

Original Research Article

Comparison of outcome following knee immobilization versus no immobilization in the immediate post operative period following arthroscopic anterior cruciate ligament reconstruction

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ABSTRACT

Background: Post operative bracing following ACL reconstruction has been traditionally used in post operative period to reduce pain limit knee range of motion to protect against valgus and varus stress. There is a lack of consensus in published literature regarding knee immobilization. The aim of this study is to compare the functional outcome and pain control in patients using knee immobilizer with those not using them in immediate post operative period.

Methods: A total of 60 patients admitted with ACL tear who were admitted from January 2020 to August 2021 were enrolled in this study and randomised into two groups, given knee immobilizer or no immobilizer following arthroscopic ACL reconstruction. Patients were assessed for pain, knee range of motion and functional outcome with 6-month follow-up.

Results: VAS score for pain was significantly lower for knee brace users ($p=0.24$) on post-op day2 but there was no significant difference on subsequent measurements. Also, the IKDC Score, arc of motion of knee joint and complication rate did not show significant difference between the two groups.

Conclusions: Based on this study, the use of a knee brace for improving short term outcome following ACL reconstruction is not justified and adds to the cost of treatment. A short cylindrical back slab for 2-3days can serve the same purpose of controlling pain and soft tissue protection.

Keywords: Anterior cruciate ligament, Knee brace, Arthroscopy, Rehabilitation

INTRODUCTION

The anterior cruciate ligament controls the motion of tibia by preventing anterior translation. It gives passive stability to the joint by guiding the knee through internal and external rotation as well as adduction and abduction movements.¹ Anterior cruciate ligament is the weaker of the two cruciate ligaments and hence torn easier than posterior cruciate ligament. Anterior cruciate ligament has poor capacity of intrinsic repair. Reconstruction, therefore, is needed to restore the knee stability.

Arthroscopic ACL reconstruction using various grafts has become the treatment of choice in ACL tear.² There is a lack of consensus in published literature regarding post-operative knee immobilization. Various reasons cited for its use include graft site protection, to limit the knee range of motion to protect against valgus and varus stress and to reduce post-operative pain.^{3,4} Reasons put forward for not using it including development of knee stiffness, decreased range of motion and increased cost of treatment. Data reported so far is inconclusive regarding the need for knee bracing after ACL reconstruction.^{5,6}

Purpose of this study is to compare the functional outcome and pain control in patients using knee immobilizer with those not using it in the immediate post-operative period.

METHODS

The study was conducted in Calcutta National Medical college and hospital, West Bengal, India with prior approval from ethical committee and written consent from every patient. This was a hospital based, prospective, comparative study. The study population

consisted of a total of 60 patients of both sexes aged 18-45 years with symptomatic ACL deficiency from clinical evaluation (positive Lachman test and/or pivot shift test) and MRI findings suggestive of ACL tear. Those requiring concomitant meniscal resection were included. Patients who had associated lower extremity fracture, ipsilateral collateral ligament injury in the past 3 months, history of previous knee surgery on either side (excluding diagnostic arthroscopy), radiological evidence of skeletal immaturity or osteoarthritis and those who needed concomitant PCL or collateral ligament repair were excluded.

Table 1: Institutional rehabilitation protocol after arthroscopic ACL reconstruction.

Time span	Week 0-2	Week 2-4	Week 4-6	Week 6-12	Week 12-20
Protocol	Partial weight bearing with crutches, Passive and active assisted knee flexion upto 90°, Full knee extension, sitting knee flexed, Isometric quadriceps and hamstring exercises	Full weight bearing, discontinue crutches when walking without a limp, Knee range of motion exercise from full extension to 120 degrees of flexion, Static and dynamic quadriceps and hamstring exercises	Progress to full range of motion, Start closed chain exercises like cycling, encouraged to engage in swimming	Knee squats, Plyometric jumps, Single leg balance, Continue previous exercises	Begin brisk walking, Gradual sports related training after 24 weeks

*Knee brace users encouraged to wear the knee brace at all times including during weight bearing and sleeping and to only take it off during exercises. Knee brace was used till 4weeks post operatively

