HOSPITAL PHYSICIAN®

ORTHOPAEDIC SPORTS MEDICINE BOARD REVIEW MANUAL

STATEMENT OF EDITORIAL PURPOSE

The *Hospital Physician Orthopaedic Sports Medicine Board Review Manual* is a peer-reviewed study guide for orthopaedic sports medicine fellows and practicing orthopaedic surgeons. Each manual reviews a topic essential to the current practice of orthopaedic sports medicine.

NOTE FROM THE PUBLISHER:
This publication has been developed without involvement of or review by the American Board of Orthopaedic Surgery.

Endorsed by the Association for Hospital Medical Education

Osteochondral Injury of the Knee

Contributors:

Jason M. Scopp, MD
Director, Cartilage Restoration Center, Peninsula Orthopaedic Associates, PA, Salisbury, MD

Bert R. Mandelbaum, MD
Fellowship Director, Santa Monica Orthopaedic and Sports Medicine Group, Santa Monica, CA

Editor:

Andrew J. Cosgarea, MD
Associate Professor, Department of Orthopaedic Surgery, Johns Hopkins University School of Medicine, Baltimore, MD

Table of Contents

Cover Illustration by Photodisc

Osteochondral Injury of the Knee

Jason M. Scopp, MD, and Bert R. Mandelbaum, MD

INTRODUCTION

Chondral and osteochondral injuries are common and typically affect a young, athletic population. In a retrospective review of more than 31,000 knee arthroscopies, Curl et al[1] reported articular cartilage damage in 63% of patients, with more than 60% having a grade III or grade IV lesion. Failure to recognize these injuries can result in long-term disability.

The stresses created during athletic activity place the knee at risk for a range of osteochondral injuries. If injury occurs, it is imperative to recognize osteochondral status as being intimately linked with limb alignment, meniscal status, and ligamentous status. A deficiency in one part of this *functional unit* can have an impact on the others and, in the short term, can lead to a loss of athletic performance. If articular cartilage loses the ability to adapt to repetitive stresses, loss of athletic performance may be followed by the development of chondropenia and ultimately osteoarthritis (OA).

This manual reviews the functional anatomy of articular cartilage, the pathophysiology of osteochondral injury, and the clinical evaluation and management of athletes with osteochondral injuries of the knee. A clinical algorithm is presented as a clinical tool to organize the treatment options for these patients.

ANATOMY AND BIOMECHANICS OF ARTICULAR CARTILAGE

Articular (or hyaline) cartilage is a viscoelastic material that allows variable load bearing by the knee during daily functional and athletic activities. Stress reduction to the subchondral bone and minimization of friction of the articular surface are essential in fulfilling this role. Articular cartilage provides joint surfaces with low-friction wear characteristics that are required for repetitive motion, allowing the athlete to perform consistently at the highest levels of activity and performance without symptoms elicited from the knee joint.

The functional characteristics of articular cartilage depend on its specific structural composition and organization.[2] Normal articular cartilage is composed of an extracellular matrix and chondrocytes. The extracellular matrix consists primarily of water, proteoglycans, and collagens. Type II collagen accounts for 90% to 95% of the total collagen volume, while types V, VI, IX, X, and XI comprise the remaining 5% to 10%.[3] Water content varies from 65% to 85%, depending on the load status and the presence or absence of degenerative changes. During the early phases of OA, the water content can increase to 90%.[3]

The functional organizational unit of articular cartilage is composed of 4 layers: the superficial tangential zone, the middle zone, the deep zone, and the calcified cartilage. The *tidemark* lies between the deep zone and the calcified cartilage and represents the transition from uncalcified to calcified cartilage. The subchondral bone and the calcified cartilage are continuous and are crucial supportive structures involved in load transmission. The resilience of the functional load-bearing unit is essential for durability and smooth joint motion.

PATHOPHYSIOLOGY OF ARTICULAR CARTILAGE INJURY

PROGRESSIVE LOSS OF CHONDRAL INTEGRITY

While the natural history of chondral injury of the knee is not well defined, it is apparent that a loss of articular integrity through injury, pathologic loading, and aging can cause degenerative changes over time. These changes begin as a loss of cartilage volume (chondropenia) and function, followed by development of articular cartilage defects that lead to elevated joint contact pressures and further joint degradation and, possibly, the eventual development of OA. The continuum of cartilage injury can be clinically depicted in a dose-response curve (**Figure 1**). As the athlete competes, a force (dose) is presented to the articular cartilage. If the cartilage is normal, a typical response occurs. However, as chondropenia and articular cartilage defects develop, the ultrastructural properties of articular cartilage can no longer provide an adequate response, leading to symptoms of pain, swelling, and a loss of athletic performance.