CAPE FEAR SPORTS MEDICINE

DIAGNOSIS AND EARLY MANAGEMENT OF KNEE INJURIES

INTRODUCTION: The knee is a common site of athletic injury. The knee injuries can be classified either into traumatic or acute and chronic, with overuse patterns of injury. I will focus primarily on traumatic injuries, identification, diagnosis and early management. Injuries to the knee, from a traumatic perspective, can have significant impact on athletes' future play. Early identification and diagnosis of injuries is extremely helpful to prevent long-term dysfunction of the knee and hopefully allow return to athletic participation. Protection from certain injuries, especially those that involve an unstable knee, can be important to identify so that the athlete does not return to participation and sustain a re-injury which can lead to further damage of the joint.

ANATOMY: The knee basically consists of two areas of articulation, the tibiofemoral joint and the patellofemoral joint. Dynamic structures about the knee, muscles and tendons provide a supportive role to the knee and provide for delicate balance to allow adaptation and changing positions if the knee joint itself as well as to assist the knee in powerful movements of the lower extremity required in sports participation, as well as a stabilizing factor for the joint and protection of the joint surface from injury. There are several excellent reference articles with regard to detailed anatomy of the knee and these will be provided in the reference section of the hand-out.

As a general overview, dynamic structures in the knee include the extensor mechanism anteriorly in the quadriceps, and posteriorly the hamstring musculature. The quadriceps include the vastus lateralis, vastus medialis, rectus femoris, and vastus intermedius. The small muscle of the genu articularis may also be included in this category. The hamstrings primarily on the medial side of the knee are important stabilizers that extend across from the pelvic girdle medially to the knee joint; the Sartorius, semitendinosus and gracilis making up the pes anserinus as well as the semimembranosus providing a contribution to the posteromedial aspect of the knee. The iliotibial band and tract are extensions of the gluteal/femoral fascia and provide an important lateral stabilizer to the knee, as well as the biceps femoris which inserts on the fibulae. The popliteus muscle is also a strong internal rotator and is also an identifiable structure in the posterolateral aspect of the knee, actually extending in an intra-articular manner through the popliteus hiatus. All the aforementioned muscles have retinacular type expansion which provide for delicate interplay between each muscle group and some have several insertion or attachment sites in a very complex manner.

The ligamentous structures of the knee are indeed also complex and one may think of those as being intra-articular versus extra-articular. In truth, the anterior cruciate ligament is the only true intra-articular ligamentous structure within the knee joint; although the posterior cruciate ligament may seem to be within the knee joint, it actually is encased in its own synovial sheath, rendering it a true extra-articular type structure. The attachment sites of the anterior cruciate ligament, namely the anterior cruciate versus the posterior cruciate ligament, are based on their attachment sites with the anterior cruciate ligament attachment site anteriorly on the tibia and the posterior cruciate ligament on the posterior aspect extra-articularly of the tibia. These ligaments have been described to have complex bundles of interligamentous fibers which may function differently based on the point of flexion or extension about the knee. Not only do the ligaments function in terms of providing stability to the joint but are also important in the normal day-to-day mechanics of the knee in terms of motion.

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The anterior cruciate ligament has had a significant amount of discussion and research based upon its function and anatomy because of the incidence of injury and significant disability- rendering with regard to injury in the athletic population. The extra-articular structures of the knee include those involving the collateral ligaments proper, the medial collateral ligament, both deep and superficial, as well as the lateral collateral ligament. There are several areas of capsular thickenings that have been described as true ligamentous structures, both posterolaterally and posteromedially, which are also very important in enhancing stability and normal function of the knee. These have now been described in a more discrete basis as the lateral ligamentous complex, deep portions of the medial collateral ligament and posterior oblique ligament as well as those expansions of the semimembranosus medially.

Other intra-articular structures in the knee joint include the cartilage of the knee, the hyaline cartilage or smooth-gliding cartilage on the end of the bones of the femur and tibia, and the undersurface of the patella as well as the bi-concave C-shaped disks making up the meniscus or fibrocartilage. The lateral meniscus is somewhat more circular in configuration and a bit more mobile in terms of dynamics, and the medial meniscus is somewhat more C-shaped in configuration, less mobile and more closely adherent to the medial capsular structures. Critical anatomic factors with regard to the meniscus are the ultra-structural orientation of the meniscus, providing for ability to accept and distribute loads as well as peripheral blood supply and lymphatic channels providing nutrition to the meniscus itself, as well as enhancing healing properties.
The smooth-gliding or hyaline cartilage is the anatomic structure that becomes injured with pathologic overload either on an acute or chronic basis and leads to “arthritis”. The hyaline cartilage is structured so that it accepts both compressive and shearing stresses in the skeletally-mature individual. Compressive stress resistance is quite high in the younger, skeletally-immature patients, but shear stresses can cause significant injury to the smooth-gliding hyaline cartilage and is important in identification of these injuries in the skeletally-immature individual. The ultra-structure of both the menisci, or fibrocartilage, and hyaline cartilage are important for their repair and healing potentials.

