



# Prevention and Management of Loss of Motion in Anterior Cruciate Ligament Surgery

Marc S. Haro, MD, MSPT,<sup>\*</sup> and K. Donald Shelbourne, MD<sup>†</sup>

Loss of knee range of motion after anterior cruciate ligament (ACL) reconstruction is a very disabling problem. Loss of motion can not only lead to the development of anterior knee pain, inability to return to sports, and persistent weakness but also be a significant cause of the early arthritic changes that are often seen with ACL injuries. Unfortunately, motion loss is often overlooked or not fully appreciated as a cause to postoperative knee pain, limited function, or subsequent arthritic changes. Loss of motion after an ACL reconstruction can have devastating outcomes that often persist despite treatment. Given the overall poor results after surgical treatment of motion loss, it is best to prevent motion issues from arising in the first place.

Oper Tech Sports Med 24:45-54 © 2015 Elsevier Inc. All rights reserved.

**KEYWORDS** Anterior cruciate ligament reconstruction, complications, arthrofibrosis, range of motion

## Introduction

The goals of an anterior cruciate ligament reconstruction (ACL-R) are to restore normal function and stability of the knee, as well as prevent future articular or meniscal injuries that may be detrimental to the health of a patient's knee. Although ACL-R procedures have been highly successful in restoring knee stability and improving function,<sup>1,2</sup> unfortunately they have been seemingly less successful in consistently getting athletes back to high-level sports or at preventing future arthritic changes.<sup>3-12</sup> Several theories have been postulated as to why some patients have poorer outcomes after ACL-R procedures. Reasons have included nonanatomical graft placement and incomplete prevention of the pivot shift phenomenon,<sup>13,14</sup> concurrent meniscal or articular cartilage injuries,<sup>15,16</sup> or loss of motion.<sup>17</sup> Although all of these factors are important and may contribute to poor outcomes, in our experience we have found that even a few degrees of motion loss after anterior cruciate ligament (ACL) surgery has a dramatic effect on functional and subjective outcomes.<sup>18,19</sup> Studies have also shown that loss of motion can not only lead to the development of anterior knee pain, the

inability to return to sports, and persistent weakness but also be a significant cause of the early arthritic changes that are often seen with ACL injuries.<sup>2,5,17</sup> Unfortunately, motion loss is often overlooked or not fully appreciated as a cause of postoperative knee pain, limited function, or subsequent arthritic changes.

Early in the history of surgical treatment of ACL injuries, owing to the complex nature of the surgeries and the fear of early graft failure or increased postoperative laxity, surgeons frequently immobilized patients for prolonged periods after surgery.<sup>20-22</sup> Only a slow and gradual restoration of motion and strength was recommended. Unfortunately, this led to unacceptable rates of knee pain and stiffness, loss of function, and inability to return to activities or sports.<sup>20,23,24</sup> In the mid to late 1980s, a trend emerged to restore full range of motion (ROM) immediately postoperatively that led the patients to an earlier return to activities and sports.<sup>25-27</sup> No detrimental effects, such as increased instability or early graft failure, were noted with an accelerated rehabilitation protocol, and the incidence of anterior knee pain and the need for subsequent procedures to regain normal motion significantly decreased.<sup>26-29</sup> Now, with the nearly universal adoption of an accelerated rehabilitation protocol after ACL surgery, the incidence of arthrofibrosis after an ACL-R has significantly decreased<sup>18</sup>; however, unfortunately postoperative stiffness is still not an uncommon complication<sup>30</sup> and can be extremely debilitating.

\*Medical University of South Carolina, Charleston, SC.

†Shelbourne Knee Center, Indianapolis, IN.

Address reprint requests to K. Donald Shelbourne, MD, 3630 Guion Rd. Indianapolis, IN 46222.

