Original article

Short-term complications in intra- and extra-articular anterior cruciate ligament reconstruction. Comparison with the literature on isolated intra-articular reconstruction. A multicenter study by the French Arthroscopy Society

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\section*{ABSTRACT}

\textbf{Introduction:} Lateral tenodesis (LT) is performed to limit the risk of iterative tear following anterior cruciate ligament (ACL) reconstruction in at-risk patients. By adding an extra procedure to isolated ACL graft, LT reconstruction increases operating time and may complicate postoperative course. The objective of the present study was to evaluate the rate of early complications. The study hypothesis was that associating ALL reconstruction to ACL reconstruction does not increase the complications rate found with isolated ACL reconstruction.

\textbf{Material and methods:} A prospective multicenter study included 392 patients: 70\% male; mean age, 29.9 years; treated by associated ACL and LT reconstruction. All adverse events were inventoried.

\textbf{Results:} Mean hospital stay was 2 days, with 468 day-surgery. Walking was resumed at a mean 27 days, with an advantage for patients treated by the hamstring technique. The early postoperative complications rate was 12\%, with 1.7\% specifically implicating LT reconstruction: pain, hematoma, stiffness in flexion and extension, and infection. There was a 5\% rate of surgical revision during the first year, predominantly comprising arthrosis for extension deficit. The 1-year recurrence rate was 2.8\%.

\textbf{Discussion:} The complications rate for combined intra- and extra-articular reconstruction was no higher than for isolated intra-articular ACL reconstruction, with no increase in infection or stiffness rates. The rate of complications specific to ALL reconstruction was low, at 1.7\%, and mainly involved fixation error causing lateral soft-tissue impingement.

\textbf{Level of evidence:} IV, prospective multicenter study.

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1. Introduction

The “rediscovery” of the anterolateral ligament (ALL) of the knee [1] has provided anatomic evidence for the biomechanical principle of extra-articular reconstruction or lateral tenodesis (LT). This is systematically associated to intra-articular anterior cruciate ligament (ACL) reconstruction, in a combined technique (ACL-LT). There has been renewed interest for this approach, as results with isolated intra-articular ACL reconstruction were not always excellent, with residual rotational instability, leading to repeat tear [2,3] and onset of degenerative lesions [2].

There are, however, few studies of recent combined reconstruction techniques [4-8]. The scientific committee of the French Society of Arthroscopy (SFA) therefore decided that a dedicated symposium was needed.

The objective of the present study was to evaluate early complications rates in combined intra- and extra-articular reconstruction compared to the literature data on isolated intra-articular ACL reconstruction.

The hypothesis of this study, coming under the aegis of the symposium, was that combined reconstruction is not associated with specific complications.

2. Material and methods

Thirteen centers regularly performing combined ACL–LT reconstruction took part in a prospective study that included 592 cases with a minimum 1-year’s follow-up, inventorying short- and medium-term complications.

2.1. Series

Immediate postoperative course and early complications were analyzed in a prospective multicenter study between June 2014 and June 2015, involving 13 centers. Indications were at the surgeon’s discretion: degree of anterior laxity on preoperative laxometry, explosive rotational snap, duration of instability, high-risk sports activity, young age, or systematic indication for combined reconstruction.

Revision surgeries were excluded.

The series comprised 392 patients, 70% male. Mean age at surgery was 29 ± 11 years (range, 14–69 years) and mean trauma-to-surgery interval was 22 ± 39 months (range, 1 day to 51 months). Sports activity consisted in pivot sport in more than 90% of cases (Fig. 1). Forty-three percent of those with sports activity played professional or competition sport (Fig. 2).

Mean preoperative subjective International Knee Documentation Committee (IKDC) score was 55 ± 16 (range, 12–98), with 97% of patients graded C or D (Fig. 3). Mean Lysholm–Tegner score was 69 ± 17 (range, 7–95). Preoperative jerk test was clunk or gross in 80% of cases; the intraoperative rate under anesthesia was almost identical, at 84%.

Fifty-four percent of patients had a meniscal lesion; the medial meniscus was conserved in 54% of cases and the lateral meniscus in 50%. Thirty-six percent of medial and 32% of lateral meniscus lesions were repaired. Eighteen percent of medial and lateral meniscus lesions were left in situ without treatment, appearing stable on arthroscopy.

Most patients had normal X-rays, only 5% showing signs of incipient osteoarthritis.

2.2. Surgical techniques

ACL reconstruction was performed under arthroscopy, and LT reconstruction was open surgery. The two were continuous, with a single graft, in 184 cases, and separate, with 2 grafts, in 208 cases (Figs. 4 and 5). Several techniques were used, according to the surgeon’s habits.

