Do Knee Bracing and Delayed Weight Bearing Affect Mid-Term Functional Outcome after Anterior Cruciate Ligament Reconstruction?

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Abstract

Purpose The aim of this study was to assess the effect of knee bracing and timing of full weight bearing after anterior cruciate ligament reconstruction (ACLR) on functional outcomes at mid-term follow-up.

Methods We performed a retrospective study on 41 patients with ACLR. Patients were divided in two groups: ACLR group, who received isolated ACL reconstruction and ACLR-OI group who received ACL reconstruction and adjunctive surgery. Information about age at surgery, bracing, full or progressive weight bearing permission after surgery were collected for the two groups. Subjective IKDC score was obtained at follow-up. Statistical analysis was performed to compare the two groups for IKDC score. Subgroup analysis was performed to assess the effect of postoperative regimen (knee bracing and weight bearing) on functional outcomes.

Results The mean age of patients was 30.8 ± 10.6 years. Mean IKDC score was 87.4 ± 13.9. The mean follow-up was 3.5 ± 1.8 years. Twenty-two (53.7%) patients underwent ACLR only, while 19 (46.3%) also received other interventions, such as meniscal repair and/or collateral ligament suture. Analysis of overall data showed no differences between the groups for IKDC score. Patients in the ACLR group exhibited a significantly better IKDC score when no brace and full weight bearing after 4 weeks from surgery was prescribed in comparison with patients who worn a brace and had delayed full weight bearing. No differences were found with respect to the use of brace and postoperative weight bearing regimen in the ACLR-OI group.

Conclusion Brace and delayed weight bearing after ACLR have a negative influence on long-term functional outcomes. Further research is required to explore possible differences in the patients operated on ACLR and other intervention with respect to the use of a brace and the timing of full weight bearing to identify optimal recovery strategies.

Level of Evidence Level III, retrospective observational study.

Keywords
- rehabilitation
- anterior cruciate ligament
- brace
- weight-bearing
- functional outcome

Introduction

Anterior cruciate ligament (ACL) rupture is a common injury, mainly affecting young, physically active individuals.[1] It is often caused by a noncontact mechanism, as sudden deceleration combined with changing in direction, pivoting, or landing with the knee in nearly full extension after a jump.[2] ACL lesion is usually combined with other injuries, typically to collateral ligaments, subchondral bone, and menisci.[3] ACL reconstruction (ACLR) is the predominant treatment in

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current practice, and the relative merits of hamstring and patellar tendon (PT) grafts have been well established.[4] Rehabilitation interventions after surgery must be both safe and effective, with the ultimate goal of returning the patients to their activities often at a high functional level.

Successful outcomes have been consistently achieved with the rehabilitation principles of early weight bearing, using a combination of weight bearing and non–weight-bearing exercise focused on quadriceps and lower extremity strength recover and meeting specific objective requirements for return to activity.[5] However, high variability in the composition and time ranges of rehabilitation components has been described. Consensus over the most effective rehabilitation protocol is lacking,[6] especially on ACL injuries combined with collateral ligament and meniscal injuries in adults.[7] This may lead to confusion among patients and therapists regarding the best protocol to adopt.[8] In particular, knee bracing and timing for weight bearing have been widely investigated.[1,9–15] Previous systematic reviews found that accelerated rehabilitation, early weight bearing, and early range of motion (ROM) gaining are possibly safe and beneficial to patient outcomes.[9,11] Recent literature showed no benefits of knee bracing after ACLR with respect to pain, stability, ROM, and protection from additional injuries.[12–15]

The aim of the present study was to assess the effects of knee bracing and timing of full weight bearing after ACLR on the functional outcomes at mid-term follow-up.

Methods

This study was designed as a retrospective observational study. The study was approved by the local ethical committee.

Patients aged between 15 and 70 years and residents of Italy, who underwent ACLR with semitendinosus and gracilis tendon grafts from 2008 to 2013 and who, 4 weeks after surgery, received a rehabilitation program for 2 weeks at our Institution were considered eligible for the study.

The rehabilitation program during the 2 weeks was based on a combination of ROM exercises, muscle strengthening, gait training, physical therapy modalities, muscles stretching, and balance and proprioception exercises.

At the beginning of the rehabilitation program, different prescriptions were provided by orthopaedic surgeons in terms of use of brace to immobilize the knee in extension and timing of weight bearing.

One hundred eight patients were contacted by means of a letter. Forty-one patients accepted to participate in the study. Their clinical records were retrieved and information about age at surgery, bracing, and timing to partial and/or full weight bearing after surgery were collected. Subjective IKDC score was obtained by directly interviewing the patient at follow-up.

The patients were divided into two groups: ACLR and ACLR-other intervention (ACLR-OI) groups. Differences between the groups for age at surgery, duration of follow-up, and IKDC score were analyzed using ANOVA for normally distributed data, otherwise with the Mann–Whitney U-test.

