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A case of ipsilateral floating hip and knee with concomitant arterial injury

Arter yaralanmasının eşlik ettiği ipsilateral yüzen kalça ve diz: Olgu sunumu

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Ipsilateral fractures of the acetabulum, femur, and tibia are rare. This severe injury is mostly seen in patients with multiple injuries caused by high-energy trauma. We report the management and outcome of a 17-year-old male motorcyclist who struck a car and sustained ipsilateral acetabular, femoral, and tibial fractures associated with arterial injury. The patient was taken to the operating theater nine hours after injury. During surgical exploration it was noted that the popliteal artery was occluded by direct pressure. He was treated with open reduction and plate fixation of the tibial fracture, followed by intramedullary nailing of the femur. Popliteal artery occlusion was spontaneously restored after reduction. Postoperative course was uneventful and the patient was discharged seven days postoperatively. At five months after injury, the patient was back to school and returned to normal activities with no gait abnormality. Bony union of all the fractures was complete within a two-year follow-up. He felt no pain on walking or running.

Key words: Accidents, traffic; acetabulum/injuries; femoral fractures; fracture fixation/methods; multiple trauma; tibial fractures.

Aynı tarafta eşzamanlı oluşan asetabulum, femur ve tibia kırığı nadirdir. Bu tip şiddetli yaralanmalar, çoklu yaralanmalarla birlikte genelde yüksek enerjili travma ile oluşmaktadır. Bu yazıda, 17 yaşındaki bir motosiklet sürücüsünün bir araca çarpması sonucu oluşan aynı taraflı asetabulum, femur ve tibia kırığının tedavisi ve sonucu sunuldu. Hasta yaralanmadan dokuz saat sonra ameliyata alındı. Cerrahi eksplorasyon sırasında popliteal arterin doğrudan bası sonucu tıkalı olduğu görüldü. Tibia kırığı açık redüksiyon ve plak fiksasyonu, femur kırığı ise intramedüller çivileme ile tedavi edildi. Popliteal arter tıkanıklığı redüksiyon sonrasında kendiliğinden düzeldi. Ameliyat sonrası dönemi sorunsuz geçiren hasta yedinci günde taburcu edildi. Yaralanmadan beş ay sonra hasta okuluna ve günlük normal aktivitelerine döndü, yürüyüşünde herhangi bir sorun yoktu. İki yıllık bir takip süresi içinde tüm kırıklarda kaynama sağlandı. Yürürken veya koşarken hastanın ağrısı yoktu.

Anahtar sözcükler: Trafik kazası; asetabulum/yaralanma; femur kırığı; kırık tespiti/yöntem; multipl travma; tibia kırığı.

Ipsilateral acetabular, femoral and tibial fractures result from high energy trauma.[1] This special injury pattern is very rare and its combination with arterial injuries makes the management challenging. Simultaneous occurrences of ipsilateral floating hip and knee with an arterial injury has not been reported. We report the management and outcome of a case with such an injury.

CASE REPORT

A 17-year-old male motorcyclist struck a car while riding at a speed of 50 mph, and sustained fractures of the ipsilateral acetabulum, femur, and tibia. He was immediately brought to a district hospital and then referred to our hospital after eight hours from the injury. On examination, he was hemodynamically stable. His left lower extremity was deformed and there was an abrasion in the anterior aspect of the proximal tibia. No other soft tissue injury was noted. However, his left foot was cooler when compared with the right. There were no associated injuries and the laboratory data were normal. An anteroposterior pelvis radiograph and computed tomography revealed an undisplaced fracture of