2.3. Assessment

Systematic pre- and postoperative assessment comprised:

- range of motion: flexion deficit at 1, 3 and 6 months and 1 year postoperatively. From month 3, flexion deficit was graded as: 1, 0–5°; 2, 6–15°; 3, 16–25°; or 4, >25°;
- extension was likewise graded as: 1, <3°; 2, 3–5°; 3, 6–10°; or 4, >10°;
- Lachman test, jerk test, differential laximetry on KT 1000™ arthrometry or Telos™ stress radiography, objective and subjective IKDC scores and Lysholm–Tegner score were assessed;
- time to recovery of gait and climbing up and down stairs;
- all adverse events, whether spontaneously resolving (pain, effusion, etc.) or requiring revision (joint lavage, material ablation, etc.);
- iterative tear was defined by instability, whether implicating a known accident or not, increased laxity, and MRI confirmation of diagnosis.

2.4. Statistical analysis

Normality of distribution was checked on Shapiro–Wilk test. Qualitative variables were compared between groups on Chi² or Fisher exact test, as appropriate. For quantitative variables, distributions were compared by non-matched Student t-test, or by non-parametric Mann–Whitney test in case of non-normal distribution. The significance threshold was set at 0.05.

Analyses used SAS 9.1.3 software (SAS Institute, Cary, NC, USA).

3. Results

3.1. Return to daily activity

Mean hospital stay was 2 days (range, 1–6 days), with 46% day-surgery. Twenty-one percent of patients required 2 days’ stay, and 19% 3 days.

Gait was recovered at a mean 26.8 days, and more rapidly (18 days) in case of hamstring graft (P<0.0001). Among the patients, 42.4% normal gait at 21 days.

Climbing up stairs was resumed at a mean 29.2 days, and more quickly (22 days) following hamstring graft (P<0.0001). Sixty-five percent of patients could climb up stairs normally at 1 month. Climbing down stairs took longer, at 36.5 days (or 26 days in case of hamstring graft; P<0.0001). Among the patients, 68.5% could climb down stairs normally at 1.5 months. Thus, a large majority of patients recovered normal everyday life around the end of the first month.

Among the patients, 82.5% had returned to work within 3 months.

3.2. Range of motion

At 1 month, 9.3% of patients had flexion below the 1-month target of 120°; 2% had grade-2 deficit at 3 months, and 0.2% at 6 months. All knees were grade 1 by 1 year. Two patients underwent knee mobilization under anesthesia due to stiffness during the first year.

At 1 month, 5% of patients had grade-2 extension deficit, with less than 1° grade 3 or 4; at least 1.6% had extension deficit at 3 months, 1% at 6 months, and none at 1 year. There were 4 arthroscopic arthrolyses (1%) to restore extension.
3.3. Adverse events and complications

During the first month, there were 48 adverse events (12%) (Table 1). Postoperative hematoma was the most frequent, with 22 cases (6%). Surgical evacuation of hemarthrosis was required in 1 case (0.4%). There were 10 cases (2.3%) of pain graded >6. There were 2 superficial (0.4%) and 1 deep infection (0.2%), requiring surgical lavage and adapted antibiotic therapy. There was 1 case of phlebitis (0.2%). There were no complications specific to the extra-articular reconstruction during the first month.

As of the 3rd month, complications specific to the extra-articular reconstruction occurred: femoral pain in 1.4% of cases and tibial pain in 0.4%. At the following two check-ups, the respective rates were 0.8% and 0.6% at 6 months and 0.2% in both cases at 1 year. In all, during the first year, the pain rate was 2.4% at the femoral site and 1.2% at the tibial site.

A large majority of complications resolved without sequelae. There were 19 revision surgeries (5%) during the first year: 4 arthroscopic arthrolyses (1%) for cyclops syndrome, and 2 knee mobilizations under anesthesia, 1 patellar tendon tenotomy.
and debridement for tendinitis, 6 meniscectomies (1.5%) after resumption of sports activity, and a 1.7% rate of surgery specific to the ALL reconstruction: 3 ablations of a femoral screw and 3 of a tibial screw.

The iterative tear rate at last follow-up (2 years) was 2.8%.

4. Discussion

This prospective study showed that postoperative course and complications are no worse in combined than in isolated ACL reconstruction.

The following comparisons are with literature reports for exclusively isolated ACL reconstruction.

Return to everyday life showed no difference compared to isolated ACL reconstruction. With a mean hospital stay of 2 days and 46% day-surgery, the present series was comparable to those reported by Lefèvre et al. [9], with 33% day-surgery, and Sajovic et al. [10], with 3 days’ hospital stay. This is largely thanks to well-controlled postoperative analgesia protocols, facilitating day-surgery, whether for isolated intra-articular ACL or combined reconstruction.

