

# Early anterior cruciate ligament reconstruction can save meniscus without any complications

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## ABSTRACT

**Background:** Early ACL reconstruction, before returning to activity eliminates recurrent episodes of instability and thereby decreases chances of meniscal and cartilage injury. However, there are no clear and uniform guidelines regarding the timing of ACL reconstruction or clarity in the definition of early and delayed reconstruction to reduce the complications after reconstruction in the ACL injured knee. The purpose of this study was to compare the clinical outcome, stability, muscle power, and postural control after early and delayed anterior cruciate ligament (ACL) reconstruction.

**Materials and Methods:** Patients who had ACL reconstruction with a quadruple hamstring tendon with a minimum 2-year followup were evaluated. Early (within 3 weeks) reconstruction group was 48 knees and delayed (more than 3 months) group was 43 knees. We compared the two groups with regard to Lysholm knee score, range of motion (ROM), Lachman test, Tegner activity scale, associated meniscal or chondral injuries, and anterior laxity. We also compared muscle strength with an isokinetic dynamometer and postural control with computed dynamic posturography at the final followup.

**Results:** While 50% of early and 70% of delayed group had meniscal injuries ( $P = 0.06$ ), of which were reparable in 42% of early group and 17% of delayed group ( $P = 0.04$ ). However, there was no significant difference in cartilage injury ( $P = 0.14$ ). At the final followup, no significant differences were found between two groups for Lysholm score ( $P = 0.28$ ), Tegner activity scale ( $P = 0.27$ ), and ROM. The stabilities regarding Lachman and pivot-shift tests, and anterior laxity also showed no significant differences between two groups. The mean extension and flexion muscles power, and postural control showed no significant inter-group differences ( $P > 0.05$ ).

**Conclusions:** Early ACL reconstruction had excellent clinical results and stability as good as delayed reconstruction without the problem of knee motion, muscle power, and postural control. Moreover, early reconstruction showed the high possibility of meniscal repair. Therefore, early ACL reconstruction should be recommended.

**Key words:** Anterior cruciate ligament, reconstruction, meniscus, meniscus repair

**MeSH terms:** Anterior cruciate ligament reconstruction, menisci, tibial, sports injuries

## INTRODUCTION

Although the reconstruction of anterior cruciate ligament (ACL) in patient with ACL injury has been considered a standard treatment, the ideal time of reconstruction has been debated among various studies.<sup>1</sup> The earlier reconstruction surgery after ACL injury can facilitate

early return to sports activity and decrease the incidence of meniscal injury. However, loss of range of motion (ROM) and wound complications are reported to occur more frequently in patients treated with an early ACL reconstruction.<sup>2</sup> Hence, Shelbourne *et al.*<sup>2</sup> suggested that delaying ACL reconstructions for more than 3 weeks till maximum of 2 months after an acute injury may decrease the incidence of arthrofibrosis, and also result in superior recovery of ROM and lower extremity power including quadriceps muscle.

Early ACL reconstruction, before returning to activity eliminates recurrent episodes of instability and thereby

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decreases chances of meniscal and cartilage injury. Many studies have reported that the delay in ACL reconstruction is associated with an increased incidence of meniscus and cartilage lesions.<sup>1,3-14</sup> Therefore, early rather than delayed ACL reconstruction has been recommended. However, there are no clear and uniform guidelines regarding the timing of ACL reconstruction or clarity in the definition of early and delayed reconstruction to reduce the complications after reconstruction in the ACL injured knee. Moreover, only a few studies compared the results of earlier ACL reconstruction regarding proprioception or recovery of muscle power compared with delayed ACL reconstruction.<sup>6,15</sup>

We hypothesized that (1) the early ACL reconstruction can reduce the incidence of meniscal or cartilage injuries compared with delayed ACL reconstruction and (2) the early ACL reconstruction has more benefits regarding recovery of muscle power and proprioception than delayed ACL reconstruction would offer. The objectives of this study were to compare the incidence of meniscal or cartilage injuries based on the arthroscopic finding during the reconstruction between early and delayed ACL reconstruction. We also compared clinical outcomes, quadriceps and hamstring muscle power and proprioception of the early ACL reconstruction with those of the delayed ACL reconstruction.

