Journal of Southeast Asian Orthopaedics
ISSN 2821-9848 (Print)
ISSN 2821-9864 (Online)
https://doi.org/10.56929/jseaortho-2023-0194 https://jseaortho.org

Comparing Clinical Outcomes of Early and Elective Reconstruction in Patients with Anterior Cruciate Ligament Tears

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Purpose: The optimal time of treatment for anterior cruciate ligament tears remains controversial. Two times are early (< 6 weeks) and elective (≥ 6 weeks) reconstruction. This retrospective study tested the hypothesis that clinical outcomes are similar between the two time groups for anterior cruciate ligament reconstruction.

Methods: A total of 61 patients were included in this study. Thirty and 31 patients were in the early and elective reconstruction groups, respectively. The collected patient data included a preoperative and 2-year postoperative range of motion, visual analog scale scores, anterior stability tests, and clinical knee scores.

Results: There were no significant differences in the 2-year postoperative range of motion, visual analog scale scores, or anterior stability tests. The Lysholm and International Knee Documentation Committee knee evaluation form scores were significantly higher in the early reconstruction group than in the elective reconstruction group.

Conclusions: Early anterior cruciate ligament reconstruction is a more effective clinical knee score than elective reconstruction in treating anterior cruciate ligament tears.

Keywords: early reconstruction, elective reconstruction, anterior cruciate ligament reconstruction, anterior cruciate ligament tears

Anterior cruciate ligament tears are the most common sports injuries and the timing of anterior cruciate ligament reconstruction determines the clinical outcomes and complications[1].

The effects of the timing of anterior cruciate ligament reconstruction on postoperative knee function and clinical outcomes remain controversial. Early reconstruction may reduce postoperative complications in patients with anterior cruciate ligament tears[2], whereas elective reconstruction can decrease knee fibrosis and improve clinical results[3]. However, elective reconstruction may be associated with reduced strength and muscle atrophy, which prevents early rehabilitation[4]. Some reviews have suggested early reconstruction benefits patients with anterior cruciate ligament tears. In a prospective randomized clinical trial by Reijman et al.[5], 165 participants with anterior cruciate ligament tears were included; compared with elective reconstruction, early reconstruction was associated with improved movement ability and knee function at the 2-year follow-up. However, no review has considered whether early or elective reconstruction should be performed to

Article history:
Received: June 25, 2023 Revised: August 15, 2023
Accepted: October 3, 2023
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treat anterior cruciate ligament tears. Therefore, this review aims to synthesize the latest research comparing the outcomes of early and elective reconstruction to help orthopedists and patients make decisions regarding the time of reconstruction.

The purpose of this study was to retrospectively compare the clinical outcomes of early and elective reconstruction and to determine whether reconstruction of anterior cruciate ligament tears improves knee joint stability.

METHODS

Our hospital annually has 20–30 patients with anterior cruciate ligament tears. We conducted a retrospective cohort review of patients diagnosed with anterior cruciate ligament tears between 2007 and 2021 based on physical examination and magnetic resonance imaging (MRI). The sample size was determined according to Bartz's (1999) central limit theorem with 30 patients per group. In the elective reconstruction group, we matched the subject selection for an equal number of patients. The inclusion criteria were as follows: associated meniscal tears, chondral defects, grade I medial collateral ligament injuries, normal alignment, normal contralateral knee, and willingness to participate in the prescribed physical therapy program. The exclusion criteria were as follows: the presence of fractures, associated medial collateral ligament injuries of grades II–III, overall erosion of the cartilage, and revision. Five patients were lost during follow-up, leaving 61 patients enrolled in our study.

Surgical Technique

All surgical procedures were performed by a single surgeon. In all cases, the autologous hamstring tendon was harvested from the ipsilateral knee joint. Both semitendinosus and gracilis tendons were harvested. The graft tendon was fixed to the femoral side using an EndoButton loop. The graft tendon was fixed to the tibia using bioabsorbable interference screws.

All patients with isolated anterior cruciate ligament tears underwent the same postoperative physical therapy program. For the first 3 weeks postoperatively, the patients were limited to partial weight-bearing with a crutch. After 3 months, the patients were able to start jogging. Six months postoperatively, the patients were allowed to participate freely in sports activities. In cases of meniscal or cartilage injury, range of motion (ROM) exercise was restricted for 3 weeks, and weight-bearing was restricted for 6 weeks.

