Full length article

Functional outcome of an early anterior cruciate ligament reconstruction in comparison to delayed: Are we waiting in vain?☆

Rajeev Raj Manandhar^{a,*}, Karthik Chandrashekhar^b, Vinay Kumaraswamy^c,
Santosh Sahanand^d, David Rajan^d

^a Department of Orthopaedic Surgery, Kathmandu Medical College Teaching Hospital, Sinamangal, Kathmandu, Nepal

^b Arathana Hospital, Pollachi, Tamil Nadu, India

^c Department of Orthopaedics, Kempegowda Institute of Medical Sciences, KR Road, VV Puram, Bengaluru, Karnataka, India

^d Ortho One, Orthopaedic Specialty Centre, 657, Trichy Road, Singanallur, Coimbatore-5, Tamil Nadu, India

ARTICLE INFO

Article history:

Received 5 September 2016

Accepted 2 March 2017

Available online 18 March 2017

Keywords:

Anterior cruciate ligament reconstruction

Early

Delayed

Results

ABSTRACT

Background: Surgical techniques of ACL reconstruction (ACLR) have evolved over the past three decades along with debate regarding timing of reconstruction. It was a widespread belief that the timing of surgery was an important factor in determining the resulting stiffness after ACLR. Delayed rather than early reconstruction of the ACL is the current recommended treatment since it is thought to give a better functional outcome. However, there is no consensus in the literature regarding the optimal time of surgical intervention. The purpose of this study was to compare the range of motion and functional outcome in patients who underwent ACLR early with those that were delayed.

Materials and Methods: The patients were randomized into two groups; patients who underwent the procedure within three weeks were kept in Group I (Early) and those patients who were reconstructed after six weeks were categorized as Group II (Delayed). Hamstring grafts were used and a standard protocol of surgery and physiotherapy was followed. The range of motion, IKDC and Tegner scores were compared.

Results: A hundred and four patients underwent ACLR; fifty-three patients were grouped as Group I (Early) and fifty one as Group II (Delayed). The range of motion of both groups was comparable. The IKDC and Tegner scores were also comparable for early (Group I) ACLR and the patients who had their ACL reconstructed after a delay of at least 6 weeks (Group II).

Conclusion: There are no clinical differences in terms of range of motion and functional results between early and delayed ACLR.

© 2017 Delhi Orthopedic Association. All rights reserved.

1. Introduction

The anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee.^{1,2} Arthroscopic reconstruction is the usual treatment for younger athletes or those with occupational or sporting pursuits since it restores stability and limits the prospective for progressive degeneration and long-term instability of the knee.^{3,4} Surgical techniques of ACL reconstruction (ACLR)

have evolved over the past three decades along with debate regarding timing of reconstruction.⁵

It was a widespread belief that the timing of surgery was an important factor in determining the resulting stiffness after ACLR.^{6,7} In a landmark publication, Shelbourne et al. recommended delaying surgery for at least 3 weeks would result in considerable decrease of arthrofibrosis.⁵

Delaying surgical intervention was thought to allow optimization of pre-operative knee range of motion and recovery of surrounding soft tissues from the initial injury potentially reducing the incidence of post-operative arthrofibrosis and wound complications.^{5,8} The knee would have recovered from the first injury. However, the ensuing surgery is then perceived by the body as a “second hit” from which healing must again commence. On the contrary, if the surgery is performed early, there is just one

☆ Study performed at Ortho One, Orthopaedic Specialty Centre, Coimbatore, Tamil Nadu, India.

* Corresponding author.

E-mail addresses: rajeevrajmanandhar@gmail.com (R.R. Manandhar), karthikwillbe@gmail.com (K. Chandrashekhar), maildrviny@gmail.com (V. Kumaraswamy), sahanand@gmail.com (S. Sahanand), davidvrajan@gmail.com (D. Rajan).

trauma.⁹ Early surgery also hastens return to sporting and work with considerable economic consequences.

