

## **Justification for Functional Knee Bracing in the Age of Arthroscopic ACL Reconstruction**

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### ***Physician Attitudes Toward Functional Bracing After ACL Reconstruction:***

We've all heard the following response from an orthopedic surgeon when asked if he or she uses functional knee bracing following ACL reconstruction: "I don't use bracing anymore because the reconstruction is so good!" When viewed in light of the original purpose of functional knee bracing, to provide mechanical stability to the knee, this response is perfectly justified. Before the late 1980's when arthroscopically assisted ACL reconstruction became the standard of care, functional knee bracing served a valuable role in providing postoperative stability. However, with the advent of the more biomechanically accurate arthroscopic techniques, one must now assume that the patient's knees are stable immediately after surgery. But to focus only on the stability provided by functional bracing ignores a number of other potential benefits. Let's first look at what we know about the outcome of current reconstructive techniques and then address the potential benefits of functional knee bracing from this perspective.

### ***Outcomes Following Knee Injury and Ligament Reconstruction:***

The development of osteoarthritis is an unfortunate sequela of injury to the meniscus, articular cartilage, and the anterior cruciate ligament (ACL)<sup>1-8</sup>. The development of osteoarthritis might also be accelerated do to loss of dynamic stability and alterations in dynamic kinematics due to neurosensory and/or neuromuscular impairments resulting from soft tissue injury of the knee. This loss of *dynamic* knee stability (the stability provided by the musculature which crosses the knee) occurs despite the knee having good *mechanical* stability following the reconstruction.

There are few long-term prospective studies of the long-term consequences of significant knee injuries but a review of the literature does reveal a good deal of retrospective information with follow-up intervals of from 5 to 20 years.<sup>1-8</sup> These retrospective reviews indicate that radiographic evidence of osteoarthritis is significantly increased after all knee injuries when compared with the uninjured knee in the same patient. A review of the retrospective data indicates that injury of the meniscus increases the risk of the development of degenerative changes in the knee approximately ten-fold. Even partial meniscectomy in an otherwise intact joint doubles the risk of accelerated degenerative changes and complete rupture of the ACL with associated meniscus rupture appears to result in long-term degenerative changes in 50% - 70% of all patients.

Another important factor related to the development of knee arthritis is articular cartilage injury. A recent study by Hjelle et al<sup>7</sup> demonstrated that visible chondral or osteochondral defects were evident in 61% of 1000 consecutive knee arthroscopies.<sup>7</sup> These authors note that many chondral or osetochondral injuries are not visually evident. The advent of magnetic resonance imaging has led to the new diagnosis of bone marrow contusion injuries following knee trauma and specifically the high incidence of injury to the

subchondral bone following ACL injury. Such bone contusion injuries diagnosed on MRI even with normal appearing articular surface at the time of arthroscopic evaluation of the joint can be troublesome, as such changes in the subchondral bone potentially can be associated with deformation of overlying articular cartilage which has been identified as a clear precursor for the development of secondary osteoarthritis.

As Dye et al point out<sup>11</sup>, restoration of structural or mechanical parameters in the injured knee does not necessarily indicate restoration of normal physiologic function. An important consideration are the kinematic changes which result not only from disruption of the mechanical structures but also from disruption of normal neurosensory mechanisms which control kinematics.

The prevalence and incidence of symptomatic osteoarthritis of the knee are increasing rapidly as the mean age of the population of the United States increases.<sup>9-10</sup> It is now the most common cause of long-term disability in the population over age 65 and increasingly, is also a leading cause of long-term disability in the population under age 65. More than one third of people aged 45 and older now report joint symptoms varying from mild discomfort to permanent loss of motion and constant deep pain. While primary idiopathic osteoarthritis is still the most common form of osteoarthritis, the prevalence of secondary osteoarthritis resulting from knee trauma also appears to be rising at an alarming rate. As Buckwalter et al<sup>12</sup> point out in their 2001 monograph, the effects of symptomatic osteoarthritis not only on the quality of life of the patient but also on the cost to healthcare and economic productivity make it imperative that better non-surgical treatments be developed. A clear implication of this assertion is that early prophylactic measures implemented following knee injury to either prevent or retard the progression of osteoarthritis following injury are both worthwhile and indicated.

### ***The Preemptive Role of Functional Bracing:***

The attitudes of orthopedic surgeons about functional knee bracing are understandable. Over the last two decades, the surgical procedures have significantly improved. Knee bracing is no longer required postoperatively to provide stability to the knee. But it's also clear from the review of outcomes following ACL reconstruction listed above, that bracing may still serve a very important role. The well established mechanical benefits of functional knee bracing<sup>16-39</sup> are outlined in detail in the book chapter entitled Knee Bracing; Science or Psychology on this web site.

The focus now should be on promoting the benefits of functional knee braces in preventing or reducing degenerative changes in the knee that are not addressed by the surgical procedure. In this regard, even off-the-shelf functional knee braces have some significant benefits:

- Functional knee braces increase the mechanical stiffness of the knee.
  - They prevent excessive anterior/posterior translation of the tibia relative to the femur which creates increased shear on the articular cartilage.

- They are stiff enough to reduce compressive loading in the affected compartment of the knee, thus allowing the cartilage an opportunity to heal following injury.
- Functional knee braces can restore knee kinematics (motion) to near normal levels following injury and surgical reconstruction.
  - Good biomechanical testing has shown that even reconstruction does not restore normal motion to the knee and that this abnormal motion contributes to the increased forces across the cartilage that result in degenerative changes.
- Functional knee bracing improves neurosensory and neuromuscular function to near normal levels.
  - Again, abnormal motion results in part from alterations in neurosensory and neuromuscular function.
- Functional knee braces can protect the patient for "accidental" loading that can occur after surgery when strength and motor control are at their worst.

Dr. Pat Smith, team physician for the University of Missouri has taken this concept even further. In his 20 years as a team physician, it was clear to him that 70% or more of his knee reconstructions developed symptomatic osteoarthritis of the knee one to five years following the initial injury or reconstruction. This continues to occur despite significant improvements in surgical techniques. While always a believer in the benefits of functional knee bracing to aid in recovery following injury or surgery, he felt that using a so-called "unloader" brace would be even better. So for the last six years, Dr. Smith has been applying the CounterForce and Fusion OA braces to virtually all football players who have sustained a knee injury or who have had a surgical reconstruction and has summarized this in a paper on this web site.

Dr. Smith has identified what he terms "at risk" patients and has routinely braced these patients with either a medial or lateral compartment unloader for the past six years. These "at risk patients are:

- Any patient with a "bone bruise" on MRI
- Any patient undergoing partial menisectomy or meniscal repair
- Any osteochondral injury (both obvious and suspected)
- Post-op microfracture
- Post-op osteochondral graft (OATS, Mosaicplasty, or ACI)
- Tibial plateau fractures

While Dr. Smith will continue to follow these patients for a minimum of ten years, the early results are most encouraging. Even at one or two years following the injury or surgery, that majority of his "at risk" patients show no degenerative changes on x-ray and report no symptoms associated with osteoarthritis. Dr. Smith has concluded that preemptive bracing is certainly cost-effective if it can be demonstrated that it can retard the progression of degenerative changes over the long-term while restoring the functional capabilities of the patient. His early results support this outcome.

### **Summary:**

- Emphasize the role of both functional knee braces and "unloader" braces in preventing or reducing degenerative changes in the knee, allowing the patient to return to reasonable activities, and preserving the long-term viability of the knee.
- For those patients treated conservatively following an ACL injury or those with a failed reconstruction, functional knee bracing is still a valuable adjunct in the treatment protocol.

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