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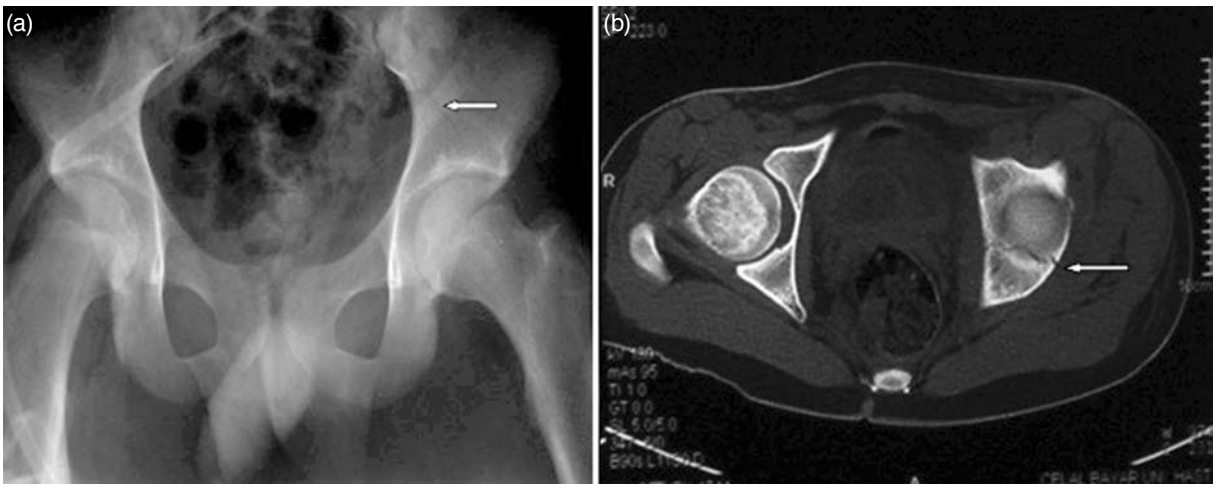

Fig. 1. (a) Anteroposterior radiograph and **(b)** computed tomography scan of the pelvis demonstrating undisplaced posterior column fracture of the left acetabulum (arrow indicating the fracture line).

the posterior column of the left acetabulum (Fig. 1). Radiographs of the left lower extremity demonstrated a displaced, AO/ASIF type 32-A3, midshaft fracture of the left femur (Fig. 2a, b) associated with displaced Salter-Harris type II epiphyseal injury of the left proximal tibia, and comminuted, displaced, AO/ASIF type 42-B3 shaft fracture of the left tibia (Fig. 2c, d).[2] The motor and sensory perception of the lower leg was normal, but pulsation of the dorsalis artery and posterior tibial artery was absent. A duplex scan examination of the lower extremity revealed interruption of blood flow at the level of proximal tibial fracture.

The patient was urgently taken to the operating theater nine hours after injury. The time from admission to operation was one hour. Under general anesthesia, single-shot angiography was obtained prior to operation and the vascular injury site was definitely localized (Fig. 3). Surgical exploration of the popliteal artery and the proximal tibial epiphyseal fracture was performed through a medial approach. During dissection, it was noted that the artery was occluded by direct pressure. The proximal tibial metaphysis was displaced posteriorly; it stretched the adjacent popliteal artery over its sharp edge causing it to course backwards, and impinged on the artery without any external visible laceration on the vessel. Two attempts were made to reduce the epiphyseal fracture. However, they failed because of the unstable distal tibial shaft fragment. We decided to stabilize the tibial shaft fracture first. It was treated with open reduction and plate fixation. A 10-hole broad DCP plate with two lag screws was used (Hipokrat, İzmir, Turkey). The epiphyseal fracture was then reduced at 90° of knee flexion and fixed with four K-wires, inserted percutaneously from medial and lateral sides, crossing the physis proximal to distal, without disturbing the articular surface (Fig. 4a). The accuracy of reduction and fixation was checked under fluoroscopy. After achievement of reduction,

Fig. 2. Anteroposterior and lateral radiographs of **(a, b)** the left femur and **(c, d)** the left tibia.

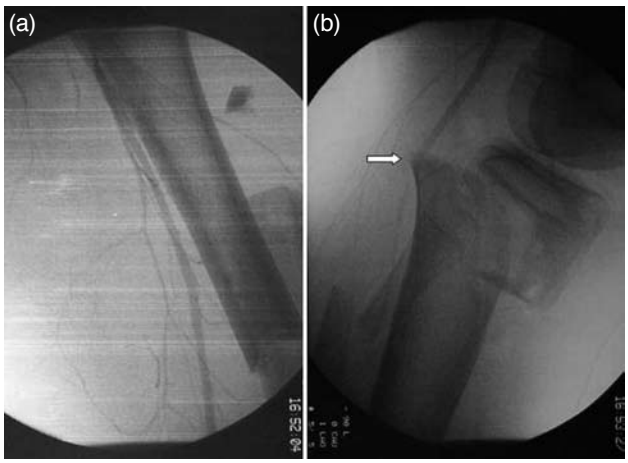

Fig. 3. Fluoroscopic views during single-shot angiography showing **(a)** normal circulation at the level of femoral fracture and **(b)** arterial occlusion at the level of proximal tibial epiphyseal fracture (arrow indicating the impingement by proximal tibial metaphysis).

normal circulation was restored immediately. The arterial flow was felt directly by digital palpation. Pedal pulses were noted as usual and evaluation of distal perfusion with hand-held Doppler was also normal. Because of adequacy of distal circulation, arterial reconstruction was not considered. The time between injury and restoration of circulation was 11 hours.