Francis et al.,¹⁰ conducted a national survey in the UK. 81% reported that they considered the ideal time span from injury to operation to be between 1 and 6 months, although it was acknowledged that only 35% of ACL reconstructions are performed within this time-frame.¹¹

Delayed reconstruction is the current recommended treatment since it is thought to give a better functional outcome.¹² Recent random controlled trials suggest that early surgery does not affect post-op range of motion. Meta-analysis of 6 studies found no difference in clinical outcome between patients who underwent early and delayed ACL reconstruction.¹³ Hence, there is no consensus in the current literature regarding the optimal time of surgical intervention.

2. Objectives

The purpose of this study was to compare the range of motion and functional outcome in patients undergoing arthroscopic assisted ACL reconstruction early within 3 weeks and delayed after 6 weeks.

3. Materials and methods

A randomized prospective study was performed on adult patients who underwent arthroscopic assisted ACL reconstruction from January 2014 to January 2015 for a period of one year. Patients with ACL insufficiency with or without associated chondral (Outerbridge I & II) injuries, meniscal injuries, which required partial meniscectomy or debridement, were included. The patients were randomized into two groups; patients who underwent the procedure within three weeks were kept in Group I (Early) and those patients who were reconstructed after six weeks were categorized as Group II (Delayed). The patients were randomized into two groups on the basis of odd and even hospital numbers. The odd numbers were placed in Group I (Early) and the even in Group 2 (Delayed). The prerequisite for surgery was knee flexion of at least 120°. Ethical clearance for the study was obtained and informed consent was taken from all patients.

All patients underwent physiotherapy, and surgery in the early group was performed as soon as flexion of 120° was achieved. The patients in the delayed group were placed on a physiotherapy program where the quadriceps was strengthened and the range of motion restored to 120° of flexion and they were operated after 6 weeks. Those patients who had undergone previous knee surgery, multi ligament injuries, associated chondral injuries > Grade III, IV (Outerbridge classification), associated meniscal injuries requiring repair and patients in whom BPTB and Quadriceps grafts were used were excluded.

3.1. Operative technique

An examination under anaesthesia was performed to confirm the findings and an anterolateral parapatellar viewing portal and accessory anteromedial parapatellar working portals were made. Diagnostic arthroscopy was done. The hamstring graft was then harvested making a vertical incision below and medial to the tibial tuberosity in between the tibial tuberosity and the medial tibial flare. After the hamstring tendons were palpated the skin was incised, the fat was pushed away using a gauze piece and the sartorius fascia was visualized. A transverse incision was made in the fascia in between the gracilis and semitendinosus tendons and the semitendinosus was isolated initially using a 90° right angled artery forceps. The tendon was removed from its insertion on the tibia and held by a luggage tag suture.¹⁴ A closed end tendon

stripper was used to strip the tendon. Then the gracilis was removed. Ethibond no 2 whipstitches were applied at the ends and a quadrupled graft construct was made.

The femoral tunnel was made using the transportal technique. The knee was placed in about 130° of flexion. The transportal guide wire was placed 30–45° in the sagittal plane and horizontal to the floor via the accessory anteromedial portal.¹⁵ Then a 4.5 mm cannulated drill was used to drill a tunnel and the length was measured. Then the femoral tunnel was made larger as needed according to the width of the graft with flower head tipped drills. The entrance to the femoral tunnel was widened and smoothed to help graft passage with a curette and rasp.

The tibial tunnel was made using the ACL jig. The graft was passed and fixed proximally with CL loop endobutton. Impingement was checked and cyclical loading done and then distal fixation was done with a bioscrew. Placement of the screw was confirmed under arthroscopic guidance, the tension in the reconstructed ligament was checked using a probe and Lachman test.

The knee was placed in a knee brace. Mobilization and partial weight bearing with a pair of crutches as tolerated was started the next day, but their range of motion was restricted to 0–90° of flexion for the first three weeks. The patients were discharged on the second post-operative day. Partial weight bearing with a pair of crutches was advised for two weeks. After two weeks, the operated side crutch was removed. Recumbent cycling was started at three weeks and the second crutch was discontinued to be used in crowded places if necessary. Half squats were started. Slow walking and jogging was allowed and speed and duration was increased.