## MATERIALS AND METHODS

101 patients who underwent ACL reconstruction from September 2008 to March 2012 were included in this prospective study. During the study period, all patients who received primary ACL reconstruction with a quadruple hamstring tendon within 3 weeks or more than 3 months after injury and followed up to minimum of 2 years were included in this study. Within this cohort, five patients with prior knee surgery, two patients with a multi-ligament knee injury, and three patients who lacked information regarding the date of injury were excluded leaving a total of 91 patients for our study group. We excluded patients that had ACLR between 3 weeks and 3 months (intermediate period) because we want to compare acute and chronic cases. This study was approved by the Institutional Review Board of our hospital. A written informed consent was taken from all patients.

The early (within 3 weeks) reconstruction group had 48 knees and delayed (more than 3 months) group was 43 knees. The average period from injury to surgery in the early reconstruction group was 2 weeks (range 1–3 weeks). Patients in this group included 35 men and 13 women with an average age of 30.1 years at the time of surgery. In the delayed group, the average period from injury to surgery was 35.6 weeks (range 12–74 weeks), and it included 36 men and seven women with an average age of 30.0 years at the time of surgery. The sex, age at surgery, and followup

duration, as well as preinjury activity score, were similar in both groups [Table 1]. All patients were followed up for minimum 2 years.

The diagnosis of an ACL tear was made by the surgeon based on history, physical examination or magnetic resonance imaging finding. The ACL reconstruction was usually performed within 1 week after the patient presented at outpatient clinic if knee showed Grade II or more than Grade II instability according to Lachman or pivot-shift test. In ACL reconstruction, we used single bundle transtibial technique, and used endobutton in femur and bio-absorbable interferential screw along with spiked washer and cortical screw in tibia fixation. Meniscus repair or resection was performed based on the surgeon's intra-operative discretion. Location and grade of cartilage injury were recorded for any lesions noted intra-operatively according to International Cartilage Repair Society (ICRS) grade system.<sup>16</sup>

The number of patients with cartilage or meniscal lesions found during the reconstruction surgery was compared between two groups. In patients with meniscal tear, we performed meniscus repair. The indications for meniscal repair include the following: (1) A complete vertical longitudinal tear more than 10 mm in length, (2) a tear within the peripheral 10–30% of the meniscus or within 3 or 4 mm of the meniscocapsular junction, (3) a peripheral tear that can be displaced toward the center of the plateau by probing, thus demonstrating instability. We also compared clinical outcomes with regards to International Knee Document Committee (IKDC) score,<sup>17</sup> ROM including flexion contracture, and Tegner activity scale.<sup>18</sup> The stability with regard to Lachman and pivot-shift test, and instrumented anterior laxity using Telos (METAX, Hungen, Germany) device were also evaluated and compared between two groups preoperatively under anesthesia before reconstruction and at the final followup.

For the comparison of proprioception, we performed a sensory organization test (SOT) by using a computerized dynamic posturography using SMART Balance Master® (NeuroCom® International, Clackamas, OR, USA). All tests were conducted at the final followup visit after ACL reconstruction. After documenting medical history and daily activities, subjects were instructed to stand on the footplate of the Smart Balance Master unit

**Table 1: Comparison of the two groups with respect to meniscal injury**

Location	Early group	Delayed group	P
Medial meniscus	14	24	0.06
Lateral meniscus	15	9	
Both	4	6	
Number of meniscal injury (%)	25 (52)	27 (62.8)	

and to face the visual surround. The 2 footplates were supported by 5 force transducers (strain gauges) mounted symmetrically on a supporting center plate. The computer receives force measurements from the dual footplates, analyzes the information, and generates a screen display or printed report. All subjects were initially familiarized with the Smart Balance Master system before undergoing tests. The SOT was designed to assess static and dynamic postural balancing ability under 6 different conditions that involve altered visual inputs and different support surfaces (SOT-1, eyes open; SOT-2, eyes closed; SOT-3, sway vision; SOT-4, eyes open with a swaying support; SOT-5, eyes closed with a swaying support; and SOT-6, sway vision with a swaying support). Among them, we evaluated the SOT-5 in the dynamic conditions. Each of the SOT condition was conducted 3 times, and the average value of the 3 trials was used for data analysis. Equilibrium scores reflected the subject's anteroposterior sway (expressed by percentages). The highest possible score was 100%, which indicated that the subject did not sway at all, and a score of 0% indicated a fall from the footplate.

