

Outcomes of Meniscal Preservation Using All-inside Meniscus Repair Devices

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Abstract

Background The thrust of meniscal surgery has now moved toward meniscal preservation. Repair is particularly indicated on the lateral side where the sequelae of resection are severe even in an older patient population.

Questions/purposes The aim of this study was to analyze the success of all-inside meniscus repairs in a carefully selected patient population.

Methods Three hundred twelve repairs were performed in 288 patients with a mean age of 32 years (range, 17–46 years). One hundred seventy-one lateral menisci and 141 medial menisci were repaired. The minimum followup was 12 months (mean, 18 months; range, 12–55 months). Medicolegal cases, major trauma, and knee dislocations were excluded. Failure was defined as persistent meniscal symptoms beyond 16 weeks, an MRI diagnosis of a non-healed meniscal tear beyond 52 weeks, reoperation for the meniscal tear, and failure to return to the patient's previous functional level.

Results There were three painful capsular sutures that required removal, two cases of complex regional pain

syndrome, and two deep venous thromboses. The repair failed in 6% of cases with associated ACL reconstruction and 14.1% of cases without ACL reconstruction. Repeat surgery was typically performed at a mean of 16 months (range, 1–44 months).

Conclusions At short-term followup, all-inside meniscus repairs have good outcomes in the majority of highly selected cases, although this was a very selected cohort with a large number of associated ACL reconstructions.

Level of Evidence Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Removal of meniscal tissue causes increased contact stress and subsequent degeneration of the articular cartilage in the long term [1, 6, 7, 10, 15, 18, 26, 27, 33]. It is crucial to preserve as much functional meniscus as possible [12, 13, 19, 34]. Repair of a torn meniscus may restore the loading profiles of the joint and the ability of the meniscus to absorb hoop stress and eliminate joint space narrowing, possibly decreasing the risk of degenerative disease [25].

Arthroscopically assisted repair has become the accepted treatment of meniscus tears in recent years and numerous studies have been published on this topic [2, 4, 21]. Arthroscopy provides easier access to the knee, reduces operating time, and avoids the risks of open surgery. Techniques of arthroscopic repair of the meniscus include inside-out repairs, outside-in repairs, and all-inside repairs. All-inside repairs are associated with fewer surgical risks, including neurovascular complications, because accessory incisions are not necessary. They

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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require simpler surgical techniques and shorter surgical times.

Our aim was to study the results of a consecutive series of all-inside meniscal repairs performed by a single surgeon (FSH) in a carefully selected patient population. It is not possible to conduct randomized, controlled trials comparing meniscus repair versus meniscectomy. A clinical followup study of a large series of meniscus repairs is thus essential to establish the success of this procedure.

The aim was to establish the success of meniscus repairs based on clinical resolution of symptoms after the procedure. We also studied the role concomitant ACL reconstruction would have on the success of meniscus repair.

Patients and Methods

In this prospective case series, 312 consecutive meniscus repairs performed by the senior author (FSH) in 288 patients were studied. Patients with a minimum followup of 12 months (mean, 18 months; range, 12–55 months) were included in this study.

The decision to repair a torn meniscus was made by the senior surgeon intraoperatively and based on the preoperative clinical symptoms, the site of the tear, and the quality of the meniscus. Inclusion criteria for meniscus repair were history of sports-related meniscus tears, absence of degenerative changes in the meniscus, and tears in the far periphery of the meniscus (red-white). Medicolegal cases and major trauma and knee dislocations were excluded. All types of meniscus tears were considered for repair, including vertical tears, horizontal tears, bucket handle tears, and complex tears. Unstable, irreparable components of complex meniscus tears were trimmed to stable torn edges before repair. Generally, red-white tears were considered for repair. White-white tears were repaired in selected cases if there was a risk of loss of a large area of torn meniscus, especially in the lateral meniscus and especially with tears noticed at ACL reconstruction. In all cases, the surgeon used arthroscopic all-inside repair devices. Depending on the type of tear, a vertical or horizontal mattress pattern of suturing was used to approximate the torn edges of the meniscus. Before repair, the edges of the meniscus tears were roughened up using an arthroscopic shaver to promote bleeding.