After three months, swimming and side running progressing to zig zag running was advised. Single leg presses and single half squats were also taught. The balance training was started at the end of the fourth month, using wobble board. Plyometrics and skill exercises were taught at the fifth month. The patient was encouraged to start playing gradually after six months. The patients were followed up at intervals of three, six and twelve weeks postoperatively, then at six months and thereafter at six-monthly intervals.

Passive range of motion was measured and compared with the opposite knee. A physiotherapist performed the range of motion assessments using a goniometer. The heel was elevated on a support to assess the total amount of extension. The final assessment was carried out on patients who had completed six months of their rehabilitation. Their pre-operative and present IKDC (International Knee Documentation Committee) and Tegner scores and range of motion were compared.

Statistical analysis was done using SPSS version 20. The mean pre-operative and post-operative IKDC and Tegner scores were compared using paired samples *t*-test. The mean scores in the two groups at the final assessment at 6 months were compared using independent samples *t*-test. A *p* value of less than 0.05 was considered to be statistically significant.

4. Results

A total of one hundred and ten patients underwent ACLR from January 2014 to January 2015. Six patients were lost to follow up and could not be contacted and were excluded from the study. Of the remaining hundred and four patients, fifty-three patients were grouped as Group I (Early) and fifty-one as Group II (Delayed). The time period from injury to surgery was 11.20 days (Range: 4–21 days) in Group I and 48 days (Range: 42–60 days) in Group II. The mean age was 30 years (Range: 18–55 years).

There were 21 female and 83 male patients. The right side was involved in 64 and left in 40 patients. The commonest mode of

injury was sports related in 73 patients (70.19%) followed by road traffic accidents (26 patients). The patients were young professionals leading active lives employed in various professions.

In Group I, 22 patients had meniscal injuries: 12 involving the lateral meniscus and 6 the medial meniscus and in four patients both menisci were involved. In Group II, 34 patients had meniscal tears, 8 involving the lateral meniscus, 20 involving medial meniscus and in 6 patients both were torn (Table 1). All identified tears were either debrided or underwent partial excision. The incidence of chondral injuries was higher in Group II (28 patients) compared to Group I (10 patients).

The range of motion of both groups was comparable. The amount of flexion following surgery was reduced in both groups for measurements made in the first three months (Table 2). There was no statistical difference between the two groups. The pre-operative and post-operative IKDC and Tegner scores were recorded. The final assessment was performed at 6 months and the final IKDC and Tegner scores were compared (Table 3).

The mean IKDC score in GI (Early) was 69.68 and in GII (Delayed) was 67.14, the difference not being statistically significant ($p=0.077$). The mean Tegner activity level scale in GI was 4.15 and in GII was 3.72, difference was not statistically significant ($p=0.064$). Thus, the functional outcome after early ACL reconstruction and delayed ACL reconstruction is comparable based on the IKDC score and Tegner activity score.

One patient in Group I had post-operative infection which resolved after daily dressings and a course of oral antibiotics.

5. Discussion

The timing of reconstruction after an ACL injury is a subject of extensive debate. The assumption that early reconstruction would lead to an increased incidence of arthrofibrosis was widespread after a landmark paper published by Shelbourne et al.,⁵ where a retrospective review of 169 patients was performed. The patients were followed for 13 weeks, and three groups were made on the basis of time from injury to surgery. Group I was less than 8 days, Group II from 8 to 21 days and Group III more than 21 days. They found a significant increase of arthrofibrosis in patients reconstructed acutely (Group I) when compared with those after 3 weeks (Group III). They also reported that an accelerated rehabilitation program resulted in significantly less arthrofibrosis in group II patients than when a slower rehabilitation protocol was employed. An ipsilateral bone tendon-bone autograft inserted via a mini open, two incision technique was employed. The graft was held with heavy sutures tied over a polypropylene ligament button. In contrast, we used an autograft hamstring via a single-incision arthroscopic technique and graft was fixed with CL loop endobutton on the femur and bioscrew in the tibia following a modern operative technique. Theoretically, the additional trauma from the arthrotomy in the mini open technique could have contributed to the increased arthrofibrosis reported in their study.⁹

Hunter et al.¹⁶ conducted a prospective study to determine the impact of surgical timing on postoperative motion and stability following ACLR. 185 patients were entered into four separate groups based on the time interval from injury to surgery. No arthrotomy or surgical intervention for other ligamentous structures was performed. No statistical difference in restoration

Table 2

Post- op Range of motion.

