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# ROTATORY KNEE DISLOCATION: AN UNCOMMON INJURY

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**ABSTRACT**
Traumatic knee dislocation constitutes an infrequently seen and true orthopedic emergency. Rotatory dislocations of the knee represent the rarest form of knee dislocation. This injury often results from impact trauma. We present a case report involving a traumatic posterolateral rotatory knee dislocation in an adult female that was successfully reduced in the emergency department. This is the first reported case of a rotatory dislocation of the knee outside the orthopedic literature.

## INTRODUCTION

Traumatic knee dislocation constitutes a true orthopedic emergency. Dislocations of the knee are relatively uncommon injuries. Rotatory dislocations are the rarest form of knee dislocation. This injury usually results from high impact trauma [1-3]. Neurovascular complications may lead to debilitating consequences if the diagnosis and treatment is delayed [1, 2, 4]. Associated morbidity includes degenerative arthritis, permanent nerve injury, and amputation. The poorest prognosis is seen in patients whose knee is dislocated for longer than 6-8 hours before the reduction [5].

Dislocation of the knee joint can cause disruption of the popliteal vessels, the collateral and cruciate ligaments, and nerve injuries. While nerve and ligament damage can be severe, it is the vascular injury that results in significant morbidity. Evaluation includes a meticulous assessment of the neurovascular status of the distal leg. A lower extremity arteriogram or CT angiogram is required to rule out a vascular injury.

The following case report involves a traumatic rotatory knee dislocation in an adult female. It was successfully reduced in the emergency department using procedural sedation and closed reduction. Review of the literature and discussion of its management follows. This is the first reported case of a rotatory knee subluxation in the emergency medicine literature.

## CASE REPORT

A 26 year old female presented with the complaint of right knee pain following an accidental fall. The patient was being carried when she was dropped onto her extended right leg. Her heel impacted into the ground and her body twisted as she fell. She immediately heard a popping noise and felt extreme pain on the lateral aspect of the knee. She was unable to move her knee or walk after the injury. She denied any numbness, paresthesias or loss of sensation.

The patient has a significant past medical history of a repaired meniscal tear in the right knee five years prior to the current injury. She has also had a laminectomy and diskectomy of L5-S1 approximately ten years ago. She is currently taking no medications. Allergies were noted to Compazine and Toradol. On further questioning, these appeared to be adverse drug reactions and not true allergies. She smokes cigarettes and drinks alcohol in social situations. On the day of the injury, she had three 12-ounce beers. She is currently a nursing student.

On physical examination, the patient was alert and in moderate distress. Vital signs revealed a blood pressure of 132/76, heart rate of 104 beats/minute, respiratory rate of 20 breaths/minute, and an oral temperature of 97.8$^{o}$ Fahrenheit. She had the odor of alcohol on her breath but did not appear to be clinically intoxicated. The physical examination was unremarkable except for the right lower extremity. Complete evaluation was limited. A small abrasion was noted over the anterior knee. The knee was locked in extension with a mild valgus deformity [Figure 1]. There was marked swelling and deformity of the knee joint. The patella was displaced medially. The tibia was externally rotated on the femur. The dorsalis pedis and posterior tibial pulses were intact and symmetrical in intensity when compared to the opposite extremity. Capillary refill was noted to be less than two seconds. Dorsiflexion and plantarflexion of the ankle was normal. She had normal sensation to light touch, pinprick, and vibration. The Achilles reflex was normal. Due to the knee being locked, we were unable to perform range of motion or stress testing of the knee. The ankle-brachial index was normal.

Initial radiographs demonstrated a posterolateral rotatory dislocation of the knee [Figures 2 & 3]. After obtaining informed consent, the patient underwent procedural sedation. Using gentle distal traction and internal rotation coupled with counter-traction of the thigh, the tibia was reduced without any complications. After reduction, the repeat neurovascular exam was unremarkable. The patient regained good range of motion with no evidence of ligamentous instability. The leg was immobilized in a posterior long leg splint. Post-reduction films demonstrated normal alignment with no evidence of a fracture. CT angiography of the right leg revealed the popliteal artery and surrounding arteries to be intact.