In patients with ACL deficiency, meniscus tears were often repaired at the time of arthroscopic ACL reconstruction. Autograft (four-strand semitendinosus and gracilis) or allograft (two semitendinosus) ACL reconstructions were performed arthroscopically. Routinely, femoral fixation for the graft was achieved using an Endoloop (Smith & Nephew, Mansfield, MA) and

interference screws (RCI; Smith & Nephew, Andover, MA) were used for tibial fixation. The grafts were tensioned at 20° of knee flexion.

Postoperative rehabilitation was started under the supervision of specialist knee physiotherapists. Patients were allowed to fully weightbear. Weightbearing with knee flexion beyond 90° was restricted for the first 12 weeks. Rotational and pivoting movements of the knee were also restricted for the first 6 weeks. In patients who underwent concomitant ACL reconstruction, there was no change in the rehabilitation program from our routine program. Closed kinetic chain physiotherapy exercises were started and lasted for 6 to 9 months depending on the progress of the individual patient.

Failure of the repair was defined by persistence of symptoms (swelling, locking, or joint pain) and/or the requirement for repeat knee arthroscopy and meniscectomy. This evaluation was performed by the senior author before the repair was classified as a failure. Failure was also defined by MRI diagnosis of a persistent tear beyond 52 weeks of surgery and inability to achieve the preoperative level of knee function. MRI scans were not routinely performed in all patients. Persistent knee symptoms in the absence of definite clinical evidence of meniscus tears were the indication for requesting an MRI scan postoperatively.

The senior author performed 312 meniscus repairs (171 lateral menisci, 141 medial menisci) in 288 patients (156 male, 132 female) using all-inside meniscus repair systems. The average patient age at the time of repair was 32 years (range, 17–46 years). In the initial 54 cases, meniscus arrows (Bionx Implants, Malvern, PA) were used for the all-inside repair. After this, the surgeon changed his practice to using meniscus repair sutures (FasT-fix; Smith & Nephew, Andover, MA). A total of 258 meniscus repairs were performed using the Fas T-fix system (Smith & Nephew, Andover, MA). An average of two arrows (range, 1–4; SD, 0.97) were used in the Bionx system (Bionx Implants) and 2.5 (range, 1–7; SD, 1.37) sutures in the Fas T-fix system (Smith & Nephew, Andover, MA). Concomitant ACL reconstruction was performed in 50% cases (156 meniscus repairs, 138 patients).

In 65 cases, the meniscus was stabilized by trimming an unstable edge before repair and in 72 cases, meniscectomy was performed on one meniscus while the other meniscus was repaired. The predominant tear pattern was a peripheral red on white type tear involving the body and posterior horn. The location of the repaired meniscus was documented using the system described by Cooper et al. [11]. The type of tear was also documented using commonly used descriptive terms such as bucket handle tears, vertical tears, horizontal tears, capsular detachment, and complex tears (Tables 1, 2).

Table 1. Summary of the pattern of tears repaired as described by Cooper et al. [11]

Lateral meniscus tears	Number of tears
E1F1	69
F1	27
E1	30
E2	12
F2	12
E2F2	18
E0	3
Medial meniscus tears	
A1	39
B1	27
A1B1	57
A0	6
B2	6
A0B0	3
B1C1	3

Table 2. Description of repaired medial and lateral meniscus tears

Type of tear	Medial meniscus tear	Lateral meniscus tear
Capsular detachment	9	3
Bucket handle tear	15	24
Complex tears	39	33
Partial vertical tears	18	36
Vertical tears	39	30
Horizontal tears	21	45

Results

There were no major intraoperative complications and no nerve injuries. Failure of the suture mechanism and/or wasted sutures was noted in an average of 0.4 occasions per case. There were three painful capsular sutures that required removal and two cases of complex regional pain syndrome. In two cases, deep venous thrombosis developed postprocedure and both cases were successfully treated with low-molecular-weight heparin.