Group	3 weeks	6 weeks	12 weeks	24 weeks
GI (Early)	10–80	6–100	2–120	–1 to 134
GII (Delayed)	8–82	5–110	2–122	–1 to 135

Table 3

Final IKDC and Tegner scores at 6 months.

Scores	GI (Early)	GII (Delayed)	P value
IKDC	69.68 $\pm$ 8.14	67.14 $\pm$ 6.08	0.077
Tegner	4.15 $\pm$ 1.45	3.72 $\pm$ 1.34	0.064

of extension or flexion in any group at any time point was found. They concluded that by using modern arthroscopic surgical techniques and an aggressive postoperative physical therapy protocol, motion and stability can be restored in a high percentage of patients and that surgical success is independent of the timing of surgery.

Many studies have investigated the effect of the timing of surgical reconstruction on patient outcomes. There is significant heterogeneity in terms of surgical technique, graft material, graft fixation devices, rehabilitation protocols and outcomes measured. This has made it difficult to clearly identify the isolated effect of time to surgery on the risk of postoperative stiffness.¹³ Our study has uniformity in terms of surgical technique, graft material, fixation devices and rehabilitation protocol and outcomes measures.

In our study, the amount of flexion following surgery was reduced in both groups for the first three months. Almekinders and colleagues¹⁷ studied 70 adults who underwent ACLR using bone patella tendon bone autograft. Patients who underwent reconstruction less than one month from injury had limitations in knee range of motion early in rehabilitation; however, after one year, there was no difference in motion between patients who underwent early or delayed surgery.

The meniscal and chondral injuries were found in both groups but they were more in the delayed group. Several authors have reported an increased risk of developing meniscal and chondral lesions with the lengthening of time from injury to surgery.¹⁸ The odds for a cartilage lesion increased by nearly 1% for each month that elapsed from the time of injury till surgery and that cartilage lesions were nearly twice as frequent if there was a concurrent meniscal tear and vice versa.¹⁹ Restoring knee stability would minimize the risk of further meniscal and chondral damage which may lead to premature degenerative joint changes.

There appears to be a lack of consensus regarding the definitions of early and delayed ACLR. Various studies have used their own definition of early and delayed. Church and Keating used 12 months as a marker to distinguish between early and delayed. Bottoni et al.⁹ defined early reconstruction as occurring at the earliest possible date from injury and delayed reconstruction as a minimum of 6 weeks from the date of injury. In our study the two groups have been constructed according to the landmark paper published by Shelbourne.

Post-operative rehabilitation has changed substantially as surgical techniques have improved. The modern arthroscopic assisted transportal ACL reconstruction technique utilized allowed accelerated rehabilitation with emphasis on early mobilization, weight bearing and lower extremity strength training. There was no difference in the range of motion in between our two groups although both groups had reduced flexion for the first three months.

Table 1

Meniscal tears: Total no. 56 patients.

Group	Medial meniscus	Lateral meniscus	Both	Total
GI (Early)	6	12	4	22
GII (Delayed)	20	8	6	34

In our study, as the transportal technique was used, physiotherapy was advised and the knee had to achieve a pre-operative flexion of 120°. Mayr et al.,²⁰ found evidence that preoperative synovitis of the knee with limited range of motion was highly significant in terms of occurrence of arthrofibrosis after ACLR. 70% of their patients, who had a swollen, inflamed knee at the time of reconstruction developed postoperative arthrofibrosis. Thus, the interval between knee trauma and ACL reconstruction was not the determining factor.

6. Conclusion

The results of early and delayed arthroscopic ACLR using hamstring autograft are comparable. There are no clinical differences in terms of range of motion and functional results. One can proceed with the surgery early rather than waiting and delaying surgery once patient has regained 120° of knee flexion.