The patient was admitted to the orthopedic service for observation and serial neurovascular exams. She did well and was discharged the following day with continued immobilization and orthopedic follow-up.

## DISCUSSION

Traumatic knee dislocations are a relatively rare occurrence. This serious injury typically results from high-energy trauma as seen with motor vehicle collisions and contact sports [1-3]. It also occurs with low impact trauma from falls, stepping into holes, and stationary hyperextension [1, 6-8]. The true incidence of knee dislocations is unknown [2]. Many go undiagnosed secondary to spontaneous reduction prior to evaluation by a physician [2, 9].

Classically, knee dislocations are described as an alteration of the normal tibiofemoral articulation. They are classified into categories based on the direction in which the tibia is displaced relative to the femur. Dislocations may be anterior, posterior, medial, lateral, or rotatory in direction [Figure 4]. They are further classified as open or closed, and reducible or irreducible.

The true incidence of each type of knee dislocation cannot be determined [6, 8, 10-14]. The number of dislocations reported in the literature is very small. Additionally, an unknown number of knee dislocations spontaneously reduce prior to seeking medical care. The largest published review of knee dislocations contained 245 patients [10]. The incidence of dislocations was 31% anterior, 25% posterior, 13% lateral, 4% rotatory, 3% medial, and 19% unspecified. The most commonly seen dislocation of the knee is in the anterior direction; in which the proximal tibia is anterior to the distal femur.

Rotatory dislocations are sub-classified based on the direction the tibia is displaced relative to the femur. They may be anterolateral, anteromedial, posteromedial, or posterolateral. Rotatory dislocations are the rarest form of knee dislocation with an incidence of 3-4% [10, 15, 16]. Our patient had a posterolateral rotatory dislocation. Abduction and rotation of the tibia while the knee is flexed usually cause rotatory dislocations. Frequently, the foot is planted on the ground and the body rotates with the pivot point being the knee.

Knee dislocations usually present with a deformed and painful knee. Occasionally, the knee is not deformed due to spontaneous reduction of the dislocation [1]. Splints applied by prehospital personnel may also reduce a dislocation or subluxation. The presence of a varus or valgus instability with the knee in full extension is a clue to the presence of a reduced knee dislocation. Diffuse tenderness about the knee associated with popliteal fossa ecchymosis and lacking a palpable hemarthrosis is suggestive of a reduced knee dislocation. A neurovascular assessment should be performed immediately, at appropriate intervals to monitor the extremity, and after any manipulation. Absent pulses or decreased pulses in the distal extremity, an abnormal ankle-brachial index, or a peroneal nerve deficit after a knee injury suggests that the knee was dislocated. Parenteral analgesics should be administered if there are no contraindications.

The knee is normally a stable joint with numerous strong ligaments for support. For a knee to become dislocated, the ligamentous structures must be disrupted to a varying degree. Because dislocations may spontaneously reduce, any knee that presents with severe ligamentous instability should be considered a spontaneously reduced dislocation until proven otherwise. If not properly managed, ligamentous instability after a knee dislocation or subluxation can lead to chronic disability. Treatment ranges from closed reduction and immobilization to open repair with reconstruction [1, 2]. Management typically depends on the extent of the injury, associated injuries, the patient's age and health status, occupation, athletic status, and the consulting orthopedist. However, long-term pain, stiffness, and loss of motion may inevitably occur regardless of the treatment method.

Damage to the popliteal artery remains the most devastating complication of a knee dislocation. The popliteal artery is injured in up to 40% of all knee

dislocations [2, 10]. Popliteal artery injury is encountered in both low and high impact injuries [7, 17]. Any evidence of vascular insufficiency distal to the knee after an injury suggests an arterial injury until proven otherwise. Failure to recognize a complete or partial popliteal artery disruption can result in ischemia requiring an amputation. Revascularization of the avascular leg is most successful when performed within six to eight hours after the initial injury [5, 18]. The incidence of amputation increases up to 86% when vascular repair is delayed greater than eight hours after the initial injury [10].

