Traumatic Bilateral Knee Dislocations, Unilateral Hip Dislocation, and Contralateral Humeral Amputation: A Case Report

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Abstract Bilateral traumatic knee dislocations are a rarity. We report a case of bilateral traumatic knee dislocations with concomitant right hip dislocation and complete traumatic amputation of the left, nondominant upper extremity at the level of the proximal one-third of the humerus. Angiograms revealed no evidence of popliteal artery injury. Orthopedic treatment consisted of immediate reduction of the dislocations and urgent revision amputation of the upper extremity. Staged, bilateral knee ligamentous reconstructions were performed on hospital days 24 and 29, respectively. Despite this constellation of devastating injuries, the patient had a satisfactory outcome. In patients with high-energy hip or knee dislocations, the bilateral hips and knees should be carefully examined to check for associated fractures and/or dislocations.

Keywords knee dislocation · hip dislocation · traumatic amputation · multiligamentous knee reconstruction

Introduction

Unilateral traumatic knee dislocations are uncommon, accounting for less than 0.02% of all orthopedic injuries [1–4]. Bilateral traumatic knee dislocations are even rarer, and there are few reports in the literature [5, 6]. Cases of ipsilateral knee and hip dislocations have also been described [7–10]. Knee dislocations are associated with a host of morbidities, including multiligamentous instability, popliteal artery injury, peroneal nerve palsy, loss of motion, amputation, and intraarticular pathology such as meniscus and cartilage damage [1, 6, 11–16]. A series of options have been reported on the optimal treatment of these injuries in

the multiple ligament injured knee with variability as to the optimal timing of treatment of various aspects of the injury [17–20]. We report a case of bilateral traumatic knee dislocations with concomitant right hip dislocation and left upper extremity traumatic amputation. The patient provided informed consent for publication of the information contained in this case report.

Case report

A 31-year-old, unrestrained female driver suffered a rollover motor vehicle accident with subsequent extrication from the vehicle. The patient's left upper extremity was found traumatically amputated at the scene. The patient presented to the emergency department with a Glasgow Coma Scale (GCS) of 4, though computed tomography (CT) scan of the head, cervical spine, chest, and abdomen revealed no gross abnormalities. Upon stabilization, the patient was admitted to the surgical intensive care unit (ICU) for further monitoring.

Initial orthopedic evaluation in the trauma bay revealed a traumatic left upper extremity complete amputation at the level of the proximal one-third of the humerus. The right hip was held in a flexed and internally rotated position, and hip radiographs confirmed posterior dislocation (Fig. 1). Both knees were dislocated posteriorly and were reduced with gentle axial traction. The right hip was then subsequently reduced while an assistant stabilized the knee. Postreduction, both knees demonstrated gross instability in all directions on range of motion and ligamentous examination. Bilateral knee immobilizers were promptly applied after reduction. Post-reduction X-rays and pelvic CT confirmed successful concentric reduction of the hip without soft tissue interposition or fracture. Knee radiographs revealed no fractures or residual anterior tibial subluxation bilaterally, but there was residual gapping on the lateral side that reflects the ligamentous instability (Fig. 2). Assessment of distal vasculature of the extremities revealed palpable dorsalis pedis

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Fig. 1. Anteroposterior (AP) radiograph of the pelvis in the trauma bay revealing a right hip dislocation

pulses and nonpalpable posterior tibial pulses bilaterally. The posterior tibial arteries had clear triphasic signal with Doppler evaluation. Capillary refill was less than 2 s in the toes, and both lower extremities remained warm and pink. A vascular consult was obtained to evaluate the popliteal arteries. Bilateral lower extremity ankle brachial indexes were 1.20 on the right and 1.03 on the left. Bilateral lower extremity angiograms revealed no evidence of arterial injury. The patient's compartments were closely monitored and there was no evidence of compartment syndrome.

After initial stabilization of the patient in the ICU, revision of the nondominant left upper extremity amputation was performed in the operating room on hospital day 1.

Fig. 2. Bilateral AP radiographs of the knees taken in the emergency room with knee immobilizers in place. Radiographs reveal asymmetric joint space and instability after closed reduction

Following surgery, the patient was maintained on low-molecular-weight heparin and compression boots for deep venous thrombosis prophylaxis. An inferior vena cava filter was placed by interventional radiology on hospital day 2 due to the increased risk of thrombotic pulmonary embolus due to prolonged immobilization and multiple extremity injuries.

On hospital day 6, following extubation, preoperative bilateral knee magnetic resonance imaging (MRIs) were obtained. The MRI of the right knee demonstrated a disruption of the anterior cruciate ligament (ACL), an intact posterior cruciate ligament (PCL), a disruption of the posterior lateral corner complex, and a tear of the medial collateral ligament (MCL) (Fig. 3). No meniscal or osteochondral pathology was visualized. The left knee MRI revealed a disruption of both the ACL and PCL (Fig. 4), an avulsion of the lateral collateral ligament (LCL) and posterior lateral corner as well as a MCL tear. A radial medial meniscus tear was also visualized.