Quadriceps and hamstring isokinetic strength was assessed at the velocities of 180°/s with a dynamometer (Biodex System 2; Biodex Medical System, Shirley, New York, USA) at the final followup visit after the ACL reconstruction. A standardized application of equipment, data collection and procedure for warm-up were applied. Before data collection was started the subjects had performed three practice repetitions at both angular velocities. The uninjured extremity was tested first and then the same procedure was performed for the injured one. Quadriceps and hamstring isokinetic peak torques of the injured extremity were expressed as a percentage compared with those of the uninjured extremity.

The same postoperative rehabilitation protocol was used in both groups. From the 1<sup>st</sup> day after surgery, a brace without angle limitation was worn, and ROM training and quadriceps strengthening exercise were initiated. Partial weight-bearing was allowed at 2 weeks after operation, and full weight-bearing was allowed at 6 weeks postoperatively. We recommended sport activities approximately 6 months after reconstruction.

### Statistical analyses

Descriptive statistics were calculated as follows: Continuous variables are presented as mean  $\pm$  standard deviation and categorical variables are described as frequencies and percentages. We used an independent sample's *t*-tests for continuous values and Chi-square test for categorical values for the comparisons of two groups. The level of significance was set to 0.05. The analysis was performed using SPSS software (SPSS for Windows Release 16.0, Chicago, IL, USA).

## RESULTS

Arthroscopic finding revealed, 25 (52%) of 48 patients in early group and 27 (62.8%) of 43 patients in delayed group had meniscal injury, which was not statistically significant ( $P = 0.06$ ) [Table 1]. Among them, we performed repair in 40% (10 out of 25 cases) in early group and 11% (3 out of 27 cases) in delayed group ( $P = 0.04$ ). Regarding cartilage injuries more than ICRS Grade I, there was no significant difference between two groups (15 and 20 cases in early and delayed group, respectively;  $P = 0.14$ ) [Table 2].

Lysholm knee (LK) score at the final followup were similar in two groups; the early reconstruction group showed  $94.5 \pm 8.9$  and the delayed reconstruction group showed  $96.3 \pm 3.7$  ( $P = 0.28$ ) [Table 3]. Preinjury and postoperative Tegner activity scales also were similar in two groups. At the final followup, the Tegner activity scores were slightly reduced in both groups compared with those of preinjury activity. The Tegner activity scores was  $6.0 \pm 1.6$  in early reconstruction group and  $5.6 \pm 1.5$  in delayed reconstruction group ( $P = 0.27$ ) [Table 3].

The maximal flexion averaged  $138.6 \pm 4.1^\circ$  and  $138.8 \pm 5.6^\circ$  in the early and the delayed reconstruction

**Table 2: Comparison of the two groups with respect to cartilage injury based on International Cartilage Repair Society grading**

Location	ICRS grade	Early group	Delayed group	P
Medial femoral condyle	1-2	4	5	0.14
	3-4	0	1	
Lateral femoral condyle	1-2	4	5	
	3-4	2	0	
Medial tibial condyle	1-2	3	7	
	3-4	0	0	
Lateral tibial condyle	1-2	0	2	
	3-4	2	0	
Number of cartilage injury	$\geq 1$	15	20	