All the tests were performed by the same participant. All preoperative assessments were performed 1 day before surgery. MRI was used when indications for surgery were uncertain. The postoperative assessment was performed 2 years post-surgery. The preoperative and postoperative results were compared. The mean ROM of the knee joints were objectively evaluated. The subjective evaluation consisted of the visual analog scale (VAS), Lysholm, and International Knee Documentation Committee (IKDC) Knee Evaluation Form scores. The anterior tibial-femoral translation was measured using the anterior drawer, Lachman, and pivot-shift tests.

Descriptive statistics were calculated for all data categories. The chi-squared test was used to compare categorical variables. An independent sample Student's t-test was used to compare continuous variables between groups. *P*-values < 0.05 were considered statistically significant.

RESULTS

The 61 patients in the study had an average age of 26.8 years (range 18–50 years). Patients were divided into two groups based on time to operation: the early reconstruction group (< 6 weeks) of 30 patients and elective reconstruction group (≥ 6 weeks) of 31 patients. All patients were followed up for more than 2 years after hospital discharge. The average follow-up was 28.1 months (range, 24–40 months). The demographic data are shown in Table 1.

Preoperatively, the mean ROM was 130.6° ± 16.2° in the early reconstruction group and 131.5° ± 17.1° in the elective reconstruction group. Postoperatively, the ROM values were 143.8° ± 8.7° and 142.9° ± 7.3°, respectively; the difference was not statistically different ($P = 0.662$). There were no cases of limitation of ROM at the final follow-up.

Table 1 Patient demographics.

	Early reconstruction group (n = 30)	Elective reconstruction group (n = 31)	*P*-value
Sex (M/F)	27:3	26:5	0.478
Age (years) (SD)	27.4 (2.8)	26.5 (2.9)	0.222
Injury time to operation (weeks) (SD) (range)	4.1 (1.5) (3.1–5.8)	8.1 (2.8) (6.0–11.8)	< 0.001
Meniscus injury (%)	21 (70%)	23 (74.1%)	0.714
Chondral defect (%)	5 (16.6%)	7 (22.5%)	0.526
Follow-up (months) (SD)	27.9 (3.1)	28.5 (3.2)	0.460

Preoperatively, the VAS scores were 4.6 ± 1.8 in the early reconstruction group and 4.4 ± 1.6 in the elective reconstruction group. Postoperatively, the figures were 1.6 ± 0.5 and 1.7 ± 0.6, respectively, with no significant difference between the groups. Preoperatively, the Lysholm scores were 69.6 ± 8.6 in the early reconstruction group and 68.2 ± 8.5 in the elective reconstruction group. Postoperatively, they were 88.5 ± 6.6 and 84.6 ± 6.4, respectively. The Lysholm scores were significantly higher in the early reconstruction group than in the elective reconstruction group ($P = 0.022$). Finally, preoperatively, the IKDC Subjective Knee Evaluation Form scores were 68.4 ± 7.9 in the early reconstruction group and 67.3 ± 7.8 in the elective reconstruction group. Postoperatively, they were 87.5 ± 6.3 and 83.7 ± 5.8, respectively. The IKDC Subjective Knee Evaluation Form scores were significantly higher in the early reconstruction group than in the elective reconstruction group ($P = 0.017$) (Table 2).

Table 2 Clinical Scores.

	Early reconstruction group (n = 30)	Elective reconstruction group (n = 31)	*P*-value
VAS score			
Preoperative	4.6 ± 1.8	4.4 ± 1.6	0.647
Last follow-up	1.6 ± 0.5	1.7 ± 0.6	0.483
Lysholm score			
Preoperative	69.6 ± 8.6	68.2 ± 8.5	0.525
Last follow-up	88.5 ± 6.6	84.6 ± 6.4	0.022
IKDC subjective knee evaluation form score			
Preoperative	68.4 ± 7.9	67.3 ± 7.8	0.586
Last follow-up	87.5 ± 6.3	83.7 ± 5.8	0.017

Preoperatively, the anterior drawer test was positive for everyone in both groups. Postoperatively, the anterior drawer test was negative in 27 cases (90%) in early reconstruction and 26 cases (83.8%) in elective reconstruction group. There were no cases of 2+ or worse and no significant differences between the groups. Preoperatively, the Lachman test was positive for everyone in both groups. Postoperatively, the Lachman test was negative in 27 cases (90%) in the early reconstruction group and 25 cases (80.6%) in elective reconstruction group. There were no cases of 2+ or worse. There were no significant differences between the groups. Preoperatively, the pivot-shift test was positive for everyone in both groups. Postoperatively, the pivot-shift test was negative in 26 cases (86.6%) and 25 cases (80.6%). There were no cases of 2+ or worse and no significant differences between the groups. (Table 3)

Table 3 Results of Anterior Stability Test.