All patients were examined clinically by Lachman test and pivot shift test before radiological investigations. Digital Xray of the knee was obtained to rule out coexistent fractures and to look for skeletal immaturity and degenerative changes. MRI was done to assess ACL injury as well as status of other ligaments. 60 patients visiting the institution from January 2020 to August 2021 satisfying the inclusion and exclusion criteria were included in this study and were randomized on admission for bracing vs no bracing (30 in each group) following ACL reconstruction. Patients underwent routine preanesthetic check-up before they were planned for surgery and operated under spinal or epidural anaesthesia. Following diagnostic arthroscopy, all patients underwent arthroscopic ACL reconstruction performed by a single experienced surgeon. Semitendinosus graft was used in all patients and graft was fixed in femoral tunnel using endobutton and in tibial tunnel using bio-absorbable screw using standard techniques (Figure 1). In the knee immobilization group, long knee brace was used and patients were encouraged to wear the knee brace at all times including during weight bearing and sleeping and to only take it off during exercises (Figure 2). Knee brace was used till 4 weeks post operatively. Same institutional rehabilitation protocol was offered to both the study groups (Table 1). Patients were assessed for pain at post-operative day 2, day 5, day 7 and day 14 using visual analogue scale. full weight bearing was allowed on day 14 after stitch removal. they were assessed at 8 weeks and then at 6 months for knee range of motion and functional knee instability using international knee

documentation committee (IKDC) subjective knee evaluation form.

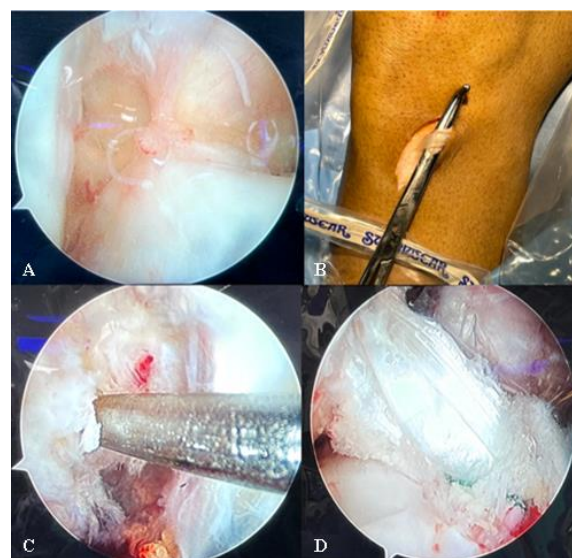


Figure 1: Operative steps of arthroscopic ACL reconstruction; A) Diagnostic arthroscopy and debridement B) Semitendinosus graft harvest C) Femoral tunnel preparation D) Graft passage through femoral tunnel.

Statistical analysis

Statistical analysis was done using IBM SPSS Statistics Software version 28.0.0.0 (198). Pearson's Chi Square

Test for independence of attributes was used for comparison across groups of categorical variables. Continuous variables were expressed as mean and compared across categorical variables using independent t-test. The continuous variables measured at repeated intervals were compared across two study groups using Mixed Between-Within or Split-Plot ANOVA. Confidence interval of 95% was chosen with $p < 0.05$ taken to be statistically significant.



Figure 2: Post-operative rehabilitation exercises; A) Static quadriceps and hamstring exercises B) Range of motion exercises C) Partial weight bearing wearing knee brace.

RESULTS

A total of 60 eligible patients of ACL tear were randomized into two groups (30 each) with only one group receiving long knee brace post-operatively. Mean age of the patients was 27.27 (SD±4.66) with 31 being male (51.67%). There was no predilection for right or left limb involvement ($p=0.438$). Knee instability (75%) and difficulty in running (13.33%) were the most common presenting symptoms followed by difficulty in walking downstairs (10%) and knee pain and swelling (1.67%). Sports injury was the most common mode of injury accounting for 60% of the cases followed by RTA in 23.33%. 31.7% of the study population had Grade 2 ACL tear and 68.3% had Grade 3 ACL tear. There was no statistically significant difference in demographics between the two groups (Table 2). Mean arc of motion in patients given knee brace was 126.17° at 8 weeks and 136.36° at 6 months post-op while patients with no immobilizer use had mean arc of motion of 127.50° at 8 weeks and 137.67° at 6 months. The difference between the 2 groups was not statistically significant. Only 3 patients (5%) had positive Lachman test post operatively, 1 patient being from knee brace user group and 2 from patients not given knee immobilizer ($p=0.554$).

Functional status was assessed using IKDC score preoperatively, at post-operative 8 weeks and at 6 months. Mean IKDC Score improved from a pre-operative mean of 42.92 to 76.03 at post-operative 8 weeks and 86.98 at post-operative 6 months but the difference between the

two groups was not statistically significant (Table 2). Pain was compared by VAS score (using independent sample t test) on day 2, day 5, day 7 and day 14 post-operatively.

