

Preemptive Postoperative/Post-Injury Knee Bracing: An Approach to Mitigating Degenerative Changes in the Knee Following Injury or Surgery in Athletes

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Abstract

This paper summarizes a novel approach to the use of preemptive offloader bracing in an orthopaedic sports medicine practice to mitigate degenerative changes in the knee following meniscal and osteochondral injuries. The underlying premise is the potential for later arthritis development in young patients who sustain such significant knee pathology, and the possibility of minimizing that risk through fitting of specific medial or lateral offloader braces. The incidence of accelerated development of degenerative changes in the knee associated with meniscal and osteochondral injury is high, and surgical intervention has not been shown to reliably reduce this incidence. Preemptive bracing following injury or surgery in these cases may help mitigate these changes while allowing the athlete to resume a competitive career.

Introduction

The development of osteoarthritis is an unfortunate sequela of injury to the meniscus, articular cartilage, and the anterior cruciate ligament (ACL)¹⁻⁸. 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.

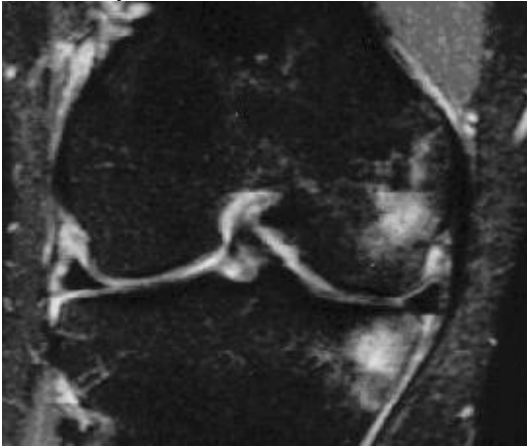
There are few long-term prospective studies of the long-term consequences of significant knee injuries but a review of the literature does reveal a good deal of retrospective information with follow-up intervals of from 5 to 20 years.¹⁻⁸ These retrospective reviews indicate that radiographic evidence 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. 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 demonstrated that visible chondral or osteochondral defects were evident in 61% of 1000 consecutive knee arthroscopies.⁷ These authors note that many chondral or osteochondral 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.



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.⁹⁻¹⁰ 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 al¹¹ 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.

Over 20 years of clinical experience in our practice including treating high level Division I college athletes has shown that an alarming percentage of patients who have sustained an osteochondral injury of the knee, had a partial meniscectomy, with or without concomitant soft tissue reconstructions such as the ACL, commonly develop symptoms, usually unicompartmental pain, several months following the index injury. Regardless of the initial treatment, many of these "at risk" patients^{table 1} invariably develop degenerative changes in the medial or lateral compartment of the knee at an accelerated rate confirmed objectively with x-ray and/or arthroscopic reevaluation. The high rate of long-term symptoms and the unquestioned acceleration in degenerative changes in this group of at risk patients suggested to us that maximal protection of the joint surfaces especially following any type of articular cartilage surgery or major meniscal removal is indicated to reduce loads and stresses which might adversely impact the articular surfaces and exacerbate long-term degenerative processes.

A Preemptive Approach to Post-Injury/Postoperative Osteoarthritis Using Knee Bracing

One approach which has shown great promise for symptomatic relief and mitigating the development of degenerative changes following knee injuries and surgery in young athletic patients is the use of so-called off-loading braces.¹²⁻²⁰ Importantly, use of these braces in this setting is based both on experimental and clinical evidence that off-loading braces can effectively reduce compartmental joint loads. In a long-term evaluation of these braces for symptomatic relief in a group of patients with symptomatic unicompartamental osteoarthritis, Barnes et al¹² reported that at a mean of 2.7 years, the majority of patients had significantly less pain and significantly improved function associated with the use of the CounterForce brace. Perhaps more interestingly, while all of the patients in this investigation were considered to be surgical candidates at the time of recruitment, at a mean of 2.7 years 76% of these patients reported significant relief of symptoms and only 24% had undergone knee arthroplasty with a mean interval of 1.6 years between the onset of symptoms and the time the surgical procedure was performed. Others have also demonstrated similar clinical benefits to the use of these braces in shorter term investigations.¹³⁻¹⁶

The essential design characteristic of all commercially produced "off-loading" braces is a valgus (or varus) directed force applied at the joint line whose goal is to reduce compressive and shearing loads in the affected compartment of the knee and thus, provide symptomatic

relief of pain. If excessive compressive and shearing loads are responsible for pain in symptomatic OA, then the clinical data clearly suggests these braces do reduce these loads. Katsuragawa¹⁷ et al demonstrated improvements in bone mineral density associated with the use of these braces in symptomatic patients and correlated this improvement with reduction of force in the affected compartment. Otis and Pollo¹⁸⁻²⁰ have demonstrated that this type of brace can reduce compressive loading in the affected compartment of the knee during dynamic weightbearing activities.

Based both on our clinical experience and the favorable literature, our



approach to mitigating degenerative changes in these young athletic patients is to utilize the CounterForce and (more recently) Fusion OA braces (Breg, Inc., Vista, CA) in a preemptive manner. Our goal

is to off-load the injured compartment of the knee following chondral injury, partial meniscectomy, or surgical repair to promote articular surface healing and reduce loads and stresses which might adversely impact long-term outcome. For the past six years we have implemented a program to apply the CounterForce off-loader brace in these patients and have been systematically acquiring data on our so-called "at-risk" patients for the past three years.

AT RISK PATIENTS

Post-op Partial Meniscectomy

Most Chondral Injuries (both obvious and suspected)

Bone Contusion Injuries

Unicompartmental Degenerative Disease

Post-op Microfracture

Post-op Autologous Osteochondral Grafting or
Autologous Chondrocyte Transplantation

Tibial Plateau Fracture (with or without ACL Reconstruction)

Table 1

For patients treated surgically, the brace is measured for at the first post-operative visit. Once the brace is fit, patients are gradually weaned from crutch use depending upon the surgical procedure and extent of the injury. All patients receiving a brace are encouraged to wear the brace at all times when weightbearing for the first 6 months following the injury or surgery. They are then encouraged to use the brace for sports or prolonged weightbearing activities for an additional 6 months to one year. It has been encouraging to see that most patients continue to wear their braces for years following the initial application because they report that it "helped" and did not hinder their function.

Discussion

In seven years, the leading edge of the baby boom will reach age 65. The Centers for Disease Control estimates that 6% of adults over the age of 30 currently show evidence of osteoarthritis of the knee.^{21,22} By the year 2020, the CDC estimates that 60 million Americans will be affected by symptomatic osteoarthritis of the knee. The CDC also estimates that, at this same time, osteoarthritis will supersede heart disease as the single biggest expense to the healthcare system. The worrying factor is that the average age of

these symptomatic patients is declining. Considering the potential economic impact of these numbers, a preemptive approach to treating this disease process seems not only reasonable but prudent. Preemptive bracing represents an "out-of-the-box" approach to potentially mitigating the progression of degenerative changes in the knee.

The key to the success of pre-emptive bracing, particularly in the young athletic population, is to identify the "at-risk" patients who will benefit most from this preemptive approach and to consider the bracing option before surgery. Patient education is critical. The patient must be instructed not only on the fit and function of the brace but also on the reason the brace is being applied. In our practice, compliance with using the brace is very high, primarily because of our commitment to patient education. In many cases, preemptive bracing is an alternative to a surgical procedure, and in the process actually fulfills multiple indications for conservative management. This type of 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. Our preliminary anecdotal experience indicates that this may be the case. Furthermore, the number of suitable patients who may benefit from preemptive bracing is considerable.

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