

# FUNCTIONAL OUTCOME OF ACCELERATED REHABILITATION IN ARTHROSCOPIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION WITH BONE PATELLAR TENDON BONE GRAFT A PROSPECTIVE STUDY

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## ABSTRACT

### INTRODUCTION

An ideal rehabilitation program post anterior cruciate ligament reconstruction enables an individual to return to pre injury levels at a faster rate with minimal to no risk of reinjury to the graft.

Rehabilitation protocols have changed considerably over time in the past. It has become "aggressive", meaning an intensive rehabilitation which includes greater variety of exercises and sports related training.

### AIM OF THE STUDY

The aim of our study is to assess the outcome of accelerated rehabilitation post anterior cruciate ligament (ACL) reconstruction.

### METHODOLOGY

106 patients were operated by a single surgeon underwent arthroscopic anterior cruciate ligament reconstruction using bone patella tendon bone graft and partial meniscectomy for associated meniscal tear. Patients were put on an accelerated rehabilitation protocol designed in our institute on first post-operative day, under the guidance of a physical therapist in consultation with the operated surgeon.

Patients were followed up at 3 weeks, 6 months and 9 months, post onset of rehabilitation, patients were assessed using KT1000 Arthrometer and Lysholm knee scoring system.

### RESULTS

Out of 106 patients, who were selected, 96(91%) were males and 10(9%) were females.

The mean pre-operative Lysholm score was 55.09. Post operatively, while on accelerated rehabilitation program the Lysholm scores were 69.73 at 3 weeks, 89.13 at 6 months and 89.19 at 9 months. In our pre-operative evaluation mean KT 1000 arthrometer score was 10.53 and post-operative at six months was 3.49. At nine months 105 patients had excellent results whereas 1 patient had good result.

### CONCLUSION

Accelerated rehabilitation protocol enables the patient to functionally recover faster to pre injury levels. A rehabilitation protocol for 6 months is sufficient in enabling a patient to get back to pre-injury levels. Functional outcome is the same with or without associated meniscal injuries.

### KEYWORDS

Accelerated rehabilitation protocol, Anterior cruciate ligament (ACL) reconstruction, Bone patella tendon graft, KT1000 Knee Arthrometer, Lysholm knee score, Prospective study.

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**INTRODUCTION:** Anterior Cruciate ligament reconstruction restores knee function to pre injury levels, without any pain. It also prevents degenerative changes in the knee. Anterior cruciate ligament, it also allows the patient to return to sporting activities.<sup>1</sup>

The rationale for rehabilitation after an anterior cruciate ligament injury is to gain a good functional stability, reach the best possible functional level and to decrease the risk for re-injury. The training programs are focused both on the injured leg, but also on the non-injured leg, hip and trunk muscles that are needed in order to stabilize the entire body. The functional stability of the knee joint is dependent on the interplay of passive structures and the dynamic system. The ligament provides an average of 86% of the total resisting force to anteriorly directed forces on the tibia.<sup>1</sup>

Rehabilitation protocols have changed considerably over time in the past. It has become "aggressive", meaning an intensive rehabilitation which includes greater variety of

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exercises and sports related training. The aim of post-operative rehabilitation after anterior cruciate ligament reconstruction is to restore normal joint motion and strength, and lower extremity performance reaching pre injury levels without producing excessive stress and strain on graft during healing and also to prevent re injury.<sup>1</sup>

**AIM OF THE STUDY:** The aim of our study is to assess the outcome of accelerated rehabilitation post anterior cruciate ligament (ACL) reconstruction.

**MATERIALS AND METHODS:** One hundred and six arthroscopic anterior cruciate ligament reconstructions using Bone patella tendon grafts were performed. Meniscal injuries if associated was treated by partial meniscectomy. This prospective study was conducted over a period of four years (2011-2014) at Vydehi institute of medical sciences and research center Bangalore in the department of Orthopaedics, after taking informed written consent from the patients.

The patients were examined pre-operatively in the outpatient by a senior orthopaedic surgeon. Evaluation was done clinically and also using K. T 1000 Arthrometer.