Table 2: Comparison of demographics and study parameters between two groups.

Parameters	Knee brace used N (%)	Knee brace not used N (%)	P value
Age in years (Mean±SD)	26.57±4.80	27.97±4.49	0.248
Sex			
Male	13 (43.33)	18 (60.00)	0.196
Female	17 (56.67)	12 (40.00)	
Side Affected			
Right	13 (43.33)	16 (53.33)	0.438
Left	17 (56.67)	14 (46.67)	
Grade of Injury			
Grade 2	10 (33.33)	9 (30.00)	0.781
Grade 3	20 (66.67)	21 (70.00)	
Arc of motion in degrees (Mean±SD)			
Post-op 8 weeks	126.17±6.65	127.50±4.87	0.379
Post-op 6 months	136.67±4.79	137.67±4.69	0.417
Post-op Lachman Test			
Positive	1 (3.33)	2 (6.67)	0.554
Negative	29 (96.67)	28 (93.33)	
IKDC Score (Mean±SD)			
Pre-op	43.07±1.68	42.77±1.92	0.523
Post-op 8 weeks	75.77±3.10	76.30±2.61	0.475
Post-op 6 months	86.43±4.26	87.53±4.42	0.330
VAS Score (Mean±SD)			0.312
Post-op Day2	6.03±0.81	6.47±0.63	0.024
Post-op Day5	4.67±0.92	4.87±1.14	0.457
Post-op Day7	3.07±0.87	2.90±0.71	0.420
Post-op Day14	0.67±0.71	0.83±0.59	0.328
Complications	4 (13.33)	4 (13.33)	1.00

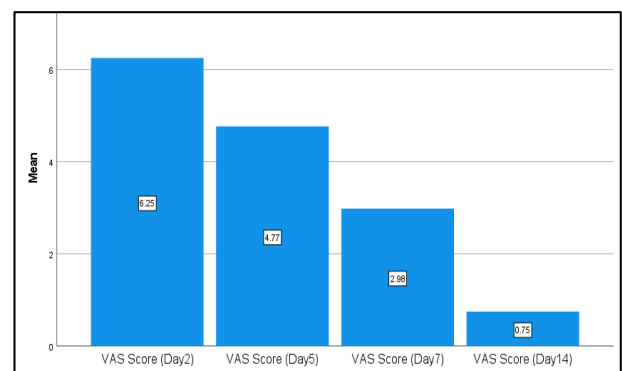
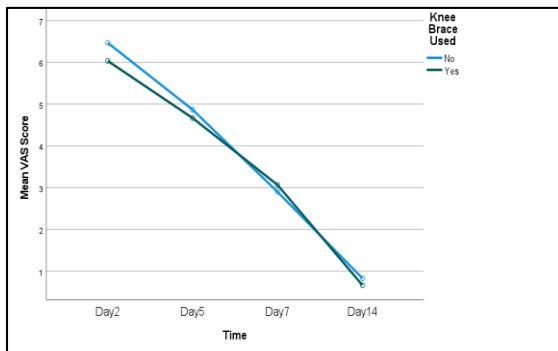


Figure 3: Bar chart showing post-operative VAS Score of study population.

Table 3: Post-operative VAS Score of two study groups.

Parameters		VAS Score (Day2)	VAS Score (Day5)	VAS Score (Day7)	VAS Score (Day14)
Knee Brace Used	Yes	Mean	6.03	4.67	3.07
		SD	0.81	0.92	0.87
	No	Mean	6.47	4.87	2.90
		SD	0.63	1.14	0.71
	P value	0.024	0.457	0.420	0.328

**Figure 4: Line diagram showing improvement of VAS Score over time in two study groups.**

VAS score after the arthroscopic surgery improved from a mean score of 6.25 (SD±0.75) on day 2 to a mean score of 0.75 (SD±0.65) on Day 14 (Figure 3). The mean VAS Score on day 2, day 5, day7 and day 14 in knee brace users were 6.03, 4.67, 3.07 and 0.67 respectively as compared to brace non users where the scores were 6.47, 4.87, 2.90 and 0.83 respectively (Table 3). VAS Score was found to be significantly lower among knee brace users only on post-operative Day 2 ($p=0.024$). There was no significant difference in VAS Score on subsequent measurements (Figure 4). 86.7% patients did not have any post-operative complications. Post-operative laxity was present in 5% and extensor lag in 3.33% patients (Table 4). There was no difference in complication rate between the two groups.