Staged, right and left knee multiligament reconstructions were performed on hospital days 24 and 29, respectively, following adequate resolution of knee swelling. A well-padded tourniquet was applied to the upper thigh of the operative extremity, but was not inflated during either procedure. Careful attention was directed toward stabilizing the contralateral extremity, and immediate examination following the removal of the sterile drapes confirmed stable dorsalis pedis and posterior tibial pulses. Vascular checks were performed on the operative extremity at various intervals during each case and consistently revealed stable pulses.

Examination under anesthesia of the right knee revealed gross instability on Lachman and anterior drawer tests of

Fig. 3. Right knee coronal T1-weighted MRI image revealing a posterolateral corner injury with midsubstance disruption of the LCL (arrow)

the ACL. Posterior drawer test revealed a stable PCL consistent with preoperative MRI. Varus and valgus stressing at 0° and 30° of the knee revealed grade III ligament disruptions laterally and medially, respectively. Posterolateral rotary instability was present on external rotation of the tibia at 30° of knee flexion. Diagnostic arthroscopy confirmed the ACL and popliteus injuries, while the menisci were found to be intact.

ACL reconstruction was then performed using an Achilles tendon allograft. However, the tibial side of the ACL graft was left free until medial and posterolateral ligament reconstruction was completed. Tibialis anterior allograft was used to reconstruct the posterolateral corner, and gracilis tendon autograft was used in MCL reconstruction, as described by Bosworth (Fig. 5) [21].

Examination under anesthesia of the left knee demonstrated gross instability in all directions and forms of testing, including Lachman, anterior and posterior drawer, varus and valgus stress at 0° and 30° of flexion, and external rotation dial tests. In addition to confirming the ligamentous injuries, the diagnostic arthroscopy also revealed a radial split tear of the posterior horn of the medial meniscus, for which partial meniscectomy was performed. The ACL was reconstructed with Achilles tendon allograft, the MCL with gracilis tendon autograft similar to the contralateral side, and the PCL with a second Achilles tendon allograft in single-bundle fashion. The LCL and posterolateral corner were repaired primarily using suture anchors, as, despite being full thickness, the LCL and popliteus stumps were found to be robust with minimal retraction. The ACL and PCL reconstructions were carried out simultaneously with final fixation (on the tibial side for the ACL and on the femoral side for the PCL) delayed until the MCL reconstruction was complete. Tensioning and

Fig. 4. Left knee sagittal T1-weighted MRI image revealing torn cruciate ligaments (red arrow)

Fig. 5. Right knee postoperative AP radiograph revealing hardware fixation of the ACL, MCL, and drill holes in the fibular head for LCL reconstruction using a docking technique

fixation of the LCL repair were completed as the final step in the multiligament reconstruction (Fig. 6).

Postoperative rehabilitation consisted of a hinged knee brace worn for the first 6 weeks postoperatively. The brace

Fig. 6. Left knee postoperative AP radiograph revealing hardware fixation of the ACL, PCL, MCL, and LCL

was locked in extension for ambulation for the first 4 weeks. At 2 weeks, the patient began knee range of motion exercises with a physical therapist. The patient was able to ambulate with the use of a walker within 4 weeks of surgery. By 6 weeks, the patient was ambulating unassisted.

Twelve months after the accident, the patient was walking without any evidence of instability. The patient did have intermittent activity-related knee pain bilaterally. Knee range of motion was 5–120° in the right knee and 0–120° in the left knee. There was no varus or valgus laxity in either knee. Lachman, anterior, and posterior drawer tests were negative bilaterally. Quadriceps strength was five out of five bilaterally. There were no complaints of hip pain or instability. Follow-up hip radiographs revealed no evidence of osteonecrosis. The patient has been fitted for an upper extremity prosthesis.

Discussion

A case of simultaneous traumatic, bilateral knee dislocations with a concomitant hip dislocation and ipsilateral upper extremity amputation has not been reported. While cases of bilateral knee dislocations and ipsilateral knee and hip dislocations have each been described, the current case represents a more devastating orthopedic injury with a unique constellation of management and rehabilitation considerations, particularly with regard to timing and sequence of interventions.

DuBois et al. recently reported a case of ipsilateral hip and knee dislocations that required the use of general anesthesia and insertion of Schanz pins in the femur to assist in the reduction of the hip [7]. In our case, the hip was easily reduced after the patient was intubated with the hip and knee in the 90/90 flexed position with an assistant stabilizing the knee. There was no acetabular fracture. This maneuver for reduction of the hip in a patient with an ipsilateral hip and knee dislocation and an associated posterior wall fracture of the acetabulum has been previously reported [22]. Open reduction of hip dislocations due to concomitant femoral head or neck fractures has also been described [9, 10].

