Knee Injuries

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ABSTRACT
Knee injuries are common complaints in patients presenting to the emergency department. An understanding of the pathogenesis and symptoms of these injuries helps the nurse practitioner recognize, treat, and refer patients appropriately. This article outlines the pathophysiology and symptoms of injuries of the knee including fractures, dislocations, subluxation, ligamentous injuries, bone tumors, meniscal tears, extensor mechanism tendinopathy and disruption, bursitis, popliteal cysts, and osteoarthritis. Specific knee injury grading and classification will also be reviewed. Key words: condyle, femur, ligament, meniscus, patella, tibia

Knee injuries are the fifth leading health complaint within the United States (Dascola & Ward, 2005). More than 2.5 million people sought care from their primary care provider in 2000 for knee injuries (Dascola & Ward, 2005). Knee injuries are often seen and treated within the emergency department. A thorough understanding of common knee ailments is important for the nurse practitioner working in the environment of the emergency department.

ANATOMY
Knee

The knee is the largest of the joints within the skeletal system. It contains three bones: the femur, patella, and tibia. There are three articulations: the patellofemoral, lateral, and medial condylar joints (Simon, Sherman, & Koenigsknecht, 2007). There are four ligaments that help to provide the stabilization of the knee joint: the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), medial collateral ligament (MCL), and the lateral collateral ligament (LCL). Figure 1 depicts the normal knee anatomy. In addition, the quadriceps tendon, pes anserinus, semimembranosus, iliotibial tract, biceps femoris, and the popliteus muscle aid in the stabilization of the knee (Simon et al., 2007). The lateral and medial menisci separate the femur and the tibia, and are composed of cartilaginous tissue. Synovial fluid lines bursae sacs, and helps to provide frictionless movement between the muscle and tendon structures of the knee (Simon et al., 2007).

INTRAARTICULAR INJURIES

Ligamentous Injuries

The PCL, ACL, MCL, and LCL act together and provide stabilization of the knee.
Ligamentous injuries are common injuries of the knee, especially in athletic individuals of all ages (Quarles & Hosey, 2004). These injuries are classified as Grades I through III. Grade I injuries are incomplete small tears of the ligament, and are considered a mild injury. Patients with a Grade I injury may present with minimal localized swelling and tenderness. Grade II injuries are considered moderate in severity and patients may present with swelling and sensitivity over the affected area. In Grade III injuries, the most severe of all three ligamentous injuries, there is complete rupture of the ligament. A patient with a Grade III injury may present with pain and edema to the affected area, and may have difficulty with ambulation (Simon et al., 2007).

According to Brown and Trojan (2004), an estimated 1 in 3,000 people in North America suffer from ACL ruptures each year. ACL injuries normally occur as a result of a valgus stress from twisting, hyperextension, or deceleration. Patients with ACL tears often report having heard a “pop” as the injury occurred (Brown & Trojan, 2004).

Tears of the PCL make up 3% of the ligamentous injuries of the knee. The mechanism of injury is commonly caused by hyperflexion, with subsequent impact to the proximal tibia (Brown & Trojan, 2004).

The MCL provides the stability to the medial aspect of the knee. It is responsible for providing resistance against valgus forces as well as stabilization of the medial meniscus, whereas the LCL provides resistance against varus stresses. MCL injuries are commonly seen in skiers. According to Quarles and Hosey (2004), other noncontact sports such as swimming and gymnastics can lead to MCL injuries due to the physical stress applied to the knee.

**Meniscus Tears**

The lateral and medial menisci separate the femoral condyles from the tibial plateau, and are composed of cartilaginous tissue. The
Menisci provide load distribution, cushion, and protection against friction, which can potentially result in osteoarthrosis (Messner & Gao, 1998). Patients with meniscal tears often report having heard a “clicking” sound with knee extension.

Medial meniscus injuries are often associated with injuries of the MCL, and occur more often than lateral meniscus injuries due to the mobility, connection, and structure of the knee. Tears to the menisci can occur as a result of trauma, or from overuse. The mechanism of traumatic injury occurs when the knee is flexed and a twisting motion is applied. These patients complain of joint tenderness and present with joint effusion. Patients with nontraumatic injury complain of joint instability, especially in regard to elevation changes such as walking down the stairs (Buttaro, Trybulski, Bailey, & Sanderberg-Cook, 2003a).