ICRS=International Cartilage Repair Society

**Table 3: Comparison of the two groups with respect to clinical outcomes**

	Early group (48)	Delayed group (43)	P
Lysholm knee score			
Postoperative	$94.5 \pm 8.9$	$96.3 \pm 3.7$	0.28
Tegner activity score			
Preinjury	$6.3 \pm 1.8$	$6.2 \pm 1.6$	0.77
Postoperative	$6.0 \pm 1.6$	$5.6 \pm 1.5$	0.27
Range of motion			
Flexion contracture	$0.3 \pm 1.7$	$0.4 \pm 1.7$	0.93
Maximal flexion	$138.6 \pm 4.1$	$138.8 \pm 5.6$	0.89
Side to side difference			
Preoperative	$10.0 \pm 4.7$	$10.6 \pm 4.1$	0.55
Postoperative	$2.7 \pm 2.5$	$2.9 \pm 2.0$	0.78

groups at the final followups ( $P = 0.89$ ) [Table 3]. The flexion contracture were  $0.3 \pm 1.7^\circ$  in the earlier reconstruction and  $0.4 \pm 1.3^\circ$  in the delayed reconstruction groups ( $P = 0.93$ ) [Table 3]. In both groups, all patients showed, at least, Grade II instability preoperatively and improved to normal or Grade I except for four cases of Grade II in early group and three cases of Grade II in delayed group. These results indicate that there were no significant differences regarding preoperative and postoperative grade in both groups ( $P = 0.93$  and  $0.58$ , respectively) [Table 4]. In the pivot-shift test at preoperatively and final followup, we could not find any inter-group differences ( $P = 0.96$ , preoperatively;  $P = 0.71$ , followup) [Table 4].

The muscle power results were not significantly different regarding extension and flexion power at the final followup between two groups ( $P = 0.07$ ,  $P = 0.06$ ). The mean extension and flexion power at the final followup were  $83.3 \pm 7.6\%$  and  $86.0 \pm 7.4\%$  in the early reconstruction group and  $80.7 \pm 5.9\%$  and  $83.2 \pm 6.9\%$  in the delayed reconstruction. In posture control, the equilibrium scores on stage 5 at the final followup also were similar in the two groups ( $P = 0.66$ ). The equilibrium scores on stage 5 were  $82.8 \pm 8.7\%$  in early group and  $82.0 \pm 8.3\%$  in delayed group.

## DISCUSSION

This study compared before 3 weeks and after 3 months ACL reconstruction groups regarding the incidence of meniscal or chondral injury and clinical outcomes including proprioception and muscle power with a minimum of 2 years followup. Our data demonstrated that the early reconstruction group showed the higher possibility of repair for meniscal injury. However, we were unable to identify any differences regarding functional scores, muscle power and posture control, ROM and incidences of meniscal or cartilage injuries. Therefore, most of our hypothesis were not proved positively by the data obtained in this study.

Some studies have cited that increased time to surgery is a risk factor for increased medial meniscus injury.<sup>5,7,11,19,20</sup> Papastergiou *et al.*<sup>11</sup> reported that the prevalence of medial meniscus tear was increased with time, especially after 3 months from injury. They recommend ACL reconstruction within 3 months after injury for reducing the risk of meniscal injury. Our results were different from previous findings that delay in surgery by 3 months has increased chances of meniscal injury. Similarly to our results, Smith *et al.*<sup>21</sup> could not find any significant increase in meniscal injury with time after ACL injury in meta-analysis study. Michalitsis *et al.*<sup>14</sup> also reported no significant increase of meniscal lesion after 3 or 12 months from injury. However, this study showed a higher probability of meniscal repair in early than delayed reconstruction.

While the prevalence of articular cartilage damage has been variably reported as about 20% in acute ACL tears, chronic ACL-deficient knees showed cartilage damage about 40% after 12 months.<sup>4,21-23</sup> Michalitsis *et al.*<sup>14</sup> also reported that there was a significant increase of chondral lesion after 12 months from injury, but not after 3 months. However, Smith *et al.*<sup>21</sup> injury in meta-analysis study reported no significant increase of chondral injury with time after ACL injury. Similar to their findings, time to surgery >3 months from injury did not have a strong increase in cartilage injury in this study. However, we could not say that our results were different from other's study because 3 months after injury might be too short period to result in cartilage damage.