Magnetic resonance imaging was done for all patients before surgery

Patients with unilateral Anterior cruciate ligament insufficiency, injury at least one month prior to surgery, instability during activities of daily living, associated with other ligament and meniscal injuries and no previous reconstruction of any of the ligaments were selected as study population. Patients with bilateral insufficiency, associated fractures in same limb and those put on delayed rehabilitation protocol were excluded. Following surgery, patients were prescribed on an accelerated rehabilitation protocol designed at our institute (Table 1) from day one. The rehabilitation was supervised by trained rehabilitation therapist in co-ordination with the surgeon. Follow up was done at 3 weeks, 6 months and at 9 months using the Lysholm knee score,<sup>2,3</sup> and KT-1000 Arthrometer.<sup>4,5</sup>

Lysholm score has both subjective and objective evaluation. The score carries maximum points for instability and pain. The maximum score is 100. Patients are graded pre operatively and post operatively as excellent, good, fair and poor.

(Table 2)

	Week 1	Week 2	Week 3	week 4-8	2 to 4 months	4 months	5 months	6 months
Active, active assisted and gentle passive ROM exercises.	+							
Gait toe walking assisted with axillary crutches.	+							
Isometric quadriceps: hamstrings: 1:2	+							
Gait, 50 % weight bearing with axillary crutches		+						
Active and active assisted knee ROM exercises.		+						
Isometric quadriceps: hamstrings: 1:2		+						
Straight leg rises.		+						
Gait, 75 % weight bearing with axillary crutches 7			+					
Active and active assisted knee ROM exercises.			+					
isometric quadriceps: hamstrings: 1:27			+					
straight leg rises .7			+					
Extension exercises			+					
Full weight bearing gait				+				
Active, active assisted knee ROM				+				
Hamstring and quadriceps strengthening				+				
Quarter squats				+				
Custom knee brace				+				
Stationary bike				+				
Cycling					+			
Jogging					+			
Swimming					+			

Trampolines						+			
Proprioception exercises						+			
Sports specific skills							+	+	+
Continue hamstrings and quadriceps strengthening							+	+	+
Continue proprioception exercises.							+	+	+

**Table 1: The accelerated rehabilitation protocol designed and followed in our institute**

Scores	
81-100	Excellent
71-80	Good
61-70	Fair
<60	Poor

<b>1. LIMP</b> (5 points)		
<input type="checkbox"/> None		5
<input type="checkbox"/> Slight or periodic		3
<input type="checkbox"/> Severe/Constant		0
<b>2. SUPPORT</b> (5 points)		
<input type="checkbox"/> None		5
<input type="checkbox"/> Cane/crutch needed		3
<input type="checkbox"/> Unable to bear weight		0
<b>3. LOCKING</b> (15 points)		
<input type="checkbox"/> None		15
<input type="checkbox"/> Catching		10
<input type="checkbox"/> Occasional		6
<input type="checkbox"/> Frequently		2
<input type="checkbox"/> Currently locked		0
<b>4. INSTABILITY</b> (25 points)		
<input type="checkbox"/> Never gives way		25
<input type="checkbox"/> Rarely with sports		20
<input type="checkbox"/> Often with sports		15
<input type="checkbox"/> Sometimes with ADL's		10
<input type="checkbox"/> Often during ADL's		5
<input type="checkbox"/> Every step		0

<b>5. PAIN</b> (25 points)		
<input type="checkbox"/> None		25
<input type="checkbox"/> Slight or periodic		20
<input type="checkbox"/> Severe/Constant		15
<input type="checkbox"/> Marked walking > 2 km		10
<input type="checkbox"/> Marked walking < 2 km		5
<input type="checkbox"/> Constant		0
<b>6. SWELLING</b> (10 points)		
<input type="checkbox"/> None		10
<input type="checkbox"/> After sports		3
<input type="checkbox"/> After daily activities		2
<input type="checkbox"/> Constant		0
<b>7. STAIRS</b> (10 points)		
<input type="checkbox"/> No problem		10
<input type="checkbox"/> Slight problem		6
<input type="checkbox"/> One step at a time		2
<input type="checkbox"/> Impossible		0
<b>8. SQUATTING</b> (5 points)		
<input type="checkbox"/> No problem		5
<input type="checkbox"/> Slight problem		4
<input type="checkbox"/> Not beyond 90°		2
<input type="checkbox"/> Impossible		0