The subgroup analysis was performed to assess the differences in IKDC score according to knee bracing (yes/no) and weight-bearing regimen (full/progressive) in the two groups with the Mann–Whitney U-test using Monte Carlo method for small samples. An analysis of the effect of postoperative regimen (bracing and weight bearing) on IKDC score at follow-up regardless of surgical treatment was performed with the Kruskal–Wallis test and the Mann–Whitney U-test for post-hoc analysis using the Monte Carlo method for small samples and the Sidak correction for multiple comparisons. The significance was considered for $p < 0.05$.

Results

The mean age of the study population (41 patients) was 30.8 ± 10.6 years. The mean IKDC score was 87.4 ± 13.9. The mean follow-up period from surgery was 3.5 ± 1.8 years. Twenty-two patients (53.7%) underwent ACL reconstruction only (ACL group), while 19 (46.3%) also received other interventions, such as total or partial meniscectomy, collateral ligament suture, and microfractures (ACL-OI group). Analysis of data showed no differences between the two groups in terms of age at the time of surgery, duration of follow-up, and IKDC score (►**Table 1**).

Twenty patients (48.8%) used knee bracing for 4 weeks, while 21 (51.2%) did not. All the patients had the prescription of partial weight bearing for 4 weeks postoperatively. Thirty-two patients (78%) were allowed to regain full weight bearing (FWB) within 2 weeks of rehabilitation, while nine patients (22%) were prescribed to continue progressive weight bearing (PWB) up to the orthopaedic visit after the rehabilitation period. In the ACLR group, 9 patients (40.9%) received a brace and 13 (59.1%) did not; 16 patients (72.7%) had FWB and 6 (27.3%) had PWB. In the ACL-OI group, 12 patients (63.2%) received a brace and 7 (36.8%) did not; 16 patients (84.2%) had FWB and 3 (15.8%) had PWB.

Subgroup analysis according to postoperative regimen demonstrated significant differences only for the ACLR group in favor of no bracing and FWB ($p = 0.001$ and $p = 0.018$, respectively), while no differences were found in ACLR-OI group. The overall results demonstrated that patients without brace and FWB had better IKDC score than subjects with brace and PWB, with a statistically significant difference ($p = 0.017$ and $p = 0.036$, respectively; ►**Table 2**).

Table 1 Comparison between groups

Variables	Group (*N*)		*p*-Value
	ACLR (22)	ACLR-OI (19)	
Age (mean ± SD)	31.4 ± 10.8	30.2 ± 10.5	ns
Follow-up, y (mean ± SD)	3.4 ± 1.6	3.6 ± 2	ns
IKDC score (mean ± SD)	89	85.6	ns

Abbreviations: ACLR, anterior cruciate ligament reconstruction; ACLR-OI, anterior cruciate ligament reconstruction + other interventions; IKDC, International Knee Documentation Committee; SD, standard deviation; ns, nonsignificant.

Table 2 Subgroup analysis for IKDC score at follow-up according to postoperative regimen

Groups (*N*)	Variables	Brace		*p*-Value	WB		*p*-Value
		No	Yes		Progressive	Full	
ACLR (22)	*N* (%)	13 (59.1%)	9 (40.9%)		6 (27.3%)	16 (72.7%)	
	IKDC score (mean ± SD)	95.1 ± 8	80.2 ± 15.6	0.001	78.0 ± 15.8	93.1 ± 10.5	0.018
ACLR-OI (19)	*N* (%)	7 (36.8%)	12 (63.2%)		3 (15.8%)	16 (84.2%)	
	IKDC score (mean ± SD)	83.3 ± 19.1	86.9 ± 11.7	ns	84.7 ± 12.8	85.7 ± 15.1	ns
Overall (41)	*N* (%)	20 (48.8%)	21 (51.2%)		32 (78%)	9 (22%)	
	IKDC score (mean ± SD)	90.9 ± 13.7	84 ± 13.6	0.017	80.3 ± 14.4	89.4 + 13.3	0.036

Abbreviations: ACLR, anterior cruciate ligament reconstruction; ACLR-OI, anterior cruciate ligament reconstruction + other interventions; IKDC, International Knee Documentation Committee; ns, nonsignificant; SD, standard deviation; WB, weight bearing.

Independently from the type of surgical treatment, significantly better results were reported in the subgroup without brace and FWB in comparison with bracing and PWB, while patients wearing a brace had worse IKDC score when FWB was not allowed (►**Table 3**).

Discussion

The overall mean IKDC score in this study appeared consistent with literature.[16,17] In the mid-term follow-up, patients without brace and who had reached FWB 6 weeks after surgery generally exhibited better IKDC scores than patients who wore a knee brace and continued to have PWB 6 weeks after surgery. This finding confirmed the previous literature that showed no advantage of a postoperative treatment with a stabilizing knee brace after ACLR.[10–15,18] However, when we analyzed separately the patients who had concomitant surgery (ACLR-OI group), no differences were found in IKDC score between the braced and unbraced subjects.