Injuries above the articular tide mark on an articular surface injury usually do not provide for any self-healing, and any healing with deeper injuries is usually one of a fibrocartilage rather than a true hyaline cartilage in terms of healing of those injuries more superficial, as well as deep to this level.
Recently-identifiable nerve fibers to various areas of both the meniscus and ligamentous structures of the knee, has been an important anatomic finding as this provides increased basis to preservation of those structures to allow for enhanced joint sensibility or proprioception, which is critical in recovering and rehabilitation of knee joint injuries. Therefore, certainly preservation of anatomic structures in their normal configuration is critical to normal function of the knee.

HISTORY: It is important to take an accurate history with regard to the patient’s injury. First, discern whether there has been a pre-existing condition prior to the acute injury, or whether this is the patient’s “index” injury with regard to the knee. If, indeed, the patient has had a previous knee injury, it is important to review the previous injury in detail in terms of the mechanism of injury, events following injury such as large amount of swelling, inability to weight bear, and prolonged return to activities because these most likely represent a serious injury and may contribute to the presenting problem. Once the acute or chronic nature of the injury is established, other important historical findings include patient’s age especially with regard to determining

skeletal maturity; patient's participation level and specific sport involvement as well as upcoming participation major events. Key points on the initial history are to discern whether the patient had immediate swelling or swelling shortly thereafter injury; ability to weight bear on the affected extremity; necessity of help to be removed from the field; any focal pain; ability to extend or flex the knee following injury as well as any distinct paresthesias at time of injury or persistence there following with regard to the lower extremity. Positive findings in any of these areas represents potential for a more significant injury and warrants very close evaluation and follow up treatment.

PHYSICAL EXAMINATION should entail as thorough examination as possible; at times, this is limited due to patient's level of discomfort, especially immediately following an acute knee injury. The sequence of examination is critical to discern an accurate examination and at the same time keep the patient as comfortable and provide as little anxiety to the patient during the examination. A thorough examination is difficult to perform on a playing field or locker room. For suspected significant injuries, it is best to provide an examining table so the patient can be comfortably supine during the exam. I find it quite beneficial to place a small rolled cushion underneath the knee for acute injuries to allow for patient's comfort, as frequently with acute injuries accompanying hemarthroses of the knee joint, the ability to lie in a supine position with the leg extended provides pain. This tends to relax the patient and allows for improved examination. The first portion of the exam is to evaluate the patient's neurovascular status as this is certainly critical in higher energy injuries as well as anyone who has complaints of numbness or tingling in the lower extremities but as a general rule, is indicated for all acute knee injuries which would include monitoring of symmetry of the pulses and a thorough neuromotor examination, specifically looking at motor function of the peroneal nerve, any accompanying swelling of the lower extremity, and attempts to identify any potential or developing compartment syndromes of the lower leg. These can occur even without a fracture. If the patient is able to, brief review of the patient's weight bearing lower extremity alignment is beneficial. Inability to achieve full terminal extension in the standing posture can lead to suspicions of significant knee injury and effusion in the joint. Lower extremity alignment can also be assessed if the patient has near full extension. Alterations in gait pattern are then identified, having the patient walk, viewing both from the front and rear. Assessment then continues with the patient in the supine position on the examining table and more directed towards the knee. At this point the patellofemoral portion of the exam is begun; noting any significant effusions, determining size of the effusion can be beneficial. Patellar apprehension is assessed in terms of the ability to provoke discomfort with translation passively of the patella, indicative of a patellar instability problem and possible dislocation. Frequently, patients will have tenderness along the medial retinacular structures of the knee, as well as apprehension in an acute patellar instability problem. Addressing the extensor mechanism is then critical to assure the patient can maintain an extended position of the knee fully extended against gravity to assure there is not a disruption of the extensor mechanism via patellar fracture, patellar tendon rupture or quadriceps rupture. Sagittal position of the patella can be beneficial for evaluation as well as breadth of the patellare tendon, prominence of the tuberosities, and excessive maltracking of the patella, especially in ligamentous injuries of the knee as these can be beneficial in the planning of any reconstructive procedures. Ligamentous examination then ensues with evaluation and comparison of the unaffected knee initially, comparing to the affected side. Important examination points are to assure that the patient does not have a significant injury. Tip-offs to more significant injuries include significant effusion, accompanying bruising, swelling about the knee, and gross instability. It is important to assess both the posterior and anterior cruciate