A high index of suspicion of an associated knee injury is prudent when a hip dislocation is encountered. A previous study prospectively evaluated the ipsilateral knee in 28 patients with hip dislocations [23]. Twenty-one (75%) of the knees were painful and 25 (89%) had visible evidence of soft tissue injury on inspection. MRI revealed evidence of some abnormality in 25 (93%) of 27 knees. The study concluded that hip dislocations warrant close attention to injury of the ipsilateral knee and liberal use of MRI is recommended to detect injuries not discovered by history and physical examination alone. Another study evaluated 187 hip dislocations and fracture–dislocations and found 46 associated knee injuries [24]. Long-term consequences of these two injuries include avascular necrosis of the femoral head, sciatic and peroneal nerve palsy, knee instability, and stiffness. However, concomitant knee dislocation is ex-

tremely rare with 0/25 and 0/46 cases, respectively, among the reported knee injuries in the above studies.

Few reports in the literature have commented on the presence and surgical repair of bilateral knee dislocations. Sisto and Warren reported on the operative treatment of 19 patients with one bilateral knee dislocation with 77% of patients returning to vigorous sports activities [6]. Complete dislocation of the knee typically results in both ACL and PCL disruption. This was the case in the left knee of our patient. The right side retained the PCL, which is an uncommon finding in the dislocated knee. Previous studies have reported that this is a favorable finding [25, 26].

Biomechanical studies have shown the importance of the LCL and popliteofibular ligament for resisting posterior translation, varus opening, and external rotation of the tibia [27]. It is recommended that the goal of surgical repair or reconstruction should be anatomic restoration of these two ligaments [27]. For right knee LCL/PLC reconstruction, we used a recently reported, unique method of reconstruction in which a graft placed through a fibular head tunnel is secured to the femur with a “docking technique” [28]. This technique’s advantages include minimal use of hardware, ease of performance, and limited tunnel placement in the femur. The latter is advantageous in cases such as ours where simultaneous ligament reconstructions are performed and osteonecrosis of the femur is a potential complication [29].

Rehabilitation after knee dislocation is challenging. Delaying reconstruction for 2–3 weeks after injury to allow for improvement in soft tissue swelling may reduce the risk of arthrofibrosis and facilitates arthroscopic techniques [12]. Delaying surgery beyond 3 weeks can be problematic for primary repair of ligament injuries, but is less of a concern for ligament reconstruction [12, 18]. The goal of postoperative rehabilitation is to maximize range of motion while minimizing the risk of recurrent instability [12, 18, 30]. A recent study suggested that hinged external fixation may be beneficial in the treatment of the dislocated knee, but the mean time from injury to surgery was still 29 days [30]. The postoperative rehabilitation program that we utilized for this patient has been previously described and is associated with good outcomes for most patients [12, 18].

Injury to multiple extremities poses additional challenges with regard to advancement of rehabilitation. Freedman et al. reported a case of ipsilateral hip and knee dislocation and emphasized early, aggressive treatment and physical therapy to promote a functional and painless lower extremity [8]. Adapting exercise programs to compensate for limb loss may allow individuals with amputations to participate in physically challenging activities that otherwise may not be available to them [31]. Remarkably, in this case, the patient progressed rapidly with physical therapy even with the loss of an upper extremity.

In patients with a high-energy dislocation of a hip or knee joint, careful examination of the bilateral hips and knees should be performed to evaluate for associated fractures and/or dislocations. Dislocations should be reduced emergently in the emergency department or operative suite. Neurovascular examination of the affected extremities prereduction and postreduction is of utmost importance.

Rapid recognition and treatment of a threatened limb is crucial to prevent further morbidity and gives the orthopedic surgeon an opportunity to maximize the functional outcome for the patient.

