



Research article

Role of accelerated rehabilitation versus standard rehabilitation following anterior cruciate ligament reconstruction using hamstring graft



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ABSTRACT

Background: There is no consensus regarding the optimal postoperative rehabilitation program after anterior cruciate ligament (ACL) reconstruction.

Material and methods: Forty patients who had a primary anterior cruciate ligament reconstruction (ACL-R) with a semitendinosus-gracilis (STG) autograft from a single orthopaedic surgeon were prospectively randomized into 2 groups. Twenty patients were randomized to the accelerated rehabilitation group (100% male, mean age 26.45 ± 4.696 years) and 20 to the standard rehabilitation group (90% male, mean age 28.90 ± 6.307 years). Patients were followed and knee laxity and Tegner activity level values were obtained at 6 weeks, 3 months and 6 months postoperatively. IKDC score and KOOS score was collected at 3 and 6 months postoperatively and functional score by single leg hop test was measured at 6 months. **Results:** There were no differences between the groups for the baseline characteristics ($P > .05$). There was no difference found between the groups in respect to A-P knee laxity, activity level, Patient satisfaction (KOOS score) and functional performance ($P > .05$). There were significant differences in the IKDC scores between groups at 3 and 6 months and in the KOOS score at 3 months ($P < .05$).

Conclusions: The current study indicate that an accelerated postoperative protocol is equivalent in terms of laxity, patient satisfaction, functional performance and activity level and better in terms of clinical outcome to a standard rehabilitation protocol after an isolated ACL-R using STG autografts.

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1. Introduction

Anterior cruciate ligament (ACL) rupture is one of the most common traumatic injuries that can result in significant functional disability.¹ Although ACL reconstruction (ACL-R) is the most widely practiced surgical intervention, controversy still exists in regard to graft selection and rehabilitation protocol, both of which are largely influenced by surgeon preference.²

Postoperative rehabilitation is a major factor contributing to the success of ACL-R and is an integral element in producing a favorable outcome after surgery. The goal of rehabilitation after ACL-R surgery is to restore normal joint range of motion (ROM),

strength, co-ordination and full function as soon as possible, without damaging the graft. In early days rehabilitation program included immobilization of the leg for 6 weeks or longer after an ACL-R procedure while inflammation diminished and the graft healed.^{3,4} Postoperative immobilization of the knee results in limited ROM, stiffness, muscular atrophy and inferior knee function, and prolonged recovery from procedure.⁵ Advancements in surgical technique and fixation have warranted re-evaluation of the use of restrictions after ACL-R. Further studies has shown that restrictions may not be necessary, and early aggressive rehabilitation has shown no adverse effects with respect to future injury rate, A-P laxity, ROM deficits, or ability to return patients back to their previous level of function.^{6,7}

This has led to interest in early rehabilitation programme. Current rehabilitation programs are aimed toward accelerated interventions with the aim of restoring the range of motion (ROM) to what it was before injury, encouraging weight bearing

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within the first week, reducing pain and swelling, and initiating and developing muscle strength.^{8,9} Current evidence indicates that intensive rehabilitation can help prevent early arthrofibrosis and restore strength and function earlier. Although a significant body of literature has shown that aggressive rehabilitation is appropriate after ACL-R using BPTB grafts,^{7,10,11} but conclusions are unclear when evaluating the effects on STG autografts. So we elected to evaluate post-operative recovery in ACL-R patient population using STG graft after accelerated rehabilitation and compared them with the outcome after standard rehabilitation.

The appropriate consent has been taken from all the patients in this study stating their wilfull participation and no objection in using/publishing their clinical and scientific data for publication in scientific journal without revealing their identity.

2. Material and methods

2.1. Patient selection and entry criteria

Patients who have complete ACL tear and clinically symptomatic for instability, of age between 18 years to 50 years of either sex between January 2014 to June 2015 have included in the study conducted at Sir Ganga Ram Hospital in department of orthopaedics. we excluded the patients who have history of previous injury or operation to knee, Simultaneous fracture or a concurrent injury to posterior cruciate ligament, posterior lateral corner, or lateral collateral ligament, Grade III medial collateral ligament tear, Evidence of osteoarthritis radiographically, Comorbidities such as diabetes or rheumatoid arthritis and have significant portion of anterior cruciate ligament found intact at the time of surgery. This study was approved by ethical committee of our hospital and all subjects signed informed-consent forms before participation.