With restoration of hemodynamic stability of the patient, fixation other fractures were performed. The femoral midshaft fracture was fixed with an antegrade, unreamed solid nail (C^{75}, Hipokrat, İzmir, Turkey) following closed reduction (Fig. 4a). Dynamic fluoroscopic stress views were taken to assess the stability of the acetabular fracture.[3] The hip was rotated internally and externally in flexion, extension, and abduction. The hip was congruent and stable on both the anteroposterior and Judet fluoroscopic views, so no other operative intervention was considered. Serial pedal pulse examinations at every two to four hours and close monitoring of distal pulses with hand-held Doppler for the first 72 hours after bony fixation showed similar intensity of pulses on both sides.

Parenteral cefazolin 3 g/day (Cefamezin, Eczacıbaşı, Turkey) was given for 48 hours. Low-molecular weight heparin (Clexane, Aventis, Turkey) was administered for 10 days, followed by oral anticoagulant treatment for two months. Meticulous follow-up of compartment pressures with a digital monitor (Stryker Instruments, Kalamazoo, MI, USA) showed pressures in normal limits. Postoperative course was uneventful and the patient was discharged seven days postopera-

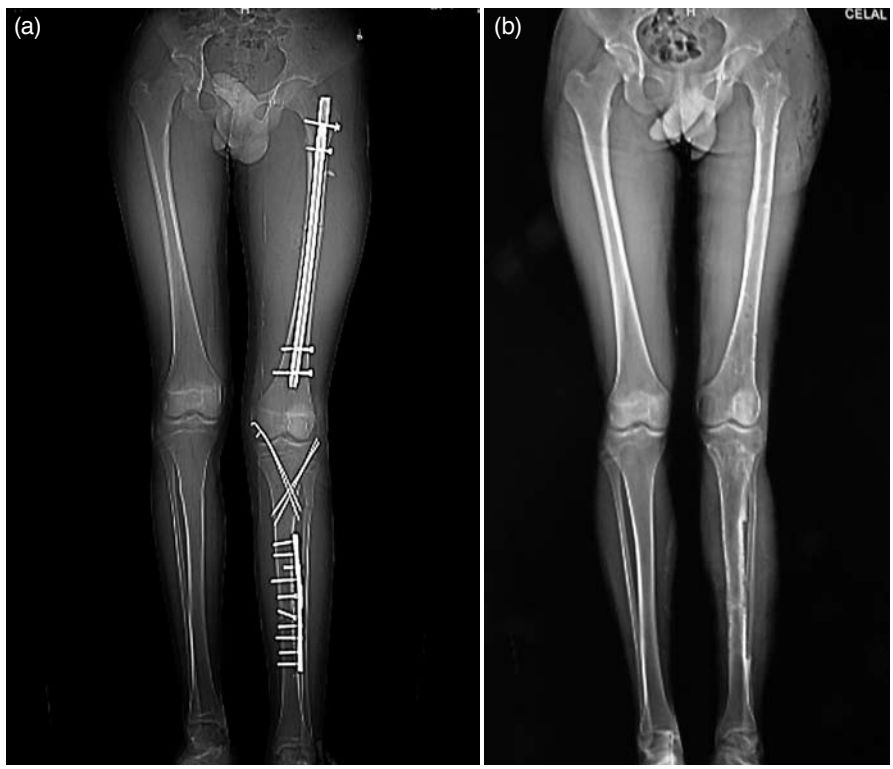

Fig. 4. Anteroposterior radiographs of the left lower extremity: **(a)** postoperative fixation and **(b)** after implant removal two years after injury.

tively, after which weight-bearing was not allowed for six weeks, then progressively increased. The K-wires were removed at eight weeks. An active rehabilitation program, including quadriceps exercises and knee range of motion was undertaken. At five months after injury, the patient was back to school and returned to normal activities with no gait abnormality. Bony union of all the fractures was complete within a two-year follow-up. The nail and plate were removed. His left hip and knee joint were stable with normal range of motion. There was no leg length discrepancy, rotational and angular malunion (Fig. 4b). He felt no pain on walking or running.

