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The Knee



Range of motion and complications following primary repair versus reconstruction of the anterior cruciate ligament

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ABSTRACT

Introduction: Recently, there has been a resurgence of interest in primary anterior cruciate ligament (ACL) repair. The procedure is less invasive than ACL reconstruction, yet studies assessing early postoperative course are lacking. Goal therefore was to assess postoperative range of motion (ROM), complications and operative times following primary repair and compare this to the gold standard of reconstruction.

Methods: A retrospective study was performed for which 52 repair and 90 reconstruction patients could be included. Patients were examined at one week and one, three and six months. Rehabilitation protocol consisted of early ROM and was equal for both groups. Outcomes were compared using independent t-tests and chi-square tests, and reported in mean \pm standard deviation.

Results: Repair had more ROM than reconstruction patients at one week ($89^\circ \pm 18$ vs. $61^\circ \pm 21$, $p < 0.01$) and one month ($125^\circ \pm 14$ vs. $116^\circ \pm 18$, $p < 0.01$) postoperatively. Fewer repair patients had 90° ROM at one week (23% vs. 84%, $p < 0.01$), and more repair patients had full ROM at one month (57% vs. 30%, $p < 0.01$). Treatment of meniscal lesions, but not chondral lesions, influenced ROM. Trends towards fewer complications (2% vs. 9%, $p = 0.19$) and infections (0% vs. 6%, $p = 0.20$) were noted following primary repair, and the procedure was significantly shorter. **Conclusions:** Following primary repair, patients had better ROM, and trends towards fewer complications than reconstruction. Primary repair is a safe, brief procedure with early ROM and low complication rates.

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1. Introduction

The first surgical treatment of an anterior cruciate ligament (ACL) injury was performed by Mayo Robson in 1895 using open primary repair [1]. Over the following decades, Ivar Palmer [2,3] and Don O'Donoghue [4,5] further popularized the treatment of open primary ACL repair, and this technique became the most commonly used treatment in the 1970s and 1980s [6–11]. However, because no appropriate patient selection was applied, surgery consisted of an invasive arthrotomy and postoperative management consisted of joint immobilization with a cast for five or six weeks, problems such as decreased range of motion (ROM), intraoperative and postoperative complications, and deterioration of outcomes at mid-term follow-up were frequently reported [11–15]. Ultimately, open primary repair was abandoned and ACL reconstruction became the gold standard [16].

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In recent years, a resurgence of interest has been noted regarding primary repair. With the modern-day understanding of only repairing patients with proximal (type I) tears [14,17–19] (using a recently modified Sherman classification [20,21]), utilizing rehabilitation protocols that stress early ROM [16,19,22], and with the modern advancements of arthroscopic technology [23,24], better results of primary repair could be expected. Indeed, DiFelice et al. were the first to report a case series of 11 patients treated with arthroscopic primary ACL repair of proximal type I tears using suture anchors [25]. They reported excellent outcomes at a mean short-term follow-up of 3.5 years. More recently, Achtnich et al. compared arthroscopic primary repair to the gold standard of single-bundle ACL reconstruction in patients with proximal type I tears, and found equivalent outcomes regarding stability, and patient reported outcomes [26]. More recently, Mackay et al. reported on the addition of an internal brace to the primary repair in order to protect healing of the repaired ligament during early rehabilitation [27].

Arthroscopic primary ACL repair is a conservative and minimally invasive approach when compared to reconstructive surgery, as no tunnels are drilled, no grafts are harvested and revision surgery, when necessary may be less complicated [17]. Furthermore, the native nerve-endings, blood supply and ligament are preserved, and thus proprioception is maintained [28]. With the less invasive nature of this surgery, one could expect a more benign postoperative course with regard to ROM and complications when compared to ACL reconstruction, but studies assessing this are lacking.

Therefore, we aimed to assess the intraoperative and early postoperative course of arthroscopic primary ACL repair patients and compare this to the gold standard of single-bundle ACL reconstruction. The hypotheses were that (I) patients undergoing primary repair had earlier return of ROM and (II) less complications when compared to reconstruction surgery, and (III) primary repair was a shorter surgical procedure than reconstruction surgery.

2. Methods

2.1. Patient selection

Following Institutional Review Board approval (Hospital for Special Surgery IRB 2016-285), a retrospective search was performed in the database of the senior author (GSD) for patients who underwent arthroscopic primary ACL repair and ACL reconstruction between April 2009 and April 2016. In the practice of the senior author, patients with type I ACL tears are treated with arthroscopic primary repair, while patients with non-repairable tears undergo ACL reconstruction. A total of 66 patients underwent primary repair and 109 patients underwent ACL reconstruction. Patients in the repair group were excluded because they had multiligamentous injuries ($n = 6$), distal avulsion tears ($n = 4$), or simultaneously conservatively treated medial collateral ligament (MCL) injuries ($n = 4$), since the focus of the study was to assess primary repair of isolated proximal ACL tears, and since MCL injuries influence postoperative ROM [29,30]. Patients in the reconstruction group were excluded because they had multiligamentous injuries ($n = 17$), or simultaneously conservatively treated MCL injuries ($n = 2$), since the focus of the study was to assess reconstruction of isolated ACL injuries, and since MCL injuries influence postoperative ROM [29,30]. No patients were excluded for meniscus tears or chondral lesions. This resulted in the inclusion of a total of 52 patients that underwent primary repair and 90 patients that underwent ACL reconstruction without any other ligamentous injuries.

2.2. Surgical techniques

Preoperatively, the senior author discussed with all patients that they would undergo primary repair when a proximal (type I) tear was present, and that they would undergo single-bundle ACL reconstruction when the tear was non-repairable. The senior author performed all surgeries. All patients had full ROM (i.e. 0 to $\geq 130^\circ$) preoperatively. Arthroscopic primary ACL repair was performed with suture anchor fixation of the anteromedial and posterolateral bundle as has been previously described [23,24]. An InternalBrace (Arthrex, Naples, FL, USA) was added to the repair in 52% of patients since the availability of this internal brace, as this was thought to protect the ligament with early ROM [19,27,31]. Single-bundle anatomic ACL reconstruction with anteromedial drilling of the femoral tunnel was performed in all patients without repairable tears using either soft tissue allograft tissue (55%) or autograft tissue with bone-patellar tendon-bone (BPTB) (43%) or hamstring autografts (3%). BPTB was fixed using interference screws, while soft tissue grafts were fixed proximally with a button or interference screw, and distally with an interference screw. The specific drilling technique (retrograde versus antegrade) differed throughout the study period.

2.3. Rehabilitation protocol

The rehabilitation protocol was the same for patients undergoing primary repair (with and without internal brace) and reconstruction with an early ROM protocol. A brace is worn in the first four weeks with weight bearing as tolerated. The brace is locked in extension until volitional quadriceps control has returned and is then unlocked for ambulation. Swelling control and ROM exercises are initiated in the first few days after surgery in a controlled fashion. Formal physical therapy is started at four weeks. After four to six weeks, the patient is advanced to gentle strengthening and a standard ACL rehabilitation protocol. Return to sports is generally based upon sport specific assessment between six and nine months postoperatively.

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