

Chapter 54 – Knee Bracing for Athletic Injuries

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Knee injuries represent the most common problem facing the sports medicine community. As sports participation continues to increase, so does the likelihood of sustaining a debilitating knee impairment. Thus, prevention, treatment, and rehabilitation of these injuries are important to both the athlete and the treating physician. Surgery is often a viable option; however, most of these injuries are treated conservatively with rest, therapy, and bracing.

The use of braces in sports medicine has long been surrounded by debate. Does the benefit of a brace justify the potential discomfort and cost? This question must be evaluated in the context of brace use and the desired purpose. Different braces serve different functions. The American Academy of Orthopaedic Surgeons (AAOS) has defined three categories of knee braces^[24]:

- 1 Rehabilitative braces—postoperative braces designed to allow protected range of motion
- 2 Functional braces—provide stability to the unstable knee and improve function
- 3 Prophylactic braces—prevent injury to a normal knee

In addition to the three proposed categories, unloader and patellofemoral braces have become popular in contemporary orthopedics. Unloader (knee osteoarthritis) braces are designed to improve the function in patients with unicompartmental arthritis and supplement other conservative management. This chapter will evaluate the current literature available for braces in each of these categories and clarify their purpose, function, and usefulness.

Rehabilitative Braces

Rehabilitative braces are designed to provide two functions, to protect a reconstructed/repared ligament and allow early motion. However, the effectiveness of attaining and the clinical need for both of these purposes has been called into question by the contemporary literature. These braces can be off-the-shelf types with thigh and calf enclosures, hinges, hinge-brace arms, and straps that encircle the brace components (Fig. 54-1). The hinges can be unlocked to allow restricted range of motion and the braces are typically long to improve the lever arm and stability. Custom braces are available at an added cost. Rehabilitation braces are most prevalent in the context of anterior cruciate ligament (ACL) reconstruction and postoperative protocols.



Figure 54-1 ACL rehabilitation braces. **A**, Breg T-Scope; postoperative ACL brace. **B**, Donjoy TROM adjuster; postoperative brace. **C**, Ossur Innovator DLX; dial for the postoperative brace.

Post–Anterior Cruciate Ligament Reconstruction Bracing

There are two main reasons to brace after ACL reconstruction—to protect the repair and avoid loss of extension. Various authors and surgeons have different opinions and protocols regarding bracing; some are based on experience and some based on the literature. This was clearly illustrated in a survey conducted by Marx and colleagues^[45] of 397 AAOS members with regard to ACL surgery. When surgeons were asked whether they braced patients postoperatively for 6 weeks, 40% responded “no” and 60% “yes.” Then, when asked if they recommended braces postoperatively for sports participation, 38% responded “no” and 62% “yes.” Despite the disparity in clinical opinion, there have been many prospective randomized clinical trials that evaluated the effect of a postoperative rehabilitation brace and a multitude of systematic reviews (Table 54-1).

Table 54-1 -- Summary of Literature: Bracing After Anterior Cruciate Ligament Reconstruction

| Study (Year) | Type | No. of Patients | Groups | Graft | Follow-Up | Results |
|--|------|-----------------|--|-------|------------|---|
| Harilainen and Sandelin (2006) ^[28] | RCT | 60 | Brace, 12 wk No brace, crutches, 2 wk | BPTB | 1, 2, 5 yr | No difference: Tegner, Lysholm scores; laxity, muscle strength |
| Brandsson et al (2001) ^[12] | RCT | 50 | Brace, 3 wk; no brace | BPTB | 2 yr | Early: Brace had less swelling, drainage, pain 2 yr: No differences in Tegner, IKDC scores, strength, laxity |

| Study (Year) | Type | No. of Patients | Groups | Graft | Follow-Up | Results |
|--|----------------|-----------------|--|-----------|------------|--|
| Moller et al (2201) ^[50] | RCT | 62 | Brace, 6 wk; no brace | BPTB | 2 yr | No differences in Lysholm, VAS, range of motion, strength, laxity |
| Risberg et al (1999) ^[65] | RCT | 60 | Rehabilitation brace, 2 wk; functional brace, 10 wk; no brace | Various | 2 yr | No differences in laxity, range of motion, strength, functional tests, pain |
| McDevitt et al (2004) ^[46] | RCT | 95 | Functional brace, 1 yr; no brace | BPTB | 2 yr | No differences in stability, functional testing, IKDC, Lysholm scores, range of motion, strength |
| Hiemstra et al (2009) ^[32] | RCT | 88 | Brace—knee immobilizer, 2 wk; no brace | Hamstring | 2 wk | No differences in VAS scores, pain medication, range of motion |
| Melegati et al (2003) ^[47] | Clinical trial | 36 | Brace locked in extension, 1 wk; brace not locked in extension | BPTB | 8 wk, 4 mo | Significant differences at 8 wk: Extension greater in extension lock group No differences in KT-1000 |
| Mikkelsen et al (2003) ^[48] | RCT | 44 | Brace set at -5 degrees for 3 mo; brace set at 0 degree for 3 mo | BPTB | 3 mo | Significant differences in 0-degree group; loss of full extension No differences in flexion, laxity, pain |

RCT, Randomized controlled trial.