In this study, we could not find any statistical significance between the early and delayed ACL reconstruction groups for the LK score and Tegner activity score, which were similar to others study.<sup>4,21</sup> In addition, the postoperative Tegner activity scores slightly reduced in both groups when compared with those of preinjury activity. We assume that this finding is probably due to the patient's unwillingness to participate in stressful activities.

**Table 4: Comparison of the two groups with respect to knee stability according to Lachman and pivot shift test**

	Grade	Early group (48)		Delayed group (43)	
		Preoperative	Postoperative	Preoperative	Postoperative
Lachman test	0	0	20	0	23
	I	0	14	0	17
	II	23	4	21	3
	III	25	0	22	0
	<i>P</i>			0.93	0.58
Pivot shift test	0	0	39	0	22
	I	31	7	29	8
	II	12	2	10	3
	III	5	0	4	0
	<i>P</i>			0.96	0.71



Recently, early ACL reconstruction is preferred thanks to aggressive rehabilitation after ACL reconstruction.<sup>3,4</sup> However, the limited ROM is still major problem in early ACL reconstruction and the ideal time of early ACL reconstruction is debatable. Similar to the study by Smith *et al.*, we could not observe any significantly limited ROM even after early reconstruction (<3 weeks). However, there has been an increasing trend toward earlier reconstruction because early and aggressive rehabilitation after ACL reconstruction can prevent the loss of ROM after reconstruction.

Recovery of muscle hamstring and quadriceps power is important for the returning to sports and occupational work. In this study, we hypothesized that the early ACL reconstruction can prevent the decrease in muscle power after ACL injury. However, in this study, early reconstruction had no benefit regarding proprioception and muscle deficit in comparison to late reconstruction group after minimum of 2 years followup.

The limitations of the study are that ROM was measured using goniometer instead of X-ray, not a prospective randomized study. The patients were allocated into one of study group based on the time from injury date when they were seen at the outpatient clinic. The last limitation is that we could not evaluate the success of meniscal repair in both groups. However, no patients showed symptoms related to meniscal tear at the followup in both groups.

## CONCLUSIONS

Early ACL reconstruction (within 3 weeks) had good clinical results and stability as good as delayed reconstruction (more than 3 months) without the limitation of knee motion, muscle power, and postural control. Moreover, early reconstruction showed a higher chance of repair the torn meniscus. Hence, early ACL reconstruction should be recommended for the increase of possibility of repair of the torn meniscus.