**Table 2: Lysholm Knee score**

**OBSERVATIONS:** Out of 106 patients, who were selected, 96 (91%) were males and 10(9%) were females. The commonest mode of injury was road traffic accident 43(41%); this may be due to increased incidence of two wheeler accidents. This was followed by non-sports twisting injury in second place 41(39%), we found out that majority 61% of the patients were in age group of 21 to 30 years. Of the 106 patients who were studied, out of which males were 96(91%) and females were 10(9%).

**RESULTS:** The mean pre-operative Lysholm score was 55.09. Post operatively, while on accelerated rehabilitation program the Lysholm scores were 69.73 at 3 weeks, 89.13 at 6 months and 89.19 at 9 months (Fig. 1). In our pre-operative evaluation mean KT1000 Arthrometer score was 10.53 and post-operative at six months was 3.49. At nine months 105 patients had excellent results whereas 1 patient had good result.

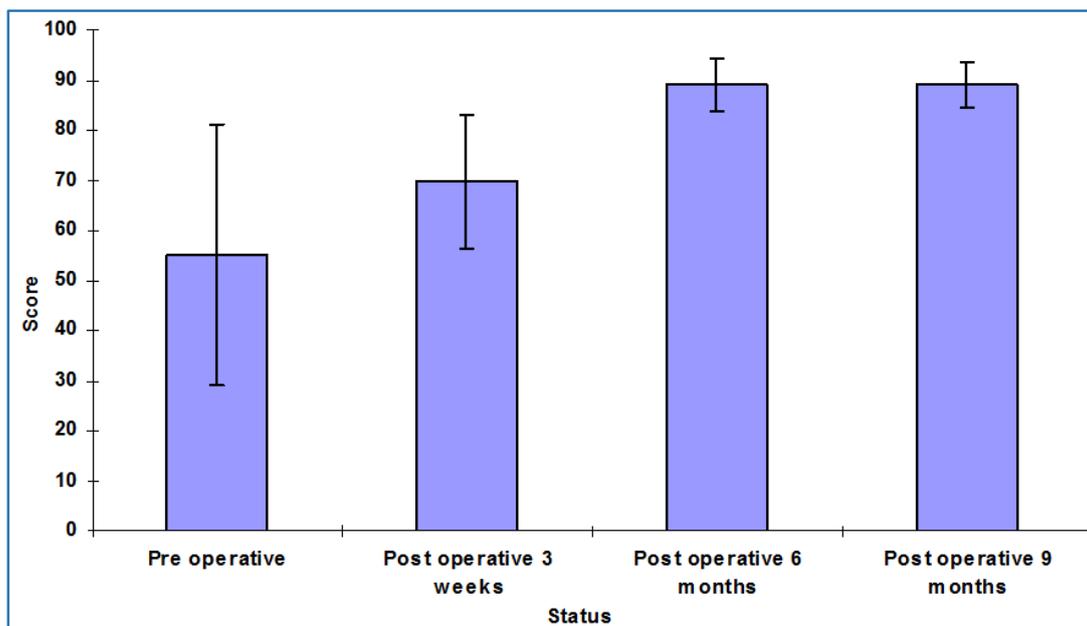


Fig. 1: Mean score graph

**DISCUSSION:** Aim of rehabilitation following anterior cruciate ligament reconstruction is to enable the patient to get back to pre-injury levels without having the risk of re injury

In the present study, we found out that majority (65 patients and 61%) of the patients were in age group of 21 to 30 years. This shows that anterior cruciate ligament injuries are common in the highly active age group, thus it becomes a priority to restore them to pre injury levels as early as possible.