2.2. Technique

Detailed history of all patients was taken and all patients were assessed and their age, sex, time since injury, involved side, X ray and MRI findings were noted. All the surgery was performed by the same surgeon by using the same technique. Arthroscopic ACL-R was done using single bundle quadruple hamstring (semite-ndinosus and gracilis) graft. After routine arthroscopic examination of joint followed by partial meniscectomy if needed, hamstring tendon graft was harvested from the ipsilateral knee. Anatomical landmarks were used to create the bone tunnels, then the graft with endobutton was passed from tibial to femoral tunnel using suture rail-road technique. Femoral fixation was done using endobutton. Then cycling of graft was done by passive flexion and extension before final tibial fixation with biodegradable interference screw. Postoperative on table examination was done by Lachman and Pivot shift test and their grading were noted.

2.3. Rehabilitation programme and follow up

After ACL-R patients was randomized to two types of rehabilitation programme and two groups of 20 cases each was made. One group followed the accelerated rehabilitation protocol²⁰ (Group A) for 19 weeks and other followed the standard rehabilitation protocol²⁰ (Group B) for 24 weeks. Common to the both programs were the limits of ROM, amount of weight bearing, restriction of movement. Use of brace, exercises and functional activities however, each program incorporated these activities over different time intervals. The cases were followed up regularly and we assessed:- anterior laxity of knee using clinical grading by

Lachman test and Pivot shift test¹² preoperatively, postoperatively on table, at 6 weeks, at 3 months and at 6 months, Knee injury and osteoarthritis outcome (KOOS) score¹³ for patient satisfaction assessed preoperatively, at 3 months and at 6 months, International knee documentation committee (IKDC) score¹⁴ for clinical assessment of patient assessed preoperatively, at 3 months and at 6 months, Tegner activity level (TAL) scale¹⁵ for activity level of patient assessed preoperatively, at 6 weeks, at 3 months and at 6 months, and Functional scoring: using single leg hop test¹⁶ assessed preoperatively, and at 6th month for functional performance of patient. On basis of above data a comparison was made between the two groups for anterior laxity of knee, patient satisfaction, clinical outcome, activity level, and functional performance.

2.4. Statistical methods

Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Continuous variables were presented as mean \pm SD or median if the data is unevenly distributed. Categorical variables were expressed as frequencies and percentages. The comparison of normally distributed continuous variables between the groups was performed using Student's t test. Nominal categorical data between the groups was compared using Chi-squared test or Fisher's exact test as appropriate. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference. Sample size of 20 per group was calculated with reference to previous study, based on a mean difference of 4 weeks in duration of rehabilitation with a population variance of (4 wks.), a two-sided alpha of 0.05, and a power of 90%.

2.5. Observations and results

A total of 40 patients were enrolled in the study, 20 in accelerated rehabilitation group (A) with average age of 26.45 years, and 20 in the standard rehabilitation group (B) with average age of 28.90 years. Gender, age, side of the involved knee, intraoperative findings and concomitant injuries were equally distributed and similar between the patients in both groups. Similarly, the time interval between the injury and surgery was comparable between the accelerated (mean = 1.479 months) and standard (mean = 4.388 months) groups. The mean is higher in the group B, because of a single case which had the duration of time since injury 4 years. The median was 1.0 in both groups. There was no difference in the incidence of tears of the medial and lateral menisci between the treatment groups. These findings indicate that the randomization procedure established 2 groups of subjects with similar baseline characteristics.

Anterior laxity of knee was measured for all the participants using clinical grading by Lachman test and Pivot shift test preoperatively then after 6 weeks, then at 3 months and 6 months. Anterior laxity of knee was found negative (Grade 0) in all the participants in both groups at 6 weeks, at 3 months and at 6 months. There was no significant difference between both groups and both groups were comparable in anterior laxity of knee.