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## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Smith JP<sup>3rd</sup>, Barrett GR. Medial and lateral meniscal tear patterns in anterior cruciate ligament-deficient knees. A prospective analysis of 575 tears. *Am J Sports Med* 2001;29:415-9.
- Shelbourne KD, Wilckens JH, Mollabashy A, DeCarlo M. Arthrofibrosis in acute anterior cruciate ligament reconstruction. The effect of timing of reconstruction and rehabilitation. *Am J Sports Med* 1991;19:332-6.
- Bernstein J. Early versus delayed reconstruction of the anterior cruciate ligament: A decision analysis approach. *J Bone Joint Surg Am* 2011;93:e48.
- Bottoni CR, Liddell TR, Trainor TJ, Freccero DM, Lindell KK. Postoperative range of motion following anterior cruciate ligament reconstruction using autograft hamstrings: A prospective, randomized clinical trial of early versus delayed reconstructions. *Am J Sports Med* 2008;36:656-62.
- Granat LP, Bahr R, Lie SA, Engebretsen L. Timing of anterior cruciate ligament reconstructive surgery and risk of cartilage lesions and meniscal tears: A cohort study based on the Norwegian National Knee Ligament Registry. *Am J Sports Med* 2009;37:955-61.
- Meighan AA, Keating JF, Will E. Outcome after reconstruction of the anterior cruciate ligament in athletic patients. A comparison of early versus delayed surgery. *J Bone Joint Surg Br* 2003;85:521-4.
- Church S, Keating JF. Reconstruction of the anterior cruciate ligament: Timing of surgery and the incidence of meniscal tears and degenerative change. *J Bone Joint Surg Br* 2005;87:1639-42.
- de Roock NJ, Lang-Stevenson A. Meniscal tears sustained awaiting anterior cruciate ligament reconstruction. *Injury* 2003;34:343-5.
- Johnson DL, Urban WP Jr., Caborn DN, Vanarthos WJ, Carlson CS. Articular cartilage changes seen with magnetic resonance imaging-detected bone bruises associated with acute anterior cruciate ligament rupture. *Am J Sports Med* 1998;26:409-14.
- Millett PJ, Willis AA, Warren RF. Associated injuries in pediatric and adolescent anterior cruciate ligament tears: Does a delay in treatment increase the risk of meniscal tear? *Arthroscopy* 2002;18:955-9.
- Papastergiou SG, Koukoulis NE, Mikalef P, Ziogas E, Voulgaropoulos H. Meniscal tears in the ACL-deficient knee: Correlation between meniscal tears and the timing of ACL reconstruction. *Knee Surg Sports Traumatol Arthrosc* 2007;15:1438-44.
- Yrrelation between meniscal tears andation of intraarticular lesions accompanying ACL ruptures in military personnel who elected not to restrict their daily activities: The effect of age and time from injury. *Knee Surg Sports Traumatol Arthrosc* 2006;14:1139-47.
- Ghodadra N, Mall NA, Karas V, Grumet RC, Kirk S, McNickle AG, *et al.* Articular and meniscal pathology associated with primary anterior cruciate ligament reconstruction. *J Knee Surg* 2013;26:185-93.
- Michalitsis S, Vlychou M, Malizos KN, Thriskos P, Hantes ME. Meniscal and articular cartilage lesions in the anterior cruciate ligament-deficient knee: Correlation between time from injury and knee scores. *Knee Surg Sports Traumatol Arthrosc* 2015;23:232-9.
- Zhou MW, Gu L, Chen YP, Yu CL, Ao YF, Huang HS, *et al.* Factors affecting proprioceptive recovery after anterior cruciate ligament reconstruction. *Chin Med J (Engl)* 2008;121:2224-8.
- Maimil-Varlet P, Aigner T, Brittberg M, Bullough P, Hollander A, Hunziker E, *et al.* Histological assessment of cartilage repair: A report by the Histology Endpoint Committee of the

- International Cartilage Repair Society (ICRS). *J Bone Joint Surg Am* 2003;85-A Suppl 2:45-57.
17. Hefti F, M the Histology Endpoint Committee of the International Cartilage Repair Society (ICRS). *J Bone Joint Surg Am* 2003;85-A Supp 1993;1:226-34.
  18. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res* 1985;198:43-9.
  19. Tandogan RN, Taser O, Kayaalp A, Taskiran E, Pinar H, Alparslan B, *et al.* Analysis of meniscal and chondral lesions accompanying anterior cruciate ligament tears: Relationship with age, time from injury, and level of sport. *Knee Surg Sports Traumatol Arthrosc* 2004;12:262-70.
  20. Yoo JC, Ahn JH, Lee SH, Yoon YC. Increasing incidence of medial meniscal tears in nonoperatively treated anterior cruciate ligament insufficiency patients documented by serial magnetic resonance imaging studies. *Am J Sports Med* 2009;37:1478-83.
  21. Smith TO, Davies L, Hing CB. Early versus delayed surgery for anterior cruciate ligament reconstruction: A systematic review and meta-analysis. *Knee Surg Sports Traumatol Arthrosc* 2010;18:304-11.
  22. Marcacci M, Zaffagnini S, Iacono F, Neri MP, Petitto A. Early versus late reconstruction for anterior cruciate ligament rupture. Results after five years of followup. *Am J Sports Med* 1995;23:690-3.
  23. Petersen W, Laprell H. Combined injuries of the medial collateral ligament and the anterior cruciate ligament. Early ACL reconstruction versus late ACL reconstruction. *Arch Orthop Trauma Surg* 1999;119:258-62.