Test	Early reconstruction group (n = 30)		Elective reconstruction group (n = 31)		*P*-value (Distribution at last follow-up)
	Preoperative	Last follow-up	Preoperative	Last follow-up	
Anterior drawer					0.478
—	0	27	0	26	
1+	5	3	5	5	
2+	19	0	22	0	
3+	6	0	4	0	
Lachman					0.303
—	0	27	0	25	
1+	4	3	6	6	
2+	21	0	21	0	
3+	5	0	4	0	
Pivot shift					0.525
—	0	26	0	25	
1+	5	4	4	6	
2+	20	0	22	0	
3+	5	0	5	0	

There were 30 cases (49.18%) of medial meniscal tears: 14 (46.6%) in the early reconstruction group and 16 (51.6%) in the elective reconstruction group. There were no significant differences between the groups. There were 24 cases (39.3%) of lateral meniscal tears: 11 (36.6%) in the early reconstruction group and 13 (43.3%) in the elective reconstruction group, with no significant differences between the groups. There were 12 cases (19.67%) of cartilage injury: 5 (16.6%) in the early reconstruction group and 7 (22.5%) in the elective reconstruction group. There were no significant differences between the groups. (Table 4). There were no significant differences in the meniscal tear patterns between the groups (Table 5). Patients with meniscal tears underwent meniscectomy or meniscal repair. Cartilage injury of International Cartilage Repair Society grade IV with an area of > 1 cm^2 surrounded by normal cartilage were treated using microfracture, and cases with overall erosion of the cartilage were excluded from the study. Meniscectomy was performed in three (10%) of the 14 patients with medial meniscal tears in the early reconstruction group, and meniscal repair was performed in the remaining 11 (36.6%). Meniscectomy was also performed in two (6.4%) of the 16 patients with medial meniscal tears in the elective reconstruction group, and meniscal repair was performed in the remaining 14 patients (45.1%). There were no significant differences between the groups. Meniscectomy was performed in two (6.6%) of the 11 cases of lateral meniscal tears in the early reconstruction group, and meniscal repair was performed in the remaining nine (30%). Meniscectomy was also performed in three (9.6%) of the 13 cases of lateral meniscal tears in the elective reconstruction group, and meniscal repair was performed in the remaining 10 cases (32.2%). There were no significant differences between the groups. Microfracture was performed in two (6.6%) of the five cases of chondral defects in the early reconstruction group and two (6.4%) of the seven cases of chondral defects in the elective reconstruction group. There were no significant differences between the groups. (Table 6)

There were five cases with limited ROM of the joint postoperatively: two patients in the early reconstruction group and three in the elective reconstruction group. In these five cases, physical therapy was administered postoperatively for 3 months. Two years after surgery, there were no cases with limited ROM or infection.

Table 4 Combined Injuries.

	Early reconstruction group (n = 30)	Elective reconstruction group (n = 31)	*P*-value
Medial meniscus	14 (46.6%)	16 (51.6%)	0.699
Lateral meniscus	11 (36.6%)	13 (43.3%)	0.673
Chondral defect	5 (16.6%)	7 (22.5%)	0.526

Table 5 Patterns of meniscal tears.

	Early reconstruction group (n = 25)	Elective reconstruction group (n = 29)	*P*-value
Vertical	6	8	
Oblique	4	6	
Radial	6	5	0.915
Horizontal	5	7	
Complex	4	3	

Table 6 Treatment of Combined Injuries.