DISCUSSION

Floating joint injury is a simultaneous skeletal disruption above and below a joint. It can be either extra-articular or intra-articular. Ipsilateral floating hip and knee injury is a very rare combination of fractures that render the hip and knee joint unstable both proximally and distally. These types of injuries are high-velocity injuries: the injury usually results from a collision between a pedestrian or a motorcyclist and a motor vehicle as seen in our case.[4]

Although the management of individual fractures of the acetabulum, femur, and tibia has been thoroughly discussed in the literature and treatment guidelines have been established, there are only a few reports on coexistent ipsilateral acetabular, femoral, and tibial fractures.[5-7] In 1992, Liebergall et al.[8] reported 17 patients with ipsilateral acetabular and femoral fractures and introduced the term floating hip. On the other hand, Müller et al.[9] reported 40 patients with this fracture combination and claimed that coexistent ipsilateral fractures of the acetabulum and femur did not represent a specific combination and thus could be treated according to the guidelines established for individual fractures. The authors suggested that the term "floating hip" be misleading and not be used. Both studies showed that operative stabilization of the femur and acetabulum gave the best clinical results, while non-operative treatment of acetabulum fractures had to be the treatment of choice in undisplaced or minimally displaced fractures.[8,9] In our case, the acetabular fracture was treated conservatively with excellent result as the hip was found stable and congruent in dynamic intraoperative fluoroscopic stress views.

The term floating knee was coined by Blake and McBryde to describe not only the fractures but also accompanying injuries and mortality associated with this severe trauma.[10] Mortality rates from floating knees range from 5% to 15% and amputations are reported in approximately 25% of patients.[11-14] Letts et al.[15] described five patterns of ipsilateral tibial and femoral fractures and made treatment recommendations on the basis of these patterns. Because of high prevalence of complications after closed treatment, operative stabilization of both fractures is recommended even for young children.[16,17] Simultaneous fractures of the proximal tibial epiphysis and diaphysis with arterial occlusion is the difference of our case from the patterns described by Letts et al. This type of physis injury with posterior displacement of the metaphyseal fragment is the equivalent of a knee dislocation in an adult, which has been described to have a high association with arterial injury. It is known that neurovascular injury is associated with up to 10% of proximal tibial epiphyseal fractures, especially those with an apex-posterior angulation.[18] Popliteal arterial injuries associated with bony injuries have a high amputation rate. It has been suggested that vascular repair should be performed before bony stabilization to decrease the period of ischemia.[19,20] However, if arterial occlusion is due to direct pressure without laceration, giving precedence to bony fixation is the only choice as was the case in our patient.

Newer noninvasive techniques such as duplex scan may also play a role in the evaluation of a vascular injury. The overall sensitivity and specificity of such tests were reported as 95% and 99%, respectively.[21] Nevertheless, angiography remains the most accurate diagnostic tool for the evaluation of a vascular injury. However, it requires at least one hour, during which the severity of ischemia may be aggravated.[19,20] In our practice, we first perform physical examination of pedal pulses as well as a gross evaluation of color and temperature, and monitor the ankle-brachial index by duplex scan in the emergency room. If there is any asymmetry between the two lower extremities and if the measurement of the Doppler ankle-brachial index is less than 0.9, then we go on with single-shot angiography in the operating theater in order not to waste time by routine angiographic procedures in the radiology department.

Post-reduction angiography was not performed in our case due to the presence of normal pedal pulses after reduction and fixation. Although post-reduction angiography is a controversial issue in the literature[22,23] it might be performed for detection of an intimal lesion or thrombosis.

The need for prophylactic fasciotomy should also be questioned in this case. Compartment syndrome should be anticipated and treated immediately with fasciotomy. We were aware that the risk for compartment syndrome was extremely high in this delayed case. For this reason, continuous compartment monitoring was carried out. We suggest meticulous follow-up of compartment pressures not only with physical examination, but also with digital monitoring. Vascular injuries should be anticipated and recognized immediately in injured extremities. Timely diagnosis and treatment can minimize ischemic insult. Although arterial reconstruction has high priority, achievement of bony stability may be required before vascular intervention.

Despite the complex nature of high-energy injuries and possible postoperative complications, this patient had an uneventful recovery with no bony deformity and functional impairment. The authors emphasize the role of immediate stabilization of this pattern of injury and meticulous postoperative follow-up for anticipated complications in achieving an excellent result.