Progression of flexion and extension was at least as good as in literature reports.

Fig. 4 presents the most recent literature data [11–13], from which it can be seen that the present series is well-positioned. Streich et al. [14] reported 2.5% flexion stiffness while Shelbourne and Gray [15] reported 17.6%; the average rate is around 15%. These two studies, both with 10 years’ follow-up, did not analyze stiffness in the same way: Streich considered an extension deficit of 10°, and Shelbourne 5°. Thus, data for stiffness need to be interpreted with great caution. In 2015, Sanders et al. [16] reported a 1.7% rate of arthrolysis, and identified risk factors including type of graft (patellar tendon), meniscectomy and cartilage lesions. Likewise, Robertson et al. [17] reported 12% stiffness at 6 months but only 5% at 1 year; as risk factors, they identified preoperative stiffness,
Table 1

<table>
<thead>
<tr>
<th>Global complications</th>
<th>Global pain (%)</th>
<th>Non-operated hematoma (%)</th>
<th>Operated hemarthrosis (%)</th>
<th>Superficial infection (%)</th>
<th>Deep infection (%)</th>
<th>Phlebitis (%)</th>
<th>Flexion contracture (%)</th>
<th>Flexion stiffness (%)</th>
<th>Femoral ALL pain (%)</th>
<th>Tibial ALL pain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 month</td>
<td>12%</td>
<td></td>
<td>6</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
<td>5</td>
<td>9.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1.4</td>
<td>0.4</td>
</tr>
<tr>
<td>6 months</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2</td>
<td>0.2</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>1 year</td>
<td>6%</td>
<td></td>
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<td></td>
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<td></td>
<td>0.2</td>
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</tbody>
</table>

Fig. 6. Flexion deficit at 1 year.

Fig. 7. Iterative tear at 2 years.

meniscectomy and medial collateral ligament involvement. The present study identified no risk factors or significant differences between techniques. Gifstad et al. [18] reported 10% flexion stiffness, without difference between patellar or hamstring grafts.

Infection was very rare in the present series, with only 1 case (0.2%). Brophy et al. [19] reported 0.8% in a series of 2198 patients, and identified diabetes, allograft and (surprisingly) hamstring graft as risk factors. Sonnery-Cottet et al. [20] reported 0.61%, with high-level sports activity and associated ALL reconstruction as risk factors; the infection rate was 5% in high-level athletes, and 0% in leisure sports players, with or without LT reconstruction.

Complications specific to LT reconstruction were rare, but with specific femoral and tibial site pain in the first months, progressively resolving except in 1.7% of patients with impingement requiring fixation material ablation.

The rate of meniscectomy following resumption of sports activity at 6 months was very low, at 1.5%. Tears were in sutured menisci with in situ lesions. However, this complication cannot be properly assessed with less than 5 years’ follow-up, and is closely related to secondary laxity [21].

The iterative tear rate of 2.8% at last follow-up (2 years) was one of the lowest in the literature for present-day reconstruction (Fig. 7). The Swedish registry [22] reported a rate of 1.6%, Desai et al. [23] 1.82%, and Leys et al. [24] 8%. Moreover, the present series did not display an abnormal rate of early iterative tear following resumption of sport, as reported elsewhere [3,25–30].
Two years’ follow-up is, however, insufficient, and reanalysis at 5 years could provide a stronger argument for the role of extra-articular reconstruction.

The strong point of the present study was the size of the series, but with the biases inherent to multicenter studies. The most important of these was the diversity of techniques. There are several types of intra-articular ACL reconstruction, using hamstring, patellar tendon or fascia lata grafts. Extra-articular reconstruction is equally varied: continuous hamstring or fascia lata graft, or separate reconstruction. It is also very difficult to compare one series to the others of the literature, where complications and adverse events are either minimized by not counting surgical revision or overestimated by including postoperative edema.

5. Conclusion

The present large multicenter series showed that associating LT to intra-articular ACL reconstruction did not affect the immediate postoperative course of ACL surgery. The complications rate was comparable to that of reported isolated intra-articular ACL reconstruction. The rate of specific LT reconstruction complications was only 1.7%, and these could be prevented in future. The 2-year iterative rate was lower than in many reports of isolated ACL reconstruction.

Disclosure of interest

JCP: royalties from SBM.
BSC: consultant with and royalties from Arthrex.
PHC: royalties from SBM.
SL: consultant with Smith & Nephew.
PPE: consultant with Depuy-Synthèse, Evolutis and Biopoly.
The other authors declare that they have no competing interest.

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