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How I Manage Knee Dislocations

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Knee dislocations are rare injuries once thought to be seen only once in an orthopedic surgeon's career. With increasing incidence, because of better recognition and survival of high-energy trauma, an orthopedic surgeon is more likely to see and should be wary of a knee dislocation. Our experience is unique in that the authors (RCS, DCW, and GT) maintain an academic sports medicine practice but also deal with complex trauma at a level I trauma center. We believe this provides us experience with both low-energy (sports related) and high-energy mechanisms, which has influenced our publications. Each knee dislocation takes on a different character, and the approach can be very different depending on each patient and mechanism of injury. We share with the reader our approach to both low-energy and high-energy knee dislocations.
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Knee dislocations (KDs) are uncommon but potentially devastating injuries that can be difficult to manage. Once thought to be rare and classically defined as a complete loss of continuity of the tibiofemoral articulation, the definition has been expanded to include bicruciate knee injuries. Our experience has shown that approximately 50% of KDs will be reduced at presentation. Some of these KDs spontaneously reduce, and some are reduced by emergency personnel before arrival in the trauma center. We found that the incidence of vascular injury is equal in dislocated and reduced KDs, emphasizing the importance of diagnosing the "spontaneously reduced" KD.[1] Furthermore, when a KD presents reduced, the position-based classification cannot be applied. With this in mind, a high index of suspicion is necessary to ensure that a knee dislocation is not missed. Most KDs are the result of high-energy trauma, but they also can be the result of low-energy trauma, such as recreational sporting activities.[2,3] Associated vascular and nerve injuries are not uncommon, with both high and low-energy injuries, and when encountered make a complex ligamentous knee injury even more difficult to manage.

Diagnosis of KDs begins with a thorough history when possible and a careful physical examination. An unrecognized or reduced KD can have devastating vascular consequences if missed. A careful physical examination of the trauma patient is essential to evaluate ligamentous stability of the knee as well as the neurovascular status of the lower extremities. Because most KDs often present as 1 component of the patient injured with multitrauma, it is essential to do a thorough survey of the patient so as not to miss any potentially life-threatening injuries, including overlooking a KD, and recognize the relative gravity of each injury in the management of the patient. Physical examination should include careful inspection of the soft tissues, a thorough neurovascular examination, and a complete ligamentous examination of a swollen knee.

Imaging of the dislocated knee is essential and can give subtle clues in a spontaneously reduced KD. Plain radiographs of the knee are helpful in identifying the direction of dislocation in those knees that present dislocated but at first glance are often considered negative in patients who had spontaneous reduction. Subtle signs of ligamentous injury such as slight joint distraction, joint subluxation, or avulsion fractures may be present in the KD and with experience will become recognizable radiographic features (Fig. 1). Obtaining plain radiographs should never delay prompt reduction but may help with the reduction maneuver and reveal associated fractures. A computed tomography scan can be useful in assessing avulsion fractures or concomitant periarticular fractures. However, magnetic resonance imaging (MRI) allows for identification of the extent and location of ligament injuries for surgical planning but sometimes does not accurately show the functional status of the ligaments. Examination under anesthesia, first, and arthroscopy, second, in con-

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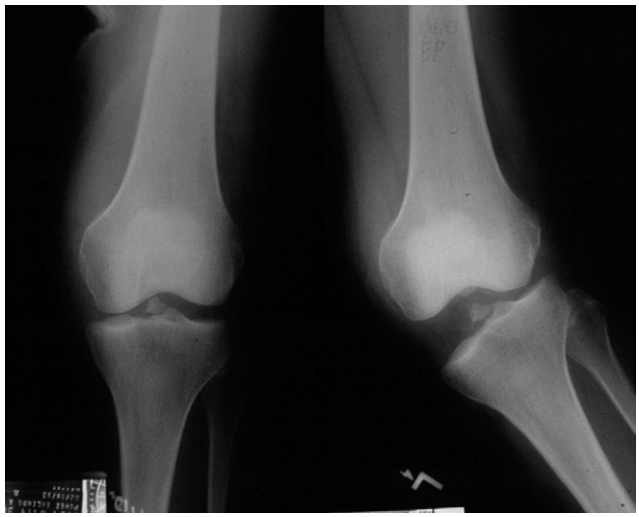

Figure 1 Anteroposterior and stress view of the knee showing avulsion fracture of tibial eminence and medial joint space opening with valgus stress (Reprinted with permission from Moore K et al.[30]).