The clinical assesment of patients was done by IKDC score. Mean preoperative IKDC was 33.65 (SD \pm 3.37) in group A and 35.32 (SD \pm 3.95) in group B and was compairable. The IKDC at 3 months was 65.37 (SD \pm 3.14) in group A and 62.11 (SD \pm 3.01) in group B and at 6 months was 80.51 (SD \pm 3.25) in group A and 78.15 (SD \pm 3.22) in group B. The difference between the two groups was significant on statistical analysis at 3 months ($p=0.002$) and at 6 months ($p=0.026$) (Table 1).

Table 1

Comparison of IKDC between group A and group B.

IKDC	GROUP A (n = 20) Mean ± SD	GROUP B (n = 20) Mean ± SD	P value
Pre-operative	33.65 ± 3.37	35.32 ± 3.95	0.158
3 Months	65.37 ± 3.14	62.11 ± 3.01	0.002
6 Months	80.51 ± 3.25	78.15 ± 3.22	0.026

Patient satisfaction was measured by KOOS score. The mean preoperative KOOS score was 49.54 (SD ± 2.71) in group A and 50.26 (SD ± 3.52) in group B and was comparable. The KOOS at 6 months was 82.39 (SD ± 3.14) in group A and 81.05 (SD ± 3.52) in group B. The difference between the two groups was non-significant ($p=0.211$). It was significant at 3 months ($p=0.007$) with KOOS score 75.24 (SD ± 3.06) in group A and 72.41 (SD ± 3.19) in group B (Table 2).

The mean preoperative Tegner activity level was 1.05 in group A and 1.35 in group B and was comparable. The mean TAL at 6 wks, 3 months and 6 months was 1.10, 4.15 and 5.95 in group A and 1.15, 3.85 and 5.55 in group B. The difference between the two groups was non-significant on statistical analysis at 6 wks, 3 months and at 6 months. (p value > .05) (Table 3). There was significant improvement in Tegner activity level within each group at 3 months and 6 months ($p < 0.001$).

Functional performance of patient was measured by single leg hop test. The mean preoperative Limb symmetry index was 6.7 in group A and 10.9 in group B and was comparable. The LSI at 6 months was 81.8 in group a and 80.5 in group b. The difference between the two groups was non-significant on statistical analysis ($p=0.254$)

3. Discussion

Rehabilitation after ACL-R plays a major role in the functional outcome of the extremity. Protocols for rehabilitation programs focus on range of motion, weight bearing, strength recovery, and functional return to activities. The protocols that have been published vary as far as prescribed length of rehabilitation and expected rate of recovery. In 1981, the postoperative regimen was based on the principles of ACL reconstruction rehabilitation

described by Paulos et al.³ Paulos released the patients after 9–12 months following surgery, to full unrestricted activity once they achieved full ROM and successfully completed the functional progression.

In 1988, the program of rigid immobilization was discarded in favor of study done by Tylar et al¹⁷ which concluded that immediate weight bearing did not compromise knee joint stability and resulted in diminished knee pain. Then Ekstrand¹⁸ evaluate the duration of entire programme, an extended 8-month rehabilitation program was compared to a 6-month rehabilitation program following ACL-R. No significant differences were found between the groups at 12 months after surgery based on the author's criteria (full ROM and 90% quadriceps muscle strength).

Shelbourne and nitz¹⁹ in 1992 developed an accelerated strengthening programme that emphasizes full knee extension on the first postoperative day and immediate weight-bearing according to the patient's tolerance. They concluded that the accelerated rehabilitation program has been more effective in reducing limitations of motion (particularly knee extension) and loss of strength while maintaining stability and preventing anterior knee pain. These concepts have been applied, principally, to the BTB operation, and rehabilitation using the multi-strand technique has been less aggressive. Within the last several years, there has been a trend toward earlier range of motion and muscle strengthening exercises.

The studies have some evidence that accelerated rehabilitation may have better outcome. So we evaluate post-operative recovery in our patient population after accelerated rehabilitation and compared them with the outcome after standard rehabilitation.

Our study demonstrated that rehabilitation with either accelerated or standard programs after ACL reconstruction with

Table 2

Comparison of KOOS between group A and group B.