Damage to the nerves that cross the knee joint can be seen in up to 49% of knee dislocations [2, 14]. Nerve injury ranges from neuropraxia to complete disruption. Clinical assessment should include a complete neurological evaluation of the lower extremity. While the common peroneal nerve is the most commonly injured nerve, the tibial nerve may also be injured [8, 14]. Traction injury, or a stretching, to the nerve is the most common mechanism of nerve injury. Knee dislocations should be reduced as soon as possible to reduce traction on the blood vessels and nerves. Occasionally, the nerve is stretched until it tears [15, 19]. Avulsion injury to the nerve is seen in up to 22% of knee dislocations [19]. Treatment of nerve injury is controversial because of the poor prognosis [1, 2, 4, 15]. Primary surgical repair and nerve grafting are generally unsuccessful. Some advocate allowing spontaneous recovery without intervention for three months before surgical repair is considered.

Initial radiographs may be delayed until the knee is reduced if the leg has diminished pulses, no pulses, or a neurological deficit distal to the knee [15]. Anteroposterior and lateral plain films accomplish radiologic evaluation. Additional views may be required if an abnormality is seen on the above two radiographs. Radiographs should be repeated after any manipulation. These repeat x-rays allow the physician to assess for a fracture not seen on the initial x-rays or possibly a bony abnormality that occurred during the reduction.

The definitive treatment of a knee dislocation is provided by the orthopedist and is often surgical. Initial treatment often involves reducing the dislocation in the emergency department. If neurovascular compromise is present, the joint should be reduced by the emergency physician as soon as possible. If the distal leg is neurovascularly intact, an orthopedist should be consulted prior to reduction. Sometimes, at the consultant's discretion, the patients are taken to the operating room for reduction and examination under general anesthesia. Unless contraindicated, procedural sedation should be provided to the patient if the joint is to be reduced in the emergency department.

Dislocations of the knee can often be reduced in the emergency department. The method of traction-countertraction with possible manipulation is required to reduce the dislocation [Figure 5]. This reduction requires the physician and an assistant; in addition to the nurse who provides monitoring during the conscious sedation. The assistant stands next to the patients' thigh. They should hold and stabilize the distal femur of the affected leg. The physician stands by the ankle and applies in-line traction while extending the knee. Often, the application of in-line traction is all that is needed to reduce the knee. If the knee does not reduce with in-line traction, the distal femur or proximal tibia should be manipulated under traction to reduce the knee to its proper anatomical relationship.

Rotatory dislocations may sometimes be irreducible in the emergency department due to buttonholing [6, 8, 20, 21]. This results from invagination of the medial joint capsule and the medial collateral ligament into the joint and becoming entrapped. The medial femoral condyle may also get caught in the rent of the invaginated joint capsule. This will cause a dimple in the skin over the medial joint line. Buttonholing is an indication for immediate open reduction.

Reduction of a knee dislocation does not necessarily restore circulation to the distal leg. Green and Allen have documented 56 pulseless distal extremities after a knee dislocation; only 5 of which had pulses restored after reduction [10]. If distal ischemia persists after reduction, surgical repair and exploration are urgent and should not be delayed to obtain an arteriogram. If necessary, the arteriogram can be performed in the operating room. Arteriography offers little information in an isolated knee injury with vascular insufficiency. The surgical approach and injury are both in the popliteal fossa.

The postreduction care involves neurovascular assessment, immobilization, and arteriography. After reduction, the neurovascular status of the extremity should be evaluated and documented. A long leg splint should be applied with the knee in $20^{o}$-$30^{o}$ of flexion. The knee should not be examined for ligamentous instability after the reduction, as it is often unstable after a dislocation. Examination will cause the patient unnecessary pain and may further damage already injured structures. Additionally, ligamentous testing adds nothing to the emergency department management of the patient.