All the patients were screened in the outpatient department clinically and using KT1000 knee arthrometer. A difference of 4 mm on KT1000 was considered significant when compared to the opposite knee. Our study indicated tear in all the 106 patients (100%). In a study conducted by Bach et al KT1000 is 95% sensitive in detecting anterior cruciate ligament injuries.<sup>6</sup>

KT1000 values of pre-operative and post-operative were compared in paired t test which showed t value (96.73 df=207) and p value ( $2.8 \times 10^{-17}$ ). This shows that there is significant improvement in the outcome of the patients post operatively in patients who have undergone anterior cruciate ligament reconstruction followed by an accelerated rehabilitation program. There is no statistical significant difference at end of 6 months and at 9 months in KT1000 arthrometer readings.

At 6 months the mean Lysholm score was 89.3, shows that the functional recovery of the operated and rehabilitated (accelerated) knee is excellent, which is comparable to the study of Shelbourne et al, who showed that a score which is 85% of the normal knee is sufficient to get the patient back into pre-operative activity level.<sup>7,8</sup>

Statistical analysis was done using the pared t test which showed the following. (Table 3).

Lysholm score	Mean ± SD	a AND b	b AND c	c AND d	a AND d
Pre-operative (a)	55.09±13.07				
3 Wks. Post-operative (b)	69.73±6.74				
6 Months Post-operative (c)	89.13±2.68				
9 Months Post-Operative (d)	89.19±2.26				
t	-	10.24	27.56	0.17	26.46
p-value	-	$3.53 \times 10^{-19}$	$9.7 \times 10^{-58}$	0.8681	$9.35 \times 10^{-50}$
Statistical significance	-	Very highly significant	Very highly significant	Not significant	Very highly significant

Table 3: Statistical comparison

There is no statistical significant difference at end of 6 months and at 9 months. This is comparable with the findings of Shelbourne, Nitz et al,<sup>9</sup> Marcacci et al,<sup>10</sup> and Freedman et al.<sup>11</sup> This indicates that only 6 months of accelerated rehabilitation protocol is sufficient.

In the present study 57(48%) of the patients had associated meniscal injuries. The outcome in rehabilitation in them was no different from the patients who did not have meniscal injuries at end of 6 months. This is comparable to

the study done by Barber et al,<sup>12</sup> and Bellabarba et al.<sup>13</sup> In their study Barber et al followed up their patients for two years and found out that re tear of meniscus was only 8 to 13% (development of pain and disability). None of our patients developed any re tear during the course of rehabilitation.

In our rehabilitation program, patients were started on partial weight bearing on post-operative day one, with weekly increments in weight bearing till patient started

unaided gait at end of 3 weeks post operatively. At the end of three weeks, patients were allowed only normal walking. None of the patients complained of any instability. This is comparable to the study conducted by Tyler et al.<sup>14</sup> The advantage of early and incremental weight bearing is that patient is able to get back to day to day activities in a shorter time frame and simultaneously the graft is not subjected to strain.

Patients on accelerated rehabilitation regain lower limb muscle strength earlier when compared to delayed rehabilitation. Early recovery of muscle strength gives additional stability and help in returning to sporting activities at a faster rate compared to delayed rehabilitation without causing stress on the graft.<sup>15</sup>

In the rehabilitation protocol we introduced proprioceptive exercises at eight weeks, which helps in improving the nervous system's ability to generate a fast and optimal muscle contraction, enhance coordination and balance and to relearn movement patterns and skills. The importance of neuromuscular training has been demonstrated in prospective controlled studies where the incidences of anterior cruciate ligament injuries were significantly lower in athletes who participated in proprioceptive training, as described by Fitzgerald et al,<sup>16</sup> and Zatterstrom R et al.<sup>17</sup>

6 patients developed anterior knee pain, 3 developed extensor lag and one patient developed complications of heterotrophic ossification at the femoral site. One patient who had associated posterior cruciate ligament tear persisted to have instability and as managed conservatively by putting him on quadriceps strengthening exercises.