junction with MRI are the most useful tools in the evaluation of ligament integrity, especially with injury to the posterior cruciate ligament (PCL) and posterolateral corner (PLC).[4]

Although KDs have traditionally been classified by direction of the dislocation, it is not applicable in those patients who present reduced, and it is not helpful in predicting the severity of the injury or in planning for surgical treatment. The anatomic classification conveys the severity and location of the ligamentous injuries as well as the neurovascular status of the limb. This also allows for better communication between providers and helps plan treatment (Table 1).[4,5] KDI identifies the cruciate intact dislocation and can involve either a tear of the PCL or the anterior cruciate ligament (ACL). An isolated bicruciate injury with functionally intact collaterals is classified as a KDII. Three-ligament dislocations, medial sided (KDIIIM) or lateral sided (KDIIIL), are the most common presentation in high-energy injuries. KDIV is a complex, difficult problem with injury to all 4 ligaments, and KDV is a fracture dislocation that can be further classified by that described by Moore[6] and others.[7] Those KDs with nerve and vascular injuries are designated by the subset N and C, respectively.

Vascular injury is commonly associated with KDs, and careful evaluation of the vascular status of the lower extremities is essential. It is our approach to use selective angiography in those patients with a high likelihood of vascular injury. Figure 2 shows the algorithm we use to help guide selection of those patients who should undergo angiography. Initial vascular examination (posterior tibialis and dorsalis pedis pulses) both pre- and postreduction is required. Those patients with signs of vascular insufficiency (ie, absent pulses or ischemia) should have immediate vascular surgery consult and popliteal artery repair or reconstruction. Stannard et al[7] showed that serial physical examinations looking for any decrease in pedal pulses, change in color or temperature, expanding hematoma around the knee, or history of an abnormal examination before presentation are indications for angiography. Ankle brachial indexes (ABIs) have been shown to be a helpful adjunct in deciding which patients should undergo angiography. An ABI of less than 0.9 has been shown to be 100% sensitive in detecting arterial injury.[8-10] At our institution, those patients with an ABI less than 0.9 require a vascular surgery consult and angiography. Patients who do not undergo angiography should be admitted for serial clinical examinations over a period of 24 to 48 hours. If the patient's clinical condition precludes serial examinations, an angiogram should be obtained promptly. We have found computed tomography angiography to be helpful and relatively easy to obtain in those patients with suspected vascular injury, but further clinical investigation is necessary to determine its role in KDs.[11,12] Although clinical examination and noninvasive testing can be reassuring, angiography remains the gold standard for diagnosing arterial injury. One should not hesitate to consult vascular surgery and perform an angiogram if concerned about vascular compromise.

Initial Treatment

Initial management is directed at the Advanced Trauma and Life Support (ATLS) ABC's and initial resuscitation of the patient. Reduction should be performed promptly in the emergency department, and the patient should be immobilized in either a posterior splint or hinged knee brace in slight flexion. Postreduction radiographs can identify avulsion fractures and confirm a concentric reduction. Any vascular injuries that are identified should be addressed within 6 to 8 hours to avoid loss of limb. Open injuries should be reduced and undergo an emergent irrigation and debridement in the operating room. For those knees that show postreduction subluxation, require open reduction of the joint, undergo vascular repair, or need extremity or soft-tissue stabilization, we routinely place a spanning external fixator (Fig. 3). Two 5.0-mm bicortical pins in both the anterolateral femur and anterior medial tibia shaft connected by bars will provide rigid stabilization of the knee joint. The pins should be placed far enough away from the knee joint to avoid compromising future reconstruction (Fig. 4).[13] The external fixator allows access to wounds and vascular structures for future monitoring. We recently completed a study evaluating the stiffness of an external fixator across the knee joint that showed an external fixator with anterolateral femoral pins to avoid the

Table 1 The Anatomic Classification of Knee Dislocations

Class	Injury
KDI	PCL-intact knee dislocation, usually ACL and LCL torn, also includes ACL intact knee with complete PCL tear
KDII	ACL and PCL torn, collaterals intact
KDIIIM	ACL, PCL and MCL torn, lateral side intact
KDIIIL	ACL, PCL and PLC torn, medial side intact
KDIV	All 4 ligaments torn
KDV	Fracture dislocation

C, arterial injury; N, nerve injury.
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