Arteriography has long been the gold standard for vascular assessment after knee dislocation. If vascular compromise exists, the dislocation should be reduced prior to arteriography. A vascular surgeon should be consulted if vascular insufficiency is identified prior to or after reduction of the knee. Although abnormal peripheral pulses are highly predictive of major arterial injury, there are documented cases of significant arterial damage despite normal peripheral pulses on initial examination [22]. The presence of pulses may not be a reliable indicator of arterial injury. It is therefore mandatory that all knee dislocations undergo arteriography [22-25]. After a popliteal injury has been confirmed, the patient may undergo surgical exploration and vascular repair. If the arteriogram shows only an intimal tear, some authors anticoagulate the patient, if no contraindications exist, for one week [1]. They believe that the risk of an intimal tear

progressing to thromboses and vascular insufficiency is very low after five to seven days.

The use of radiologic imaging is mandatory [26-29]. The role of duplex ultrasonography has increased over the years. Unfortunately, this may not be available 24 hours a day. CT angiography is available 24 hours a day, cost effective, quick, and reliable in identifying vascular injuries. Arterial arteriography is considered the 'gold standard'. Its use is expensive, requires specially trained personnel in the radiology suite, slow, and may miss proximal extremity vascular injuries due to the technique. MRI is usually not available 24 hours a day, expensive, and slow.

All patients with a knee dislocation that is reduced spontaneously or in the emergency department should be admitted for observation. Evidence of vascular compromise may be delayed. Neurovascular checks should be performed every one to two hours. The patient should have urgent arteriography to evaluate the arterial tree around the knee prior to discharge from the hospital.

**Fig 1. The affected right leg with a valgus deformity**

**Fig 2. Anteroposterior radiograph of the dislocated knee**

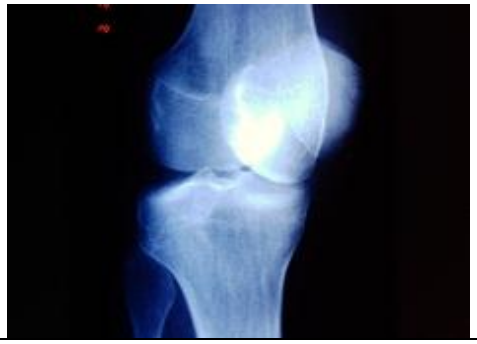

**Fig 3. Lateral radiograph of the dislocated knee**

**Fig 4. The types or directions of knee dislocations**

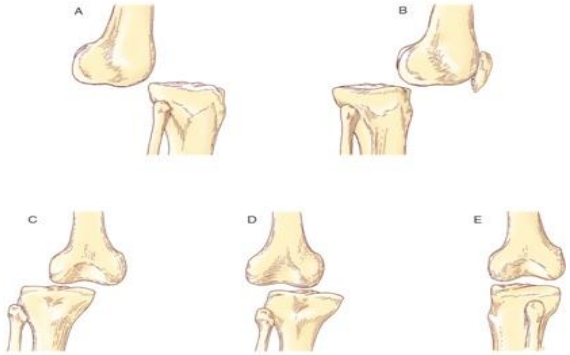


**Fig 5. The method to reduce a knee dislocation**


## CONCLUSION

The emergency medicine literature has a paucity on the topic of knee dislocations. We presented a case of a posterolateral rotatory knee dislocation. Traumatic knee dislocations are associated with a significant incidence of neurovascular injury and can be limb threatening. Neurovascular status of the injured limb should be promptly assessed. Those patients who present with abnormal pulse exam, limb pallor, coolness, cyanosis, and or decreased capillary refill have acute ischemia requiring immediate surgical exploration and vascular repair. Amputation and severe disability can be avoided if the vascular repair is completed on a pulseless distal leg within 6-8 hours of the injury. Those with normal vascular exams who do not show signs of acute ischemia should be hospitalized for serial neurovascular exams. Arteriography

is the standard means of arterial evaluation and is required on all patients with a knee dislocation.

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**CONFLICT OF INTEREST**

The author declares that he has no conflicts of interest.

**STATEMENT OF HUMAN & ANIMAL RIGHTS**

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by the author. This report was found by the institutional review board to be exempt (#66-03).

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