

Open Pelvic Fracture With Vaginal Laceration and Arterial Injury in a Pediatric Patient

Lisa K. Cannada, MD, John F. Scovell, MD, Brent Bauer, MD, and David A. Podeszwa, MD

Open pelvic fractures occur in up to 3% to 5% of all adult pelvic fractures.^{1,2} The incidence is even lower in pediatric pelvic fractures. Open pelvic fractures in children are reported as small series or isolated case reports. Open pelvic fractures are known to be associated with many other severe injuries.¹⁻⁷ Pelvic fractures in pediatric patients differ significantly from those in adults.^{3,8} The ability of the pediatric pelvis to deform plastically—a result of the elasticity of the pediatric bone and the presence of more cartilaginous structures—leads to its absorbing significantly more energy before breaking. Therefore, presence of a pelvic fracture in a pediatric trauma patient should heighten suspicion for other significant injuries.

This is the first known English-literature report of an open pelvic fracture sustained with vaginal laceration and internal iliac artery injury.

The patient's guardians provided written informed consent for print and electronic publication of this case report.

Dr. Cannada is Associate Professor, Department of Orthopaedic Surgery, Saint Louis University, St. Louis, Missouri. Dr. Scovell is Orthopedic Surgeon, Lubbock Sports Medicine, Lubbock, Texas.

Dr. Bauer, at the time of this writing, was Orthopedic Resident, University of Texas Southwestern, Dallas, Texas.

Dr. Podeszwa is Assistant Professor, University of Texas Southwestern.

Address correspondence to: Lisa K. Cannada, MD, Department of Orthopaedic Surgery, Saint Louis University, 3635 Vista Ave, 7th Floor, St. Louis, MO 63110 (tel, 314-577-8850; fax, 314-268-5121; e-mail, Lcannada@slu.edu).

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CASE REPORT

An unrestrained backseat passenger, a 3-year-old girl, was ejected during a collision of motor vehicles. She was transferred from the accident scene to our hospital. On arrival, she was awake and alert (Glasgow Coma Scale score, 15). An unstable pelvis was noted. The patient had a complicated wound involving the right inguinal region extending to the perineum. The wound was grossly contaminated with dirt and debris. The right lower extremity was cold and pulseless.

During physical examination, the patient could move the right foot and had sensation in the right lower extremity. An anteroposterior (AP) pelvic radiograph showed a pubic diastasis of greater than 8 cm. Fractures of the right pubic rami and ilium were also identified (Figure 1). The bladder appeared normal, and there was no extravasation when normal saline was flushed through the patient's Foley catheter.

The patient was emergently taken to the operating room. She received IV cefazolin 400 mg and IV gentamicin 40 mg. The femoral vessel on the right was identified and no pulse was present on direct examination or Doppler signal. The proximal portion of the external iliac artery

was identified, and a palpable and Doppler pulse was present proximally, but a significant change in the Doppler pulse was detected distally. The middle portion of the vessel appeared bruised. The iliac artery was opened distal to the middle portion, and a brisk back-flow from the leg was noted. The injury to the vessel was 4 cm long. A No. 6 carotid shunt was used to bypass the injured zone of the vessel. Immediately, the right lower extremity became pink, and palpable pulses were present in the right foot. Ischemic time was approximately 1.5 hours from time of injury.

With blood flow restored to the right lower extremity, the orthopedic team then addressed the pelvic diastasis. We placed 4-mm stainless steel half-pins into the superior crest of the iliac wings bilaterally, and placement was confirmed by fluoroscopy. An external fixation frame (Synthes, Paoli, Pennsylvania) was constructed, and the pelvis was reduced.

With the external fixator in place, the pediatric surgeons proceeded with the external iliac repair. A 3.5 mm polytetrafluoroethylene graft was used to complete the repair.

After vessel repair, the other injuries were addressed. A laparotomy was performed, and a through-and-



Figure 1. Anteroposterior radiograph shows open-book pelvic fracture.