ligaments as well as collateral ligament structures of the knee as well as accompanying rotator instability patterns. It is especially important in a significant knee ligamentous injury to assure that the patient does not have a knee dislocation. Any suspicions for this warrant urgent arteriographic evaluation. Any combined ligamentous instabilities on examination represent more severe injuries to the knee and should heighten suspicion of higher energy injury to the knee. Evaluation on Lachman testing, Godfrey testing, of posterior sag or drawer testing are important as well as testing for medial and lateral instability, both with the knee in full extension and will 20-30 degree knee flexion to assess the collateral ligament structures of the knee. When examining for Lachman testing, at times an acutely injured patient maintaining a small bump or cushion under the knee allows for more comfortable exam. Any focal bony tenderness with accompanying bruising or significant swelling is concern for fracture. Joint line examination is then critical to note 1) whether there is focal joint line tenderness, this can best be done with the knee slightly flexed and once the joint line is identified using the fingertip to directly examine the joint line throughout, can be significantly beneficial documenting exact location of focal tenderness. 2) Inability to achieve full extension with focal joint line tenderness and normal ligamentous examination is of concern for peripheral meniscal injury, especially if there is an accompanying large hemarthrosis. 3) Any focal tenderness along the articular surface, especially with regard to skeletally immature individuals, relates concern for osteochondral fractures. Although with significant ligamentous injuries to the knee, any of these can occur in combination.

I believe radiographs are essential for evaluation of anyone with a posttraumatic hemarthrosis of the knee. These should include at least AP/lateral, notch and Merchant views and occasionally oblique views may be quite beneficial, especially for suspected osteochondral surface injuries in a skeletally immature individual.

Critical Knee Injuries include those involving significant ligamentous injuries which may allow for significant instability about the knee in the future. These would certainly include posterior cruciate ligament and anterior cruciate ligament injuries as well as combined ligamentous injuries of the knee. Commonly, isolated medial collateral ligament injuries can be treated conservatively. Lateral collateral ligament injuries are infrequent and, if present, are frequently involved with a combined ligamentous injury. Injuries to the anterior cruciate ligament can be significantly disabling to athletic performance and occur in a significant frequency with regard to posterior cruciate ligament injuries. Suspicions need to be high in skeletally immature individuals for ostechondral or chondral surface injuries as their cartilage seems to fail more in a shearing or torsional mechanism and these individuals appear to be more predisposed to this type of injury pattern than ligamentous injuries to the knee. X-rays may frequently be normal in these individuals.

High level of suspicion is warranted for meniscal tears, especially in the young athlete, with large hemarthroses, are frequently accompanied by ligamentous injury of the knee, usually the anterior cruciate ligament injury. In anyone with an anterior cruciate ligament injury, one should be suspicious for meniscal pathology, especially if they have had a longstanding injury and have had frequent giving way episodes. Hemarthrosis there following frequent giving way episodes and focal joint line pain, is commonly associated with unstable meniscal tears and represents a significant future problem for the athlete.

Patellar dislocations with chronic and acute instability problems in the athlete, also can represent significant disability, especially if associated with osteochondral fracture following patellar relocation after dislocation. These need to be sought out carefully as well with radiographic evaluation as well as clinical suspicion.
Any neurovascular compromise needs to be treated obviously in an urgent situation. Close attention to significant injuries with accompanying swelling and parathesias warrant concern for compartment syndromes of the lower extremity. These can occur even without a distinct fracture and a high level of suspicion needs to be maintained, with continued close observation/referral for urgent definitive evaluation and treatment.

In “critical” knee injuries, it is important that on initial evaluation, as long as there is no neurovascular compromise or significant instability of the knee, that referral to an orthopedic surgeon is prudent, especially in those individuals with a posttraumatic acute hemarthrosis.

Aspiration of the knee can occasionally be beneficial early on if the hemarthrosis is quite tense and painful; if not painful, there is not an absolute indication to remove the hemarthrosis although is suspected osteochondral fractures, the evidence of fat globules in the bloody hemarthrosis can be helpful diagnostically.

Most cases of acute hemarthroses of the knee are not associated with osteochondral surface injury or fracture and associated with acute anterior cruciate ligament injury. It is not unreasonable to begin the injured athlete on an ice, compression and gentle active range of motion program to facilitate normalization of knee function; frequently, crutch use is beneficial as there will be significant amount of quadriceps inhibition, making ambulation difficult. In any acute osteochondral surface injuries or fractures, obviously the patient should be maintained in the non-weight bearing mode until further treatment can be carried out.

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