (0/57)	3.4% (1/29)
Central 1/3 + Middle 1/3	1.7% (1/57)	6.9% (2/29)
Central + Middle + Peripheral 1/3	1.7% (1/57)	0.0% (0/29)

ANTERIOR/POSTERIOR	Medial Meniscus (n=57)	Lateral Meniscus (n=29)
Anterior	0.0% (0/57)	3.4% (1/29)
Posterior	78.9% (45/57)	82.8% (24/29)
Anterior + Posterior	21.1% (12/57)	13.8% (4/29)

Table 2

Repaired Meniscal Tears Stratified by Type

	Medial Meniscus (n=57)	Lateral Meniscus (n=29)
Longitudinal (vertical)	80.7% (46/57)	69.0% (20/29)
Bucket Handle	12.3% (7/57)	13.8% (4/29)
Oblique	7.0% (4/57)	13.8% (4/29)
Horizontal	0.0% (0/57)	3.4% (1/29)
Radial	0.0% (0/57)	0.0% (0/29)
Complex	0.0% (0/57)	0.0% (0/29)

Table 3

Number of Sutures/Devices/Implants

	Medial Meniscus	Lateral Meniscus
Average (SD)	3.0 (1.8)	2.9 (1.9)
Range	(1–10)	(1–9)