Figure 2. Immediate postoperative radiograph shows pelvic reduction.

through injury to the rectum and an injury to the rectal sphincter complex were noted. These injuries required a diverting colostomy. Next, the extensive wounds involving the perineum were repaired. There was a laceration from the right crus of the clitoral hood along the bulbocavernosus muscle, in addition to a laceration along the edge of the introitus of the vagina, through the transverse perineal muscles and into the perineal body and along the right anal sphincter. Digital examination demonstrated a defect into the body of the fourchette of the vagina, and this was repaired.

The patient tolerated the procedure well. After it was completed, she was taken to the intensive care unit and remained intubated. She was in stable condition. Postoperative radiographs showed the fracture reduction (Figure 2). Heparin infusion for graft preservation was started, but the inpatient postoperative course became complicated. Less than 24 hours after surgery, hemoglobin level dropped to 4.9 g/dL. Heparin infusion was discontinued, and the patient was transfused. Reexploration of the groin region revealed continued retroperitoneal bleeding. The bleeding was controlled.

The patient was extubated on posttrauma day (PTD) 2. On PTD 6, there was copious serous drainage from the right groin wound. The patient was afebrile but had an elevated erythrocyte sedimentation rate (ESR) of 49 mm/h and C-reactive protein (CRP) of 3.6 mg/dL. White blood cell count remained stable, around 10,000/mm³, throughout the postopera-



Figure 3. Anteroposterior radiograph of pelvis at 29-month follow-up.

tive course. Clindamycin was used to manage the drainage. When the patient was discharged home with a peripherally inserted central catheter on PTD 11, ESR was 49 mm/h, CRP was 2.2 mg/dL, and there were no clinical signs of infection.

For 8 weeks, the patient remained non-weight-bearing on the bilateral lower extremities. The pelvic external fixation was removed 8 weeks after surgery. The colostomy was reversed 4 months after injury.

At the latest orthopedic follow-up, 29 months after injury (Figure 3), the patient's mother reported that the girl had no complaints of pain, no activity limitation, and no genitourinary complaints. The patient had normal gait and no leg-length discrepancy. She had symmetric hip range of motion with flexion of more than 110°, internal rotation of 45°, and external rotation of 65° and abduction of 65°.

DISCUSSION

Pelvic fractures in children are not common. In a review of the National Pediatric Trauma Registry, the number of pediatric pelvic fractures over a 5-year period was found to represent 3% of pediatric trauma patients, or half the frequency in adults.¹ In many series of pediatric pelvic fractures, the open-book fracture is extremely rare, and often is not even mentioned. The most common mechanism of injury for pelvic fractures is blunt trauma; most frequently, a child is struck by a motor

vehicle.^{3,4,7-9} It has been reported that symphysis widening is normally 10 mm to 12 mm within the first 3 years, compared with 2 mm to 4 mm in adults.⁴ Clearly, our patient had significantly more widening than what is considered a normal variant.

In a 12-year review, Spiguel and colleagues⁵ found pelvic fractures in 13 of 2850 pediatric admissions. Eight of the 13 patients (62%) presented with an associated injury, but no patient had an open pelvic fracture. The pediatric pelvis is shallow compared with the adult pelvis and offers less bony protection to the abdominal and pelvic system throughout. Thus, there may be an increased incidence of intra-abdominal or intrapelvic injuries.^{5,10}

The largest series of pediatric open pelvic fractures was reported by Mosheiff and colleagues.² In their retrospective study, they identified 15 patients treated over a 12-year period. Mortality of open pelvic fractures was 20%. Ten of the 15 patients (67%) presented with unstable type III or type IV pelvic fractures (Torode and Zieg classification of pelvic fractures). Ten patients (67%) had severe superficial soft-tissue injuries in the immediate area around the pelvis, and 12 patients (80%) had injuries in the anal-rectal-genitourinary region. Concomitant head, chest, and extremity injuries are commonly associated with pelvic fractures; however, in this series of open pelvic fractures, only 2 patients had additional injuries.