Table 4: Post-operative complications in study population.

Parameters		N	%
Post-op complications	Laxity	3	5.00
	Extensor lag	2	3.33
	Superficial wound infection	1	1.67
	Arthrofibrosis	1	1.67
	Donor site infection	1	1.67
	None	52	86.67

DISCUSSION

ACL remains the most commonly injured ligament in the knee joint, which commonly occurs in non-contact

injuries like pivoting and side cutting with foot fixed on the ground. Due to poor healing capacity, ACL reconstruction using various grafts is the gold standard treatment.² Bone-patellar tendon-bone graft and semitendinosus-gracilis tendon grafts are most commonly used and various studies have shown equal functional outcome.⁷ In this study we have used semitendinosus graft. Knee braces have traditionally been used in the post-operative period following ACL reconstruction but considerable debate exists in literature regarding its efficacy and rationale of use.^{5,6} Graft site protection, limiting varus-valgus stress and reducing post-operative pain are commonly cited reasons for using it while concern for lost of motion is the most common reason for not using it.^{3,4} Our study consisted of 60 patients (Mean age 27.27; SD±4.6), randomized into two groups where half of the patients were given a unhinged long extension knee brace immediately post operatively while the other half were not given any bracing. Naik et al, Wright et al in their studies did not find significant difference in range of motion in braced and unbraced patients following ACL reconstruction.^{8,9} We did not find any significant difference in range of motion between the two groups at 8 weeks and 6months post-operatively, which is in line with findings of previous studies.^{8,9} However Melegati et al reports that patients given braces locked in full extension had better extension and Mikkelsen et al in their study concluded that hyperextension brace was an easy of ensuring full knee extension.^{10,11} Two of our patients had extensor lag at 6months post operatively, both of them were in unbraced group. Although biomechanical studies under controlled laboratory environment demonstrated ability of knee brace to restore normal knee kinematics in ACL reconstructed knees, multiple studies have failed to demonstrate any significant long term improvement in knee laxity, functional scores and patient related outcomes.^{3,8,11-14} Our results support these findings and we did not find a significant difference in post-operative Lachman test ($p=0.554$), IKDC Score at 8 weeks ($p=0.475$) and 6 months post operatively ($p=0.330$) between braced and unbraced groups. Brandsson et al reported a significant reduction in pain in knee brace users in the first two weeks following ACL reconstruction.³ Other studies have failed to observe a significant pain reduction i.e., difference in VAS Score both immediately post-operatively and up to 1 year in braced patients compared to unbraced ones.^{8,9,11,15} In this study, we compared VAS score between the two groups on post-operative day 2, day 5, day 7 and day 14. VAS Score was found to be

significantly lower among knee brace users only on operative Day 2 ($p=0.024$). There was no significant difference in VAS Score on subsequent measurements. These findings corroborate with published literature. One patient developed arthrofibrosis and required subsequent arthroscopic debridement. 3 patients had Grade 2 laxity by Lachman test but did not have functional limitations. Extensor lag was present in 2 patients. One patient developed superficial wound infection and one patient had graft site infection which healed with debridement and antibiotics. There was no difference in complication rate between braced and unbraced patients.

Limitations

The study however had a few limitations. It had a small sample size of 60 patients and only a short term follow up up to 6 months. Hence long-term effects of knee brace on graft protection and return to sports was not studied. Also, other studies reporting better functional outcome with knee brace have used range of motion knee braces. Our patients could not afford hinged range of motion knee braces hence long extension knee brace was used for this study which may affect the results.

CONCLUSION

The findings of this study indicate that there is no significant difference in knee laxity, range of motion and IKDC score between patients given knee immobilizer vs no immobilizer in the immediate post-operative period following ACL reconstruction. Furthermore, patients using a knee immobilizer had a significantly lower VAS score only on second post operative day. There was no difference between the two groups at any subsequent pain recording on VAS scale upto 14th post operative day. Based on our data, the use of a knee brace for improving short term outcome following ACL reconstruction is not justified. Use of a knee brace adds to the cost of treatment which is particularly significant for patients of lower socioeconomic status commonly visiting our institute. A short cylindrical back slab can serve the same purpose of controlling pain and soft tissue protection. We recommend the use of a slab instead of long extension knee brace for two to three days until first dressing. Further studies are required to assess whether hinged range of motion knee brace has any advantage over long extension knee brace and whether it has any role of long-term use for graft protection and return to sports.

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