	Early reconstruction group (n = 30)	Elective reconstruction group (n = 31)	*P*-value
Medial meniscus			
Meniscectomy	3 (10%)	2 (6.4%)	0.613
Repair	11 (36.6%)	14 (45.1%)	0.500
Lateral meniscus			
Meniscectomy	2 (6.6%)	3 (9.6%)	0.668
Repair	9 (30%)	10 (32.2%)	0.829
Chondral defect			
Microfracture	2 (6.6%)	2 (6.4%)	0.972
Observation	3 (10%)	5 (16.1%)	0.478

DISCUSSION

The current review found no significant differences in operative time, range of motion, knee stability, Tegner score, IKDC rating scale, or complications between early and elective reconstructions. Early reconstruction was better than elective reconstruction in terms of the Lysholm score at 2 years[6]. These results will help orthopedic surgeons and patients with anterior cruciate ligament tears to decide between early and elective reconstruction. Our review may be used to reduce anxiety in patients awaiting surgery for anterior cruciate ligament tears because the differences in outcomes between the two groups are clear.

The timing of reconstruction is an important factor in determining the postoperative outcomes[6]. Although many reviews have studied the effects of reconstruction timing on patient outcomes, optimal timing remains controversial. Currently, there are no definitions for early or elective reconstruction, and various reviews have used their own time cutoffs to define early and elective reconstructions. For example, in a study by Barenius et al.[7] early reconstruction was defined as an injury-to-operative time of < 5 months, and reconstruction at > 5 months was defined as elective reconstruction. In a study by Fithian et al.[8] early reconstruction was defined as an operation

performed within 3 months. In addition, other studies[5,9,12,13,14] defined injury-to-surgery times ranging from 8 days to 10 weeks. Such a large difference could have led to considerable heterogeneity in the conclusions of this study. Therefore, we redefined early reconstruction as an injury-to-surgery time within 6 weeks to minimize the overlap among the different definitions and make our conclusion more standardized and reliable. This definition has been used in some reports[5,9]. A definition of early reconstruction should be established in the future as it will reduce the noticeable heterogeneity in reporting.

Although many reviews have studied the improved knee function after reconstruction in patients with anterior cruciate ligament tears, the effect of reconstruction timing on functional improvement is unclear. Hunter et al.[10] divided 185 patients into four subgroups based on injury-to-operation and concluded no significant differences in flexion and extension in the subgroups at any time. However, few reviews have attempted to define optimal reconstruction timing. Most reviews have focused on comparing early and elective reconstruction. Some reviews conducted before the 21st century[11] reported that patients with anterior cruciate ligament tears can achieve better joint stability and less movement limitation after elective reconstruction than after early reconstruction. However, other reviews have reported that early reconstruction is better clinical outcomes[12]. These differences may be due to differences in the rehabilitation protocols. Effective modern early rehabilitation after reconstruction plays an important role in improving functional outcomes. Furthermore, we speculate that preoperative physiotherapy in the elective reconstruction group would be useful for improving clinical outcomes. Deabate et al.[13] found that early reconstruction provides similar good functional outcomes as elective reconstruction without increasing the risk of complications, such as range of motion limitation and arthrofibrosis. However, the follow-up periods in the included studies were heterogeneous, and long-term outcomes were lacking. To reduce heterogeneity, the results of the included studies were stratified by follow-up period.

We found no significant differences in postoperative range of motion, visual analog scale score, anterior drawer test, Lachman test, or pivot-shift test. The Lysholm and IKDC knee evaluation form scores were significantly higher in the early reconstruction group than in the elective reconstruction group. This differs from the results of Smith et al.[14] and Deabate et al.[13] These differences may be attributed to the inclusion of different items of interest in the different scoring systems.

The current review found no significant differences between early and elective reconstruction, such as anterior cruciate ligament retear and infection, and the rates of these complications were consistent with those reported in the literature[15]. This suggests that the timing of the operation has little effect on surgical complications.

This study had several limitations. This was a retrospective study; therefore, there was a potential for selection bias. In some cases, detailed information was not available. In these cases, we recorded the total clinical scores rather than the scores for individual factors. Therefore, we may not have been able to draw conclusions based on the results of this study. Finally, the follow-up period of 2 years may be short to conclude long-term outcomes; to improve this study in terms of clinical outcomes and rate of complications, we plan to extend the follow-up duration to 5 years.

CONCLUSIONS

Early anterior cruciate ligament reconstruction is a more effective clinical knee score than elective reconstruction for treating anterior cruciate ligament tears.

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