Original Article

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Functional Outcome of Accelerated Rehabilitation in Arthroscopic Anterior Cruciate Ligament Reconstruction with Semitendinosis and Gracilis Graft

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Abstract

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

Aim of Study: (1) The aim of our study is to assess the outcome of accelerated rehabilitation post-ACL reconstruction, (2) a rehabilitation program for a duration of 6 months is sufficient when compared to 9 months, (3) role of KT 1000 arthrometer in the diagnosis of ACL tears.

Materials and Methods: A total of 106 patients were operated by a single surgeon underwent arthroscopic anterior cruciate ligament reconstruction using quadrupled semitendinosis and gracilis graft and partial meniscectomy for associated meniscal tear. Patients were put on an accelerated rehabilitation protocol designed in our institute on the 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 KT 1000 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. Postoperatively 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 6 months was 3.49. At 9 months, 105 patients had excellent results, whereas 1 patient had a 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. KT 1000 knee arthrometer plays a vital role in diagnosing ACL injuries and can be used to compare pre-operative and post-operative ligament status.

Key words: Accelerated rehabilitation protocol, Anterior cruciate ligament reconstruction, KT 1000 knee arthrometer, Lysholm knee score, Prospective study

INTRODUCTION

Anterior cruciate ligament (ACL) reconstruction restores knee function to pre-injury levels, without any pain. It also prevents degenerative changes in the knee. ACL, it also allows the patient to return to sporting activities.[1]

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The rationale for rehabilitation after an ACL injury is to gain a good functional stability, reach the best possible functional level and to decrease the risk for reinjury. The training programs are focused both on the injured leg, but also on the non-injured leg, hip, and trunk muscles that are needed 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

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an average of 86% of the total resisting force to anteriorly directed forces on the tibia.[1]

Rehabilitation protocols have changed considerably over time in the past. It has become "aggressive," meaning an intensive rehabilitation which includes a greater variety of exercises and sports related training. The aim of post-operative rehabilitation after ACL 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 reinjury.[1]

Aim of the Study

1. The aim of our study is to assess the outcome of accelerated rehabilitation post-ACL reconstruction
2. A rehabilitation program for a duration of 6 months is sufficient when compared to 9 months
3. Role of KT 1000 arthrometer in the diagnosis of ACL tears.

MATERIALS AND METHODS

106 arthroscopic ACL reconstructions using quadrupled semitendinosis and gracilis grafts were performed. Meniscal injuries if associated were treated by partial meniscectomy.

This prospective study was conducted over a period of 4-year (2011-2014) at Vydehi Institute of Medical Sciences and Research Center Bengaluru in the Department of Orthopaedics.

All patients were examined preoperatively in the outpatient by a senior orthopedic surgeon. Evaluation was done clinically and also using KT 1000 arthrometer. Magnetic resonance imaging was done for all patients before surgery.

Patients with unilateral ACL insufficiency, injury at least 1 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 the 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 1. The rehabilitation was supervised by trained rehabilitation therapist in coordination with the surgeon. Follow-up was done at 3 weeks, at 6 months, and at 9 months using the Lysholm knee score,[2,3] and KT 1000 arthrometer.[4,5]

Lysholm score has both subjective and objective evaluation. The score carries maximum points for instability and pain. The maximum points are 100. Patients are graded

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

Rehabilitation Modality	Week 1	Week 2	Week 3	Week 4-8	2-4 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						+	+	+

ROM: Range of motion

preoperatively and postoperatively as excellent, good, fair, and poor.

Scores:
81-100 - Excellent
71-80 - Good
61-70 - Fair
<60 poor (Table 2)

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 nonsports twisting injury in second place 41 (39%); we found out that majority 61% of the patients were in age group of 21-30 years. Of the 106 patients who were studied, out of which males were 96 (91%) and females were 10 (9%).