## Causes of Loss of Motion

The causes of motion loss after ACL surgery are often multifactorial and can involve the loss of extension or flexion, or both. However, the loss of full terminal extension is typically more symptomatic than the loss of flexion.<sup>31</sup> Loss of motion can result from preoperative, intraoperative, and postoperative factors. Preoperatively, the timing of surgery, not obtaining symmetrical motion before a reconstruction, inadequate quadriceps muscle control to maintain normal motion postoperatively, and not being psychologically ready to participate in rehabilitation after surgery<sup>32-34</sup> can all contribute to postoperative motion issues. Performing surgery during the acute inflammatory phase has been shown by several authors to lead to significantly increased rates of postoperative stiffness.<sup>35,36,33</sup> Intraoperative factors include tunnel malposition,<sup>37</sup> especially placing the tibial tunnel too far anterior, over-tensioning the graft, placing too large a graft, or not performing an adequate notchplasty that can lead to a loss of motion. Other intraoperative elements that can lead to excessive scarring and subsequent arthrofibrosis include excessive trauma to the infrapatellar fat pad, the development of a postoperative hemarthrosis, and concomitant extracapsular procedures such as an medial collateral ligament repair.<sup>27</sup> Extensive soft tissue trauma that is frequently encountered with knee dislocations can also lead to a loss of motion, especially if the knee is operated on during the acute inflammatory phase or if intracapsular and extracapsular procedures are performed at the same time.<sup>38</sup> Postoperatively, the most common cause of motion loss is an inadequate rehabilitation protocol that does not emphasize minimizing a postoperative hemarthrosis and regaining early, symmetrical knee ROM. However, other factors to consider are displaced meniscal tears or the development of a cyclops lesion.<sup>39</sup>

## History

A thorough history needs to be obtained from patients who present with loss of motion. Often patients would not know that loss of motion is their issue and present with complaints of “knee pain,” continued weakness, muscle atrophy, or not being able to return to their previous level of function. It is important to find out the details of their surgery, including the date of the surgery, the status of the articular cartilage, whether any meniscal procedures were performed, and whether any arthritic changes were seen at the time of surgery. Each of these factors may contribute to the cause of loss of motion. For example, if a bucket handle meniscal tear repair was performed, the repair may have failed and now may be locked in the intercondylar notch, causing a mechanical block to full motion. Obtaining arthroscopic images from the surgery can be useful in evaluating for any intraoperative factors that might have led to loss of motion.

Potentially even more important than the surgical details, the specifics about their preoperative and postoperative rehabilitation need to be ascertained. Important questions to ask are the following: what was the status of their knee before

surgery? Did they have an effusion or full motion before surgery? How soon after their injury did they undergo surgery? We have found that patients who have persistent pain after knee surgery likely had motion loss before surgery that was left untreated or undertreated.

## Physical Examination

A thorough examination of both of the patient's knees is required to fully assess the degree of motion loss. Normal knee ROM is frequently misreported with 0° extension (neutral) and 135° flexion as being normal.<sup>40,41</sup> Although it varies from person to person, on average, men have 5° hyperextension and women have 6°.<sup>42</sup> The International Knee Documentation Committee (IKDC) classifies normal motion as extension within 2° and flexion within 5° of the contralateral extremity. To individualize rehabilitation goals to each patient, the contralateral uninjured knee should be used as reference for a patient's normal knee ROM.

To restore normal ROM, one must have an appreciation and understanding on how to assess a patient's motion. The examination should always begin with the normal, uninjured knee before examining the injured or “not-normal knee.” It is important that both of the patient's knees be exposed to the mid-thigh level for the examination. It is also important to examine the patient on an examination table that is long enough to allow the patient's legs to be fully supported on the table, including the heels. This allows for visual assessment of heel height compared to the table during passive knee hyperextension (Fig. 1). Oftentimes, a subtle flexion contracture can be detected with visual observation of the knee alone. Patients also often stand with their weight shifted off of the injured leg and onto their normal knee (Fig. 2). Their injured knee would be held in a flexed position and they often have visible quadriceps atrophy. During ambulation, patients with a loss of terminal extension remain in greater angles of knee flexion during the terminal swing phase of gait, resulting in initial contact with a flatfoot or forefoot contact instead of heel strike. They often complain that 1 leg feels shorter than the other leg



**Figure 1** Examiner performs an assessment of passive knee extension range of motion. The examiner uses 1 hand to secure the thigh down on the table whereas the other hand lifts the foot upward, bringing the knee into full available extension. (Color version of figure is available online.)

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