Anterior knee pain is one of the common symptoms patient come with during rehabilitation. This is more due to post-operative extensor mechanism dysfunction than due to graft donor site morbidity. Thus it highlights the importance of regaining quadriceps strength at an earlier time.<sup>18</sup>

**CONCLUSION:** Accelerated rehabilitation protocol enables the patient to functionally recover faster to pre injury levels. A rehabilitation protocol for 6 months is sufficient in enabling a patient to get back to pre-injury levels. Functional outcome is the same with or without associated meniscal injuries.

#### REFERENCES:

1. Beynon BD, Uh BS, Johnson RJ, et al. Rehabilitation after anterior cruciate ligament reconstruction: a prospective, randomized, double-blind comparison of programs administered over 2 different time intervals. *Am J Sports Med* 2005;33(3):347-35.
2. Lysholm, Gillquist. Evaluation of knee ligament surgery, results with special emphasis on the use of scoring scale, *Am JSM* 1982;10(3)150-154.
3. Lysholm, Tegnee. Rating in the evaluation of knee ligament injuries. *Clini Ortho Res* 1985;198:43-9.
4. Forster IW, Warren-Smith CD, Tew M. Is the KT1000 knee ligament arthrometer reliable? *J Bone Joint Surg Br* 1989;71(5):843-7.
5. Wroble RR, Van Ginkel LA, Grood ES, et al. Repeatability of the KT-1000 arthrometer in a normal population. *Am J Sports Med* 1990;18(4):396-9.
6. Bach R, Russell F Warren, William M Flynn, et al. Arthrometric evaluation of knees that have a torn anterior cruciate ligament. *J Bone Joint Surg* 1990;72(9):1299-1306.
7. Shelbourne KD. Gray anterior cruciate ligament reconstruction with autogenous patellar tendon grafts followed by accelerated rehabilitation. *Am JSM* 1997;25(6)786-95.
8. Shelbourne KD, Thomas ER, Wilckens JH. Ligament stability two to six years after anterior cruciate ligament reconstruction with autogenous patellar tendon graft and participation in accelerated rehabilitation. *Am JSM* 1995;23(5):575-9.
9. Shelbourne KD, Nitz P. Accelerated rehabilitation after anterior cruciate ligament reconstruction. *J Orthop Sports Phys Ther* 1992;15(6):256-264.
10. Marcacci m et al. Early versus late reconstruction for Anterior cruciate ligament rupture:Results after five years of follow up. *Am j sports med* 1995;23(6):690-693.
11. Freedman KB, Glasgow MT, Glasgow SG, et al. Anterior cruciate ligament injury and reconstruction among university students. *Clinical Orthopaedics and Related Research* 1998;356:208-212.
12. Barber FA, Click SD. Meniscus repair rehabilitation with concurrent anterior cruciate reconstruction. *Arthroscopy* 1997;13(4):433-437.
13. Bellabarba C, Bush-Joseph CA, Bach BR. Patterns of meniscal injury in the anterior cruciate-deficient knee: a review of the literature. *Am J Orthop* 1997;26(1):18-23.
14. Tyler TF, McHugh MP, Gleim GW, et al. Association of KT-1000 measurements with clinical tests of knee stability 1 year following anterior cruciate ligament reconstruction. *J Orthop Sports Phys Ther* 1999;29(9):540-5.
15. Noyes FR, Mangine RE, Barber S. Early knee motion after open and arthroscopic anterior cruciate ligament reconstruction *Am JSM* 1987;15(2):149-60.
16. Fitzgerald GK. Open versus closed kinetic chain exercise: issues in rehabilitation after anterior cruciate ligament reconstructive surgery. *Phys Ther* 1997;77(12):1747-54.
17. Zätterström R, Friden T, Lindstrand A, et al. The effect of physiotherapy on standing balance in chronic anterior cruciate ligament insufficiency. *Am J Sports Med* 1994;22(4):531-536.
18. Shelbourne KD, Trumper RV. Preventing anterior knee pain after anterior cruciate ligament reconstruction. *Am J Sports Med* 1997;25(1):41-47.