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References

- Hoover N (1961) Injuries of the popliteal artery associated with dislocation of the knee. *Surg Clin North Am* 41:1099–1112
- Kennedy JC (1963) Complete dislocation of the knee joint. *J Bone Joint Surg* 45:889–903
- Quinlan AG, Sharrard WJW (1958) Posterolateral dislocation of the knee with capsular interposition. *J Bone Joint Surg* 40:660–663
- Rihn JA, Cha PS, Groff YJ, Harner CD (2004) The acutely dislocated knee: evaluation and management. *J Am Acad Orthop Surg* 12(5):334–346, Oct
- Marinovic I (1956) Case of bilateral knee dislocation of the knee. *Acta Chir Jugosl* 3(2):163–169
- Sisto DJ, Warren RF (1985) Complete knee dislocation. *Clin Orthop Relat Res* (198):94–101, Sept
- DuBois B, Montgomery WH Jr, Dunbar RP, Chapman J (2006) Simultaneous ipsilateral posterior knee and hip dislocations: case report, including a technique for closed reduction of the hip. *J Orthop Trauma* 20(3):216–219, Mar
- Freedman DM, Freedman EL, Shapiro MS (1994) Ipsilateral hip and knee dislocation. *J Orthop Trauma* 8(2):177–180
- Kreibich ND, Moran CG, Pinder I (1989) Ipsilateral hip and knee dislocation: a case report. *Acta Orthop Scand* 60:90–91
- Millea TP, Romanelli RR, Segal LS (1991) Ipsilateral fracture-dislocation of the hip, knee, and ankle. *J Trauma* 31:416–419
- Almekinders LC, Logan TC (1992) Results following treatment of traumatic dislocations of the knee joint. *Clin Orthop* 284:203–207
- Cole BJ, Harner CD (1999) The multiple ligament injured knee. *Clin Sports Med* 18:241–262
- Green NE, Allen BL (1977) Vascular injuries associated with dislocation of the knee. *J Bone Joint Surg* 59:236–239
- Niall DM, Nutton RW, Keating JF (2005) Palsy of the peroneal nerve after traumatic dislocation of the knee. *J Bone Joint Surg Br* 87(5):664–667, May
- Richter M (2002) Comparison of surgical repair or reconstruction of the cruciate ligaments versus nonsurgical treatment in patients with traumatic knee dislocations. *Am J Sports Med* 30:718–727
- Taylor AR, Arden GP, Rainey HA (1972) Traumatic dislocation of the knee joint: a report of forty-three cases with special reference to conservative treatment. *J Bone Joint Surg Br* 54:96–102
- Chhabra A, Cha PS, Rihn JA, Cole B, Bennett CH, Waltrip RL, Harner CD (2005) Surgical management of knee dislocations. Surgical technique. *J Bone Joint Surg* 87:1–21
- Harner CD, Waltrip RL, Bennett CH, Francis KA, Cole B, Irrgang JJ (2004) Surgical management of knee dislocations. *J Bone Joint Surg* 86:262–273
- Noyes FR, Barber-Westin SD (1997) Reconstruction of the anterior and posterior cruciate ligaments after knee dislocation: use of early protected postoperative motion to decrease arthrofibrosis. *Am J Sports Med* 25:769–778
- Shapiro MS, Freedman EL (1995) Allograft reconstruction of the anterior and posterior cruciate ligaments after traumatic knee dislocation. *Am J Sports Med* 23:580–587
- Bosworth DM (1952) Transplantation of the semitendinosus for repair of laceration of medial collateral ligament of the knee. *J Bone Joint Surg Am* 34-A(1):196–202, Jan
- Schierz A, Hotz T, Kach K (2002) Ipsilateral knee and hip joint dislocation. *Unfallchirurg* 105(7):660–663
- Schmidt GL, Sciulli R, Altman GT (2005) Knee injury in patients experiencing a high-energy traumatic ipsilateral hip dislocation. *J Bone Joint Surg* 87(6):1200–1204, Jun
- Tabuenca J, Truan JR (2000) Knee injuries in traumatic hip dislocation. *Clin Orthop Relat Res* (377):78–83, Aug
- Cooper DE, Speer KP, Wickiewicz TL, Warren RF (1992) Complete knee dislocation without posterior cruciate ligament disruption. A report of four cases and review of the literature. *Clin Orthop Relat Res* (284):228–233, Nov
- Shelbourne KD, Pritchard J, Rettig AC, McCarroll JR, Vanmeter CD (1992) Knee dislocations with intact PCL. *Orthop Rev* 21(5):607–608 610–611, May
- Gollehon DL, Torzilli PA, Warren RF (1987) The role of the posterolateral and cruciate ligaments in the stability of the human knee. A biomechanical study. *J Bone Joint Surg* 69:233–242
- Verma NN, Mithofer K, Battaglia M, MacGillivray JD (2005) The docking technique for posterolateral corner reconstruction. *Arthroscopy* 21(2):238–242
- Athanasian EA, Wickiewicz TL, Warren RF (1995) Osteonecrosis of the femoral condyle after arthroscopic reconstruction of a cruciate ligament: report of two cases. *J Bone Joint Surg* 77:1418–1422
- Stannard JP, Sheils TM, McGwin G, Volgas DA, Alonso JE (2003) Use of a hinged external knee fixator after surgery for knee dislocation. *Arthroscopy* 19(6):626–631, Jul–Aug
- Donachy JE, Brannon KD, Hughes LS, Seahorn J, Crutcher TT, Christian EL (2004) Strength and endurance training of an individual with left upper and lower limb amputations. *Disabil Rehabil* 26(8):495–499, Apr 22