In the majority of patients, improvement was noted in meniscus symptoms after surgery, which continued until final followup (minimum, 12 months). A total of 268 repairs were successful in 247 patients. This gives an overall success rate of 85.9%. Failure of meniscus repair occurred in 10.3% (32 repairs: Fast T-fix; Smith & Nephew, Andover, MA) of the cases in which the suture mechanism was used. A higher failure rate 22.2% (12 repairs: meniscus arrow; Bionx Implants) was noted when meniscus arrows were used. When meniscus repair was undertaken along with ACL reconstruction, failure was

noted in 6% (nine meniscus repairs) of the cases compared with the total failure rate of 14.1% (44 meniscus repairs) in this series. However, because these groups were not comparable, no statistical significance could be identified. In the majority of failed cases, there were ongoing symptoms postsurgery, although some patients were transiently better. Repeat surgery was typically performed at a mean of 16 months (range, 1–44 months).

Discussion

This study aimed to establish the clinical success of using all-inside meniscus repair and the influence of concomitant ACL reconstruction on the success of meniscus repairs. In our study, an 86% overall clinical success rate judged by resolution of meniscal symptoms was noted with all-inside repairs undertaken for nondegenerate, traumatic tears in the peripheral zone of the meniscus. The success rate of repairs increased to 94% when concomitant ACL reconstruction was undertaken.

Using clinical symptoms to assess repaired meniscal tears provides only indirect evidence of successful healing. However, this had to be accepted because routine repeat arthroscopy and assessment of the meniscus is not feasible in routine clinical practice. Moreover, the majority of our patients did not want to be followed up once their symptoms settled after successful surgical management and were discharged from outpatient clinics. We did not routinely collect outcome scores in our patients. Another limitation was the lack of observer reliability analysis in determining failed meniscus repair clinically. The senior author assessed patients with persistent symptoms to diagnose failed repair. Also, the study relies on patients reporting symptoms after their procedure. We appreciate that there may be a small group of patients who do not report their inability to get back to specific sports or who change their lifestyle postinjury.

The primary function of the meniscus is to evenly distribute load across the knee. With the knee in extension, approximately 50% of the load is transmitted to the menisci. This is increased to almost 90% with the knee flexed at 90° [23]. The menisci also play a role in knee stability. They deepen the socket of the tibia to better conform to the ovoid shape of the femoral condyles; the menisci act as secondary stabilizers in the anterior cruciate ligament-deficient knee [24]. The posterior horn of the medial meniscus particularly is important for this function because it acts as a wedge to resist anterior translation [5, 20]. The meniscus also has a role in joint lubrication, which significantly reduces the coefficient of friction in the knee [32]. Meniscal preservation is therefore advantageous, particularly in the younger age group.

The peripheral blood supply is the key to healing of the meniscus. It is capable of producing a healing response similar to that seen in other connective tissues [3, 8, 10, 16, 17, 26]. Typically, tears in the peripheral one-third of the meniscus are vascular and suitable for repair. Meniscus tears between 3 and 5 mm from the periphery may be variable in vascularity [14]. Repair should be considered if observable bleeding is noted in the tear at the time of arthroscopy.

Vertical tears are more amenable to repair [6, 7, 30] than complete radial tears [30] and chronic bucket handle tears [7]. Complex tears may have impaired vascularity [14] and are less likely to heal with repair. To avoid near-total meniscectomy, we excise the unstable nonvascular edges of complex meniscus tears and repair to the vascularized periphery.

In our series, we noted a lower failure rate when meniscus repair was undertaken with concomitant ACL reconstruction. This is well documented in the literature (62%–96% healing rate in ACL reconstructed group versus 17%–22% in patients without ACL reconstruction) [14, 31, 33]. The stability provided by ACL reconstruction and the favorable healing environment from the postsurgery hemarthrosis may be responsible for this finding [9, 28, 29, 36, 37].

Lozano et al. [22] extensively reviewed the outcome of all-inside meniscus repair devices. They noted paucity in randomized, controlled trials comparing different all-inside meniscus repairs. However, no substantial differences were noted in failure rates among various meniscus devices. No difference was noted in failure rate with length of followup either.

In conclusion, arthroscopic all-inside meniscus repair is a successful option in preserving torn menisci. It is crucial to individually consider this option with every meniscus tear encountered during arthroscopy of the knee. Careful selection of patients and meniscus tears optimizes the success of meniscal repairs. Nondegenerate tears at the periphery of the meniscus and tears associated with ACL reconstruction have a higher success rate for repair. At this stage, all-inside meniscal repairs appear to have good outcomes in highly selected cases, although this series is a very selected cohort with a large number of associated ACL reconstructions.

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