Conflict of interest

The authors declare that they have no conflict of interest

Acknowledgements

We acknowledge Dr Umesh Aryal and Dr Krishna Khanal for their support with the statistical data management and preparation for the study

References

1. Clayton RA, Court-Brown CM. The epidemiology of musculoskeletal tendinous and ligamentous injuries. *Injury*. 2008;39:1338–1344.
2. Meighan AS, 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*. 2003;85-B:521–524.
3. Amis AA, Dawkins GP. Functional anatomy of the anterior cruciate ligament. Fibre bundle actions related to ligament replacements and injuries. *J Bone Joint Surg*. 1991;73-B:260–267.
4. Jomha NM, Borton DC, Clingeffer AJ, Pinczewski LA. Long term osteoarthritic changes in anterior cruciate ligament reconstructed knees. *Clin Orthop Relat Res*. 1999;358:188–193.
5. Shelbourne KD, Wilckens JH, Mollabashy A, Decarlos M. Arthrofibrosis in acute anterior cruciate ligament reconstruction: the effect of timing of reconstruction and rehabilitation. *Am J Sports Med*. 1991;19:332–336.
6. Beynnon BD, Johnson RJ, Abate JA, Fleming BC, Nichols CE. Treatment of anterior cruciate ligament injuries: part I. *Am J Sports Med*. 2005;33:1579–1602.
7. Magit D, Wolff A, Sutton K, Medvecky MJ. Arthrofibrosis of the knee. *J Am Acad Orthop Surg*. 2007;15:682–694.
8. Mohtadi NG, Webster-Bogaert S, Fowler PJ. Limitation of motion following anterior cruciate ligament reconstruction. A case-control study. *Am J Sports Med*. 1991;19:620–625.
9. 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 reconstruction. *Am J Sports Med*. 2008;36:656–662.
10. Francis A, Thomas RWM, McGregor A. Anterior cruciate ligament rupture: reconstruction surgery and rehabilitation: a nation-wide survey of current practice. *Knee*. 2001;8:13–18.
11. 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;18:304–311.
12. Raviraj A, Anand A, Kodikal G, Chandrashekar M, Pai S. A comparison of early and delayed arthroscopically-assisted reconstruction of the anterior cruciate ligament using hamstring autograft. *J Bone Joint Surg Br*. 2010;92:521–526.
13. Kwok CS, Harrison T, Servant C. The optimal timing for anterior cruciate ligament reconstruction with respect to the risk of postoperative stiffness. *Arthroscopy*. 2013;29(3):556–565.
14. Woodacre T, Marshall M, Hockings M. Luggage tag technique for preparation of anterior cruciate ligament grafts. *Techn Knee Surg*. 2011;10(4):231.
15. Iyyampillai G, Raman ET, Rajan DV, Krishnamoorthy A, Sahanand S. Determinants of femoral tunnel length in anterior cruciate ligament reconstruction: CT analysis of the influence of tunnel orientation on the length. *Knee Surg Relat Res*. 2013;25(4):207–214.
16. Hunter RE, Mastrangelo J, Freeman JR, Purnell ML, Jones RH. The impact of surgical timing on postoperative motion and stability following anterior cruciate ligament reconstruction. *Arthroscopy*. 1996;12(6):667–674.
17. Almekinders LC, Moore T, Freedman D, Taft TN. Postoperative problems following anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 1995;3(2):78–82.
18. Brambilla L, Pulici L, Carimati G, et al. Prevalence of associated lesions in anterior cruciate ligament reconstruction: correlation with surgical timing and with patient age, sex, and body mass index. *Am J Sports Med*. 2015;43(12):2966–2973.
19. Granan LP, Bahr R, Lie SA, Engebretsen L. Timing of anterior cruciate ligament reconstructive surgery and risk of cartilage lesions and meniscal tears. *Am J Sports Med*. 2009;37(5):955–961.
20. Mayr HO, Weig TG, Plitz W. Arthrofibrosis following ACL reconstruction – reasons and outcome. *Arch Orthop Trauma Surg*. 2004;124:518–522.