Table 2: Lysholm knee scores

Limp (5 points)	
None	5
Slight or periodic	3
Severe/constant	0
Support (5 points)	
None	5
Cane/crutch needed	3
Unable to bear weight	0
Locking (15 points)	
None	15
Catching	10
Occasional	6
Frequently	2
Currently locked	0
Instability (25 points)	
Never gives way	25
Rarely with sports	20
Often with sports	15
Sometimes with ADL's	10
Often during ADL's	5
Every step	0
Pain (25 points)	
None	25
Slight or periodic	20
Severe/constant	15
Marked walking >2 km	10
Marked walking <2 km	5
Constant	0
Swelling (10 points)	
None	10
After sports	3
After daily activities	2
Constant	0
Stairs (10 points)	
No problem	10
Slight problem	6
One step at a time	2
Impossible	0
Squatting (5 points)	
No problem	5
Slight problem	4
Not beyond 90°	2
Impossible	0

RESULTS

The mean pre-operative Lysholm score was 55.09. Postoperatively 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 (Figure 1). In our pre-operative evaluation mean KT 1000 arthrometer score was 10.53 and post-operative at 6 months was 3.49. At 9 months, 105 patients had excellent results, whereas 1 patient had a good result.

DISCUSSION

The aim of rehabilitation the following ACL reconstruction is to enable the patient to get back to pre-injury levels without having the risk of reinjury.

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

All the patients were screened in the outpatient department clinically and using KT 1000 knee arthrometer. A difference of 4 mm on KT 1000 was considered significant when compared to the opposite knee. Our study indicated a tear in all the 106 patients (100%). In a study conducted by Bach *et al.*, KT 1000 is 95% sensitive in detecting ACL injuries.[6]

KT 1000 values of pre-operative and post-operative were compared in paired *t*-test which showed *t* value (96.73 df = 207) and *P* value (2.8×10^{-17}). This shows that there is a significant improvement in the outcome of the patients postoperatively in patients who have

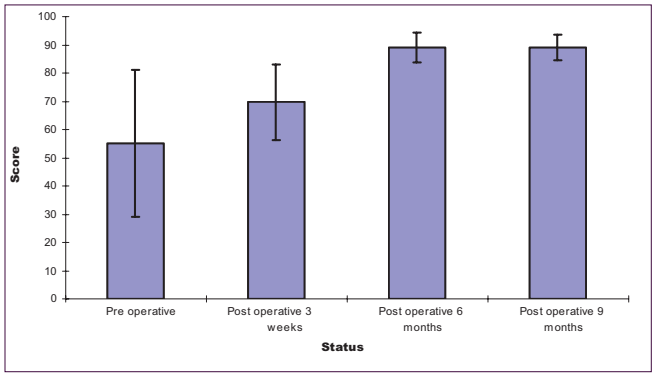

Figure 1: Mean lysholm scores

Table 3: Statistical Analysis

Lysholm score	Mean±SD	a and b	b and c	c and d	a and d
Pre-operative (a)	55.09±13.07				
3 Weeks 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-value	-	10.24	27.56	0.17	26.46
P-value	-	3.53×10^{-19}	9.7×10^{-58}	0.8681	9.35×10^{-50}
Statistical significance	-	Very highly significant	Very highly significant	Not significant	Very highly significant

SD: Standard deviation

undergone ACL reconstruction followed by an accelerated rehabilitation program. There is no statistically significant difference at the end of 6 months and at 9 months In KT 1000 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.[7,8]

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

There is no statistically significant difference at end of 6 months and at 9 months. This is comparable with the findings of Shelbourne and Nitz,[9] Marcacci *et al.*,[10] and Freedman *et al.*[11] This indicates that only 6 months of accelerated rehabilitation protocol is sufficient.

In this 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 and Click,[12] and Bellabarba *et al.*[13] In their study Barber *et al.*, followed up their patients for 2 years and found out that retear of meniscus was only 8-13% (development of pain and disability). None of our patients developed any retear during the course of rehabilitation.

In our rehabilitation program, patients were started on partial weight bearing on post-operative day 1 with weekly increments in weight bearing until patient started unaided gait at end of 3 weeks postoperatively. At end of 3 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.*[14] 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 in 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.[15]

In the rehabilitation protocol, we introduced proprioceptive exercises at 8 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 ACL injuries were significantly lower in athletes who participated in proprioceptive training, as described by Fitzgerald,[16] and Zätterström *et al.*[17]

CONCLUSION

Accelerated rehabilitation protocol enables the patient to functionally recover a 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. KT 1000 knee arthrometer plays a vital role in diagnosing ACL injuries and can be used to compare pre-operative and post-operative ligament status.

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