Harilainen and associates^[28,29] completed a randomized controlled study with a braced and an unbraced group. The braced group used a rehabilitation brace for 12 weeks postoperatively with a gradual increase in weight bearing, whereas the unbraced group was allowed immediate range of motion with the use of crutches for 2 weeks. The 1-, 2- and 5-year follow-up examinations revealed no differences in Tegner activity level, Lysholm knee score, laxity, or isokinetic thigh muscle strength.

Brandsson and coworkers^[12] also completed a prospective randomized clinical trial on the usefulness of postoperative rehabilitation braces in 50 patients. ACL reconstruction was completed with a bone-patellar tendon-bone (BPTB) autograft and patients were randomized to undergo rehabilitation for 3 weeks with or without a brace. Patients were followed for 2 years and, at the early follow-up visits rehabilitation with a brace resulted in fewer problems with swelling, a lower prevalence of hemarthrosis and wound drainage, and less pain throughout the early recovery period compared with rehabilitation without a brace. The 2-year follow-up revealed no differences between groups with regard to Tegner activity level, International Knee Documentation Committee (IKDC) rating, one-legged hop and isokinetic strength, or KT-1000 knee laxity.

Another randomized prospective clinical trial was completed by Moller and colleagues.^[50] They randomized 62 patients to 6 weeks of rehabilitation with or without a brace followed by a specific program for up to 6 months. In the early follow-up period, the braced group had slightly higher Tegner scores. At the 2-year follow-up, there were no differences in Lysholm, visual analogue scale (VAS) scores, range of motion, isokinetic strength, or laxity. The authors concluded that a postoperative knee brace provides no additional benefit. Risberg and associates,^[65] in a prospective randomized study, compared an unbraced population with a braced population that included the use of a postoperative rehabilitative knee brace for 2 weeks and then a functional brace for an additional 10 weeks. There were no differences between the groups except at the 3-month point. Despite greater thigh atrophy, the braced group showed an improved Cincinnati knee score. Otherwise, KT-1000 laxity,

Cincinnati knee score, goniometry-measured range of motion testing, computed tomography (CT), thigh atrophy measurement, Cybex testing, functional knee tests, and VAS scores all were equal at 6 weeks, 3 and 6 months, and 1 and 2 years. It should also be noted that 24% of subjects in the brace group discontinued use prior to the 3-month time period.

A complete analysis of bracing after ACL reconstruction was done by McDevitt and coworkers.^[46] The authors prospectively randomized 95 patients over three institutions to brace wear for 1 year post-ACL reconstruction or no brace. All patients had a BPTB autograft and were held in extension for 3 weeks postoperatively and then followed up at 2 years. No significant differences were found between the groups in knee stability, functional testing with the single-leg hop test, IKDC scores, Lysholm scores, knee range of motion, or isokinetic strength testing. Two braced subjects had reinjuries and three nonbraced subjects had reinjuries.

The referenced studies are, for the most part, high-quality prospective randomized clinical trials that showed no quantifiable long-term benefit to postoperative bracing following ACL reconstruction with regard to activity level, subjective outcome, or knee laxity. However, some surgeons believe that a brace in the immediate postoperative period can provide the patient additional comfort. Hiemstra and colleagues^[32] looked at patients braced for the first 2 days, with a follow-up of 14 days. They found that bracing did not provide any additional pain relief in the acute period above and beyond that for nonimmobilized patients.

Bracing has also been proposed as a way to reduce any potential flexion contracture. Petsche and Hutchinson^[56] have identified loss of knee extension as the biggest problem after ACL reconstruction. Potential causes include surgical technique, graft placement, and postoperative contracture. Melegati and coworkers^[47] have evaluated the effect of bracing BPTB ACL reconstructions in extension for the first week. In this study, 36 subjects were allocated to an extension bracing group or a brace group with 0 to 90 degrees of motion for the first week. All patients were then allowed unrestricted motion after the first week. They found that at the 4- and 8-week postoperative points, there was a significant difference with regard to the two groups; the extension brace group had extension closer to that of the normal knee.

Mikkelsen and coworkers^[48] have evaluated the concept that the 0-degree setting on a brace does not represent true anatomic 0 degree and that this discrepancy affects the postoperative knee extension in patients who have undergone ACL reconstruction. Five subjects were placed in postoperative dressings and extension braces. Radiographs were taken to determine alignment. With the brace set at 0 degree, no subject had an anatomically straight leg (mean, +2.8 degrees) when compared with the -5-degree (mean, -2.5 degrees) and -10-degree (mean, -4.1 degrees) settings. Then, in a prospective study of ACL-reconstructed knees, they compared the differences between a hyperextension brace (-5 degrees) and an extension brace (0 degree) postoperatively. No significant differences were found between the groups in terms of knee flexion, sagittal knee laxity, or postoperative pain. However, only 2 of 22 patients in the hyperextension brace group had an extension loss more than 2 degrees, whereas 12 of 22 in the extension brace group had a loss more than 2 degrees.

In summary, knee bracing in the postoperative period continues to be used by many practicing surgeons for a variety of reasons. However, the evidence that a brace confers additional stability, improves range of motion, protects the graft, reduces pain, or improves subjective outcomes is limited. Most prospective randomized clinical trials have shown no difference between braced and unbraced subjects at long-term follow-up. To the contrary, if the brace is used to maintain extension, there is a moderate amount of literature that supports bracing in the acute postoperative period to prevent flexion contractures.