The use of a brace is widespread, because it is considered to have positive effects on joint stability and protects the graft by minimizing the stress forces across the knee. However, disadvantages of bracing have been claimed, including the potential muscle atrophy, loss of knee extension at the removal, decreased patient's perception of maximal performance, increased fatigability during exercise, and additional costs.[12–15,18] Unfortunately, no evidence exists on effectiveness of bracing in patients with ACLR and concomitant surgery,[18] and this issue needs to be confirmed by further research.

Regarding the timing of full weight-bearing prescription, great differences among orthopaedic surgeons are common, both for isolated ACLR and ACLR combined with meniscal repair/resection or other additional surgery. Two literature reviews concluded that 2 years postoperatively, the outcomes in patients with a lateral meniscus repair, medial meniscus resection, or lateral meniscus resection, were not significantly different from that of patients with an isolated ACLR.[19] Also, the concomitant meniscal injuries had no significant influence on the outcomes up to 8-year follow-up.[20] This point is particularly relevant, since the association of meniscal resection and ACL reconstruction has been demonstrated to increase the rate of osteoarthritis over the long term, at a minimum 10 years after ACL injury.[19] In this study, the type of intervention did not influence IKDC score at a mean follow-up of 3.5 years postoperatively. However, when separately analyzed, patients with ACLR and adjunctive surgery demonstrated no difference in functional outcomes with respect to the weight-bearing timing. The different provisions of surgeons stressed in this study

Table 3 Effect of postoperative regimen on IKDC score at follow-up regardless of surgical treatment

Subgroups (*N*)	Bracing	WB	Surgical treatment (*N*)	IKDC score (mean ± SD)	*p*-Value	Post-hoc test (*p*-Values)					
						Subgroups (pairwise comparisons)					
						1 vs. 4	2 vs. 4	3 vs. 4	1 vs. 2	1 vs. 3	2 vs. 3
Subgroup 1 (17)	No	Full	ACLR (11) ACLR-OI (6)	90.9 ± 14.8	0.02	0.032	ns	0.03	ns	ns	ns
Subgroup 2 (3)	No	Progressive	ACLR (2) ACLR-OI (1)	91.0 ± 6.2							
Subgroup 3 (15)	Yes	Full	ACLR (5) ACLR-OI (10)	87.6 ± 11.7							
Subgroup 4 (6)	Yes	Progressive	ACLR (4) ACLR (2)	74.9 ± 14.7							

Abbreviations: ACLR, anterior cruciate ligament reconstruction; ACLR-OI, anterior cruciate ligament reconstruction + other interventions; IKDC, International Knee Documentation Committee; ns, nonsignificant; SD, standard deviation; WB, weight bearing.

well describe the need for further research in the area to gain evidences for optimal and shared postoperative management in ACLR.

Also, rehabilitation programs after ACL reconstruction, with or without additional surgery, lack the standards.[6,7] In this study, the protocol followed during 2 weeks of supervised rehabilitation was designed according to the evidence obtained from literature. Both open and closed kinetic chain exercises were utilized,[21,22] emphasizing weight bearing when possible and ROM and progressive muscular strengthening.[9–11,23] Neuromuscular electrical stimulation (NMES) combined with exercise was employed for quadriceps strength[24–26] together with proprioceptive and balance exercises, which have been demonstrated to improve joint position sense, muscle strength, and perceived knee joint function.[27,28]

Although preoperative rehabilitation seems to be effective in improving the outcomes after surgery,[29,30] this was not carried out in the present cohort of patients. Furthermore, with respect to the duration of the rehabilitation, there is evidence that a postoperative one year rehabilitation, individually tailored based on possible concomitant surgery, graft source, and the patient's functional status, and associated to a preoperative rehabilitation, improves the postoperative outcomes.[31]

This study has some limitations. According to the rules of the National Health System, we were unable to follow patients for a long period in hospital and usually, after the first 2 weeks of postoperative rehabilitation in hospital, patients were advised to continue rehabilitation in the outpatient clinics. This could represent a bias in the study since, due to the retrospective nature of the study, the information on the timing and type of rehabilitation that patients had after the period in our institute and that could have affected the final outcome, was not available. In addition, the small number of patients in subgroups is a relevant limitation of this study. Unfortunately, only 38% of eligible patients for the study accepted to participate. It is possible that since these patients were young and easily returned to their usual daily activities after surgery without any further problem at this long-term follow up, they were not interested in answering to the call.

In conclusion, data in this study evidenced a better midterm functional outcome when patients with isolated ACLR were not immobilized with a knee brace after surgery and had full weight bearing in 6 weeks after surgery. In the case of ACLR with concomitant intervention on menisci or ligaments, data were not clearly in favor of any of the condition explored in terms of bracing and weight bearing. Caution should be exercised in interpreting the results in ACLR-OI group due to the small number of cases, asking for further research in the field.

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