REFERENCES

1. Brainard BJ, Slauterbeck J, Benjamin JB. Fracture patterns and mechanisms in pedestrian motor-vehicle trauma: the ipsilateral dyad. J Orthop Trauma 1992; 6:279-82.
2. Murphy WM, Leu D. Fracture classification: biological significance. In: Ruedi TP, Murphy WM, editors. AO principles of fracture management. 4th ed. Stuttgart: Georg Thieme Verlag; 2000. p. 45-58.
3. Tornetta P 3rd. Non-operative management of acetabular fractures. The use of dynamic stress views. J Bone Joint Surg [Br] 1999;81:67-70.
4. Bohn WW, Durbin RA. Ipsilateral fractures of the femur and tibia in children and adolescents. J Bone Joint Surg [Am] 1991;73:429-39.
5. Bone LB, Johnson KD, Weigelt J, Scheinberg R. Early versus delayed stabilization of femoral fractures. A prospective randomized study. J Bone Joint Surg [Am] 1989;71:336-40.
6. Court-Brown CM, Byrnes T, McLaughlin G. Intramedullary nailing of tibial diaphyseal fractures in adolescents with open physes. Injury 2003;34:781-5.
7. Letournel E. The treatment of acetabular fractures through the ilioinguinal approach. Clin Orthop Relat Res 1993;(292):62-76.
8. Liebergall M, Mosheiff R, Safran O, Peyser A, Segal D. The floating hip injury: patterns of injury. Injury 2002;33:717-22.
9. Muller EJ, Siebenrock K, Ekkernkamp A, Ganz R, Muhr G. Ipsilateral fractures of the pelvis and the femur-floating hip? A retrospective analysis of 42 cases. Arch Orthop Trauma Surg 1999;119:179-82.
10. Blake R, McBryde A Jr. The floating knee: Ipsilateral fractures of the tibia and femur. South Med J 1975;68:13-6.
11. Fraser RD, Hunter GA, Waddell JP. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg [Br] 1978;60:510-5.
12. Karlstrom G, Olerud S. Ipsilateral fracture of the femur and tibia. J Bone Joint Surg [Am] 1977;59:240-3.
13. Paul GR, Sawka MW, Whitelaw GP. Fractures of the ipsilateral femur and tibia: emphasis on intra-articular and soft tissue injury. J Orthop Trauma 1990;4:309-14.
14. Veith RG, Winquist RA, Hansen ST Jr. Ipsilateral fractures of the femur and tibia. A report of fifty-seven consecutive cases. J Bone Joint Surg [Am] 1984;66:991-1002.
15. Letts M, Vincent N, Gouw G. The "floating knee" in children. J Bone Joint Surg [Br] 1986;68:442-6.
16. Ostrum RF. Treatment of floating knee injuries through a single percutaneous approach. Clin Orthop Relat Res 2000;(375):43-50.
17. Yue JJ, Churchill RS, Cooperman DR, Yasko AW, Wilber JH, Thompson GH. The floating knee in the pediatric patient. Nonoperative versus operative stabilization. Clin Orthop Relat Res 2000;(376):124-36.
18. Shelton WR, Canale ST. Fractures of the tibia through the proximal tibial epiphyseal cartilage. J Bone Joint Surg [Am] 1979;61:167-73.
19. Martin LC, McKenney MG, Sosa JL, Ginzburg E, Puente I, Sleeman D, et al. Management of lower extremity arterial trauma. J Trauma 1994;37:591-8.
20. Pretre R, Bruschweiler I, Rossier J, Chilcott M, Bednarkiewicz M, Kursteiner K, et al. Lower limb trauma with injury to the popliteal vessels. J Trauma 1996;40:595-601.
21. Sclafani SJ, Cooper R, Shaftan GW, Goldstein AS, Glanz S, Gordon DH. Arterial trauma: diagnostic and therapeutic angiography. Radiology 1986;161:165-72.
22. Klineberg EO, Crites BM, Flinn WR, Archibald JD, Moorman CT 3rd. The role of arteriography in assessing popliteal artery injury in knee dislocations. J Trauma 2004;56:786-90.
23. Stannard JP, Sheils TM, Lopez-Ben RR, McGwin G Jr, Robinson JT, Volgas DA. Vascular injuries in knee dislocations: the role of physical examination in determining the need for arteriography. J Bone Joint Surg [Am] 2004;86:910-5.