**EXTRAARTICULAR INJURIES**

**Extensor Mechanism Tendinopathy**

Often referred to as jumper’s knee, extensor mechanism tendinopathy is the result of inflammation or tearing of the patellar tendon, or quadriceps tendon. It is most often seen in teenage boys, and caused by the repetitive motion of jumping or by a rapid increase in velocity followed by a sudden deceleration (Calmbach & Hutchens, 2003; Simon et al., 2007).

**Extensor Mechanism Disruption**

Quadriceps and patellar tendon ruptures are often reported as a sudden collapsing of the knee followed by excruciating pain. Commonly, the mechanism of injury is reported as an accidental trip down an incline, however, a traumatic blow against a contracted quadriceps muscle can also bring about such an injury. Ruptures of the quadriceps tendon are more often seen in middle-aged adults (Simon et al., 2007).

**Bursitis**

The bursa is a synovial-lined cavity that aids in friction reduction between the bony structures of the knee. There are seven different bursae throughout the knee, which include the gastrocnemius and fibular head, popliteal, semimembranous, prepatellar, superficial, and deep infrapatellar, and anserine. Inflammation of the bursa sac, bursitis, can be caused by an acute injury or from chronic mistreatment of the knee (Simon et al., 2007).

**Popliteal Cyst**

The synovial cavity of the knee connects with the semimembranous bursa sac. When this area becomes inflamed, large amounts of synovial fluid enter into the bursa sac causing the sac to spread outward and extend through the popliteal fossa. It is this phenomenon that causes a popliteal cyst, better known as Baker’s cyst. Once ruptured, the Baker’s cyst
is difficult to distinguish from a vessel thrombosis. It should be noted that Baker’s cysts are never aspirated (Simon et al., 2007).

**Osteoarthritis**

Osteoarthritis, according to Hawker et al. (2000), is the largest contributor to long-term disability in individuals (Figure 2). Women have a higher incidence of osteoarthritis than men (Hawker et al., 2000). Osteoarthritis has the highest rate of incidence among arthritic ailments, and is most often diagnosed between 40 and 60 years of age. It occurs as a result of the ineffective articular cartilage. As the body ages, the articular cartilage naturally starts to become less effective. As the condition progresses, the articular cartilage first softens, becomes overextended with fluid, and eventually thins out. This leads to remodeling of the cartilaginous surface, and finally results in friction upon joint movement causing osteoarthritis. Patients with osteoarthritis often complain of joint stiffness, as well as unilateral pain. Age, obesity, genetics, injury, and repetitive occupations or sports are considered to be a few of the contributors of osteoarthritis (Buttaro et al., 2003b).

**DISLOCATION AND SUBLUXATION**

**Knee Dislocation**

According to Simon et al. (2007), dislocations of the knee occur in less than 0.02% of the population presenting with knee complaints. Knee dislocations are always considered orthopedic emergencies owing to the potential involvement and injury of the popliteal artery. Up to 86% of patients require amputation if treatment is delayed for more than 8 hr following injury. Injury to peroneal and tibial nerves occurs a minimum of 16% of the time in knee dislocations (Simon et al., 2007).

A *Q angle* is a measurement used to determine the alignment of the quadriceps muscle and the patella (Figure 3) (Simon et al., 2007). A standard measurement is 15°, yet in young women, the quadriceps angle is increased, making them more susceptible to patellar subluxation (Calmbach & Hutchens, 2003).

**Patellar Dislocation**

Patellar dislocation, or subluxation, occurs as a result of direct trauma to the patella or from overflexion of the knee. On examination, joint effusion may be present and, more commonly, the patella may be subluxed to the lateral side of the joint (Wolfson et al., 2005).

**FRACTURES**

As stated by Uphold and Graham (2003), 6% of traumatic knee injuries result in fractures. Fractures can occur at the femoral condyle, tibial plateau, and patella.
Distal Femur Fractures

Distal femur fractures are classified depending on the extent of injury. The three variations of fractures include supracondylar, condylar, and bicondylar (Figures 4 and 5). A supracondylar fracture is a complete break off the distal head of the femur’s shaft of the bone. A condylar fracture is one that occurs unilaterally at a femoral condyle, whereas a bicondylar fracture includes bilateral femoral condyles fractures (Simon et al., 2007).