Vaginal lacerations can occur in open or closed pelvic fractures. A 10-year retrospective review of 114 female patients with pelvic fractures found a 3.5% incidence of vaginal lacerations.¹¹ For most adult vaginal lacerations, management includes debridement and primary surgical closure or vaginal packing with antibiotic coverage. Complications of delayed management of unrecognized vaginal lacerations in children have been reported to include vaginal stricture, dyspareunia, osteomyelitis, and pelvic abscess.⁶

There is a paucity of literature regarding long-term follow-up of pediatric pelvic fractures. In a prospective multicenter study of functional outcomes, Signorino and colleagues¹² found that, at 6 months, the average functional outcomes of pediatric pelvic fractures were nearing normal. In the past, many pediatric pelvic fractures, including unstable pelvic fractures, were managed nonoperatively. Historically, it was believed that the immature pelvis remodels after injury. However, Smith and colleagues¹³ evaluated 23 skeletally immature unstable pelvic fractures a mean of 6.5 years after injury and found improved clinical and functional outcomes in those patients with pelvic asymmetry of less than 1 cm. We restored our patient's pelvic symmetry, though there still was some increased diastasis.

Karunakar and colleagues¹⁴ reported on 18 patients who were younger than age 16 and had unstable pelvic fractures or acetabular fractures with good operative management results over a 7-year period. Of the 18 patients, only 4 had skeletally immature unstable pelvic fractures—again demonstrating the rarity of this injury—and these were managed with surgery. All these surgically treated, skeletally immature patients had a good outcome at short-term follow-up (mean, 31 months).

The anatomy of the immature skeleton allows it to withstand a significantly stronger force before breaking. Children's blood vessels, particularly the arteries, undergo vasoconstriction—as opposed to the more friable, arteriosclerotic vessels found in adults. Children's vessels are smaller and therefore easier to constrict to create an occlusion. Constriction and occlusion reduce hemorrhaging and thereby prevent the coagulation process from becoming overwhelmed, which results in life-threatening coagulopathy.^{1,15} Although not common, hemorrhage from a pelvic fracture can have catastrophic effects if it goes unrecognized or is not managed in a timely fashion. Wali¹⁶ reported an

internal iliac artery injury in the fractured pelvis of an 8-year-old patient. Hit by a motor vehicle, the child had sustained multiple fractures of the pelvis and femur along with a ruptured urethra. The fractures were closed and managed nonoperatively. One month after injury, the patient presented with a large pseudoaneurysm of the left internal iliac artery. Ligation of the internal iliac artery was performed.

Heinrich and colleagues¹⁷ described a case of open pelvic fracture with vaginal lacerations and diaphragmatic rupture in a 4-year-old child. The patient had other orthopedic injuries and, ultimately, the open pelvic fracture was managed with an external fixator. Even though at follow-up the patient had a malunion of the Malgaigne fracture and significant pelvic asymmetry, the clinical outcome was good.

CONCLUSION

Pelvic ring injuries with vaginal lacerations are not uncommon in themselves. What made our patient's case unique is that it was an open unstable pelvic fracture of the Young-Burgess anteroposterior compression type, with an accompanying vascular injury. This fracture pattern in this age group is extremely rare, and it was sustained in a collision of motor vehicles instead of in the typical pedestrian-versus-motor-vehicle accident.^{4,8,14} Our patient's mechanism most likely was the impact of abducted feet against the front seat of her car, as she was an unrestrained backseat passenger. The forces leading to her injury were significant. With her pulseless extremity, suspicion of a vascular injury from the open pelvic fracture was high. The soft-tissue extent of the injury involving the vaginal laceration and rectal injury was not fully realized before surgery. Surgical management was required for stability of this unstable pelvic fracture and for preventing further damage to repaired structures. The outcome was good, despite the rare, life-threatening injury.

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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