KOOS	GROUP A (n = 20) Mean ± SD	GROUP B (n = 20) Mean ± SD	P value
Pre-operative	49.54 ± 2.71	50.26 ± 3.52	0.472
3 Months	75.24 ± 3.06	72.41 ± 3.19	0.007
6 months	82.39 ± 3.14	81.05 ± 3.52	0.211

Table 3

Comparison of Tegner activity level between group A and group B.

Tegner activity level	GROUP A (n = 20) Mean ± SD	GROUP B (n = 20) Mean ± SD	P value
Pre-operative	1.05 ± 0.759	1.35 ± 0.813	0.235
6 Weeks	1.10 ± 0.308	1.15 ± 0.366	0.643
3 Months	4.15 ± 0.366	3.85 ± 0.587	0.06
6 months	5.95 ± 0.999	5.55 ± 0.759	0.162

a hamstring autograft produces the same effect on the primary outcome (the knee laxity) and a majority of the secondary outcomes patient satisfaction, functional performance and Tegner activity level. But clinical outcome measured by IKDC score shows significant improvement at 3 months (p value=0.002) and 6 months (p value=0.026) in accelerated rehabilitation group compared to standard group. KOOS score also shows significant improvement at 3 months (p value=0.007) follow up but at 6 months follow up there is no difference in patient satisfaction (KOOS score) between two groups. There is significant improvement in IKDC and KOOS within the same group at 3 months and 6 months follow up.

There is no difference found in anterior laxity of knee at the 6 weeks, 3 months and 6 months postoperatively in both rehabilitation programme as measured by clinical grading and both groups are comparable preoperatively in laxity of knee with P value of 0.127 for Lachman test and 0.058 for the Pivot shift test. Similarly there is no significant difference found in Tegner activity level and single leg hop test between two rehabilitation programme at 6 weeks, 3 months and at 6 months follow ups. However there is significant improvement in the Tegner activity level and functional outcome within the same group at 6 months follow up with P value < .001.

Our results of the study coincide with the previous study done by Beynon et al.²⁰ in 2005 in which anterior cruciate ligament reconstruction with a BPTB graft followed by either accelerated or non-accelerated rehabilitation produces the same increase of anterior knee laxity. Both programs had the same effect in terms of clinical assessment, patient satisfaction, functional performance, and the biomarkers of articular cartilage metabolism. Previous studies have compared the effects of early aggressive rehabilitation protocols on outcomes after ACL-R using BPTB grafts, although the results of this study are congruent with the literature, we feel there is a lack of evidence addressing the effect of early aggressive rehabilitation on STG autografts.

Macdonald et al.²¹ also shows early accelerated rehabilitation after anterior cruciate ligament reconstruction with semitendinosus and gracilis tendon autograft and a ligament augmentation device does not seem to affect the results adversely. Cristenson et al.²² also found no differences between early aggressive and non aggressive rehabilitation after isolated ACL-R using STG autografts for the primary outcomes of A-P knee laxity and subjective IKDC score. In addition, no differences were observed for secondary outcomes between groups for differences in ROM and peak isometric force.

As surgical advancements with STG grafts improve, the rehabilitation model should adapt to the changes, and concepts of early aggressive rehabilitation. Early aggressive rehabilitation has been established for years, but there are discrepancies in the literature relative to overemphasis on BPTB grafts and lack of postoperative management on STG grafts. Our findings are clinically relevant since STG autografts have gained popularity in comparison with other graft choices, and limited research has been conducted evaluating the effects of early aggressive rehabilitation on functional outcomes. This evidence is important for guiding clinicians in making appropriate decisions on postoperative rehabilitation and restrictions after surgery.

4. Conclusion

We found that there is no difference in anterior laxity of knee, patient satisfaction, activity level and functional performance in accelerated and standard rehabilitation group. Clinical outcome measured by IKDC score was found better in accelerated group and statistically significant. Patient satisfaction measured by KOOS score was also better at 3 months follow up in accelerated group.

The current study indicate that an accelerated postoperative protocol is equivalent in terms of laxity, patient satisfaction, functional performance and activity level and better in terms of clinical outcome to a standard rehabilitation protocol after an isolated ACL-R using STG graft.

Conflict of interest

None.

Author contribution

All the author contributed equally for the completion of the scientific work, data analysis and preparation of manuscript.

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