Because of the close approximation of the popliteal vessels to the distal femur, more injuries of these vascular structures should be considered when assessing distal femur fractures (Simon et al., 2007). Another consideration that must be accounted for is the involvement of the growth plate in the pediatric population. Salter-Harris fractures can initially be stabilized by an advanced practice nurse, however, patients with Salter-Harris fractures need to be further evaluated by an orthopedist (Cerepani & Ramponi, 2007).

Proximal Tibial Fractures

According to Simon et al. (2007), tibial fractures are classified in regard to the anatomy of the fracture, and include tibial epiphyseal, tibial subcondylar, tibial tuberosity, and proximal tibial plateau fractures.
Tibial spine, and tibial plateau fractures. Tibial plateau fractures occur as a result of excessive compression and/or rotation of the tibial plateau. Tibial plateau fractures can be further divided (Types 1–6) on the basis of the extent of the injury (Figure 6). Type 1 fractures, also known as split fractures, are fractures of the lateral condyle. These fractures are the least acute of the six fracture types. Type 2 fractures are fractures of the lateral condyle with involvement of the medial tibial plateau, which is compressed downward.

Type 3 fractures occur when there is depression of the lateral condyle, whereas Type 4 fractures are fractures of the medial condyle. Type 5 fractures involve both the lateral and medial tibial condyles, and involve downward compression and displacement of the tibial plateau. The most extensive tibial plateau injuries are the Type 6 fractures representing a complete separation from the shaft of the tibia along with bicondylar fractures and depression of the tibial plateau (Simon et al., 2007) (Figures 7 and 8).

Figure 6. Tibial plateau fractures (Types 1–6).
Figure 7. Comminuted and displaced anterior tibial plateau fracture.

Figure 8. Nondisplaced proximal tibial fracture. Note the fracture line below the level of the joint at the same level as the fibular fracture.

Figure 9. Fracture of the spines of the knee. Note the blunted tips of the tibial spine: indicating a tear of cruciate ligaments at the spine insertion.

Tibial Spine Fractures

The tibial spine is a bony prominence that lies at the proximal end of the tibia. Fractures of the tibial spine are most commonly seen in children 8 to 14 years of age. These injuries normally occur when the knee is hyperflexed or hyperextended and an indirect force is applied to the knee. This injury may also include injury to the cruciate and collateral ligaments (Simon et al., 2007) (Figure 9).

Tibial Tuberosity Fractures

Tibial tuberosity fractures are uncommon, and occur when the quadriceps is engaged against a flexed knee. Like the tibial spine fracture, tibial tuberosity fractures are most often seen in a younger population (Simon et al., 2007). According to Drabicki, Greer, and...
DeMeo (2006), Osgood-Schlatter disease, an overuse syndrome causing irritation and potential development disturbance of the tibial tuberosity (Calmbach & Hutchens, 2003), is thought to increase a patient’s risk of developing a stress fracture to this area.

**Subcondylar Tibial Fractures and Epiphyseal Fractures**

Fractures that occur at the tibial metaphysis are termed subcondylar tibial fractures. These fractures normally have condylar involvement as well (Simon et al., 2007). Epiphyseal fractures are uncommon in the long bones surrounding the knee, but need immediate attention owing to the possibility of bone growth retardation or abnormality (Simon et al., 2007).

**Patella Fractures**

Patella fractures are most commonly seen in patients from 20 to 50 years of age (Simon et al., 2007). These fractures occur from trauma directly applied to the patella, and are often seen in the emergency department in patients involved in automobile crashes (Figure 10).

**TUMORS**

Tumors of the musculoskeletal areas of the knee are very uncommon, however, many are misdiagnosed and mistreated as athletic injuries (Figure 11). Malignant tumors of the knee include osteosarcoma, Ewing’s sarcoma,

In a study by Muscolo et al. (2003) of 667 knee tumors, 3.7% were misdiagnosed and treated as sports-related injuries. The researchers reported that the delay in diagnosis affected surgical treatment in 15 of the 25 misdiagnosed patients.

**CONCLUSION**

A general overview of common knee disorders was presented. For the nurse practitioner working in the emergency department, understanding the pathogenesis and symptoms of common knee disorders is imperative for the safety of these patients.

**REFERENCES**


