

**Kruse LM, Gray B, Wright RW. Rehabilitation After Anterior Cruciate Ligament Reconstruction: A Systematic Review. JBJS Am 2012;94:1737-48.**

Design: Systematic review of clinical trials

Study question: In patients who are recovering from ACL reconstruction, are there clinically significant differences between different rehabilitation protocols?

PICOS:

- Patient population: Patients in the postoperative period after ACL reconstruction, either hamstring autograft or bone-patella-bone
- Interventions and comparisons: different forms of postoperative rehabilitation
  - o Knee bracing versus no knee bracing
  - o Accelerated strengthening exercises versus standard exercise programs
  - o Home-based rehabilitation versus outpatient physical rehabilitation
  - o Neuromuscular training such as proprioceptive and balance training, perturbation training, and vibratory stimulation versus strength training, placebo treatment, or standard rehabilitation
  - o Miscellaneous interventions
    - Vitamin E or C versus placebo
    - Hyaluronic acid injection versus placebo
    - Running training versus control
    - Continuous passive motion versus continuous active motion
    - Instructional video versus control
    - One-leg cycling versus control
- Outcomes: Variable depending on the study, but commonly measured outcomes included pain VAS, joint stability, patient-reported functional scores, and several kinetic and technical measures such femoral/tibial tunnel diameter on CT scan, isokinetic strength, and quadriceps lag
- Study types: Either randomized controlled trials or prospective comparative trials published in English in a peer-reviewed journal
  - o Exclusion criteria included non-English articles, case-control studies, irrelevant subject matter, systematic reviews, and conference or meeting abstracts

Study selection:

- Databases included PubMed, EMBASE, and the Cochrane Register between January 2006 and December 2010

- All three authors independently searched and selected articles for inclusion, reconciling the results through discussion
- Determination of evidence level was based on the Oxford Centre for Evidence-based Medicine (CEBM) criteria (<http://www.cebm.net/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/>), which rate study quality according to the focus of the study and the study design suitability for answering the particular type of question, and highlight the method of randomization, blinding when relevant, baseline similarity of groups, completeness of followup, and groups having similar interventions other than the intervention being tested in the study

#### Results :

- 85 articles were screened following the database search, and 29 articles were selected for the systematic review
- No meta-analysis was planned, and the studies were so highly variable in the nature of the populations and interventions that quantitative pooling would probably have been impractical
- For many of the planned comparisons, the available study data were not sufficient to support clear conclusions, but the authors did find some consistencies in the included studies
  - Postoperative bracing designed to protect against varus or valgus stresses and improve range of motion, had not been found to be effective in previously published systematic reviews
    - Six new studies were published between 2006 and 2010
    - None of these studies reported that knee bracing reduced postoperative pain, increased knee stability, increased range of motion, or improved functional scores compared to no bracing
  - Accelerated strengthening has had a paucity of information in the past, but no evidence that it was harmful
    - Five studies were included which were published between 2006 and 2010
    - Comparisons included eccentric exercise starting at 3 weeks postop versus 12 weeks or versus 9 weeks, immediate strengthening versus beginning at 2 weeks, immediate knee motion versus 2 weeks of bracing prior to starting rehabilitation
    - Immediate postoperative range of motion from 0° to 90° of flexion, weight-bearing as tolerated on postop day 2, and immediate straight-leg raises and quadriceps contractions were likely to be as safe as later initiation of rehabilitation, and may improve or accelerate strength gains compared to waiting

- Home-based rehabilitation was compared to outpatient rehabilitation in four previously published trials, which had suggested that a motivated patient could obtain reasonable results with minimal supervision; two additional studies between 2006 and 2010 were included in the review
  - One study provided longer-term data from a previously published trial, with followup on 88 of 129 original patients (68%) between 26 and 59 months after surgery; range of motion, joint laxity, and muscle strength were similar, with a slight advantage for the home therapy group on an ACL quality of life scale measure
  - The second trial suffered from some methodological limitations which precluded clear conclusions
- Neuromuscular training was evaluated in 9 randomized trials, which evaluated proprioceptive and balance training, perturbation training, and vibratory stimulation
  - All of the interventions appeared safe but their effect size was small, and they are not likely to have a large influence on return to full activity
- The remaining comparisons did not identify significant benefits with Vitamin C or E, hyaluronic acid injection, or continuous passive motion; single leg cycling may improve cardiovascular fitness

Authors' conclusions:

- Although many studies are at risk of selection bias, some valuable conclusions appear to be warranted
- Knee bracing does not provide any benefit and is not necessary
- Accelerated rehabilitation beginning with immediate postoperative weight-bearing, flexion range of motion in the range from 0° to 90°, and closed-chain strengthening exercises, appear to have no injurious effects; eccentric quadriceps and hamstring training three weeks after surgery is probably safe and may be safe earlier, but further research is needed
- Home-based rehabilitation can be as effective as outpatient-based rehabilitation in motivated patients
- Continuous passive motion is not effective and is not recommended

Comments:

- The biases inherent in the included studies makes conclusions tentative in nature, but not all biases necessarily undermine study conclusions
  - For example, in the discussion of the articles on knee bracing, one study is thought to have had a treatment bias because of low compliance with the use of the knee immobilizer

- However, low compliance is also an informative outcome of treatment and points to patient acceptance of the device, their rejection of it strengthens, rather than undermines, the conclusion that knee bracing is not effective
- The CEBM criteria for evaluating studies is brief in comparison to the Cochrane Risk of Bias tool for evaluating randomized trials, but for present purposes is likely to capture the important and relevant considerations for evaluating the effectiveness of a wide variety of interventions
- The authors evaluated the quality of studies, but did not include a table indicating which studies satisfied which quality criteria; while quality scoring is not usually a useful exercise, a table showing which studies were well-randomized, adequately blinded, and had sufficient control of attrition, would have made the review more informative

Assessment: Adequate systematic review to support good evidence that in the setting of ACL rehabilitation, knee bracing is not helpful, continuous passive motion has no benefits, and home exercises are likely to be as effective as outpatient rehabilitation in motivated patients; there is some evidence that rehabilitation can begin safely as early as in the immediate postoperative period with weight-bearing, flexion up to 9 degrees, and quadriceps strengthening. Neuromuscular training such as proprioceptive and balance training, vibratory stimulation, and perturbation training have not yet shown clinically important benefit