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CASE REPORT

Intracanal Sacral Nerve Impingement Following Percutaneous Iliosacral Screw Pelvic Fixation

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ABSTRACT

We present a trauma patient with an unstable pelvic fracture for whom the initial treatment with percutaneous iliosacral screws resulted in an impingement on the spinal canal and sacral nerves. This treatment was revised with spinopelvic fixation, which provided an improved neurological recovery. This case report reviews the literature pertaining to the technique and complications associated with percutaneous iliosacral screw fixation for pelvic injuries. It emphasizes the merits of the preoperative evaluation of the patient's pelvis morphology and the importance of achieving an adequate reduction to avoid complications.

INTRODUCTION

Percutaneous iliosacral screws are useful in treating vertical posterior pelvic fractures and iliosacral disruptions. Iliosacral screws are far less invasive than spinopelvic fixation, and result in much lower morbidity. However, safe placement of the iliosacral screws is technically difficult and highly dependent on fracture reduction and adequate fluoroscopy. Inaccurate placement can result in neurological impingement or injury, most commonly involving the L5 nerve root as it traverses the anterior sacrum. This report reviews the evaluation and management of a case in which impingement on the spinal canal and sacral nerves occurred following percutaneous iliosacral screw fixation of an unstable pelvic fracture. The patient was informed that data concerning the case would be submitted for publication, and she provided consent.

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CASE REPORT

A 47-year-old white female was involved in a motor vehicle collision (MVC) in which she collided with a cow while driving.

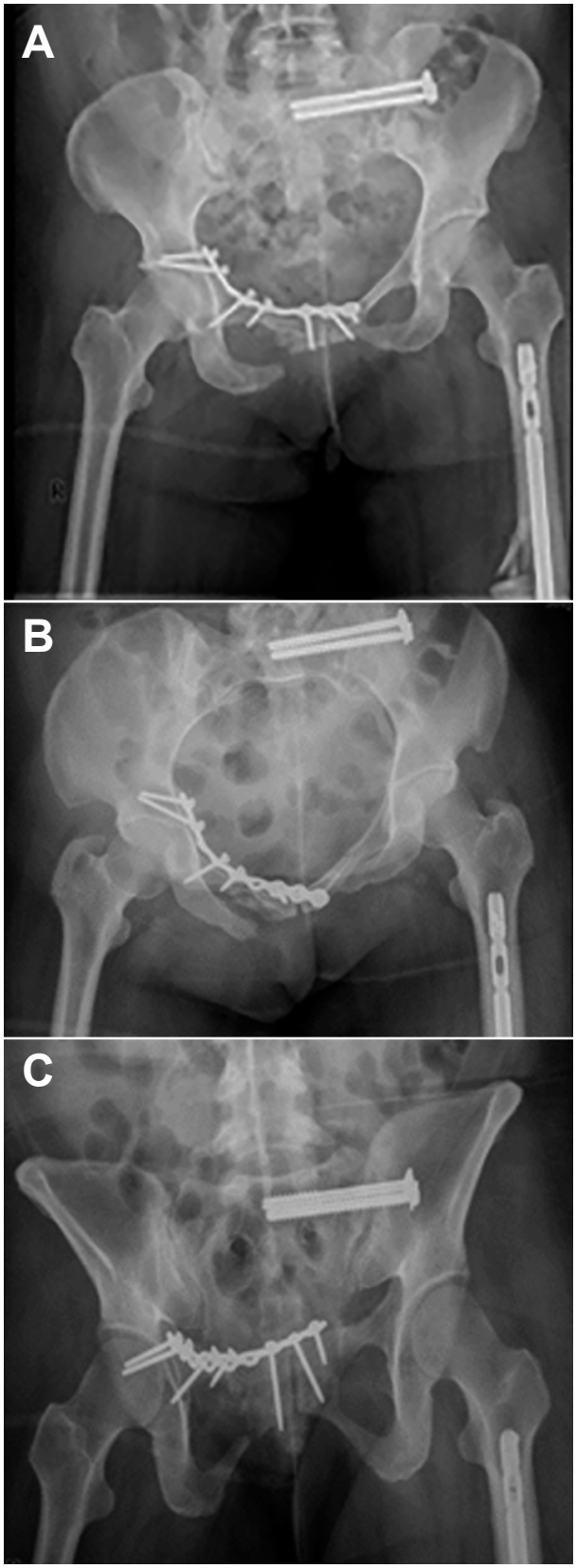

Figure 1. Radiographs of pelvis showing iliosacral screws and anterior pelvic fixation performed at an outside facility (**A**); inlet (**B**) and outlet (**C**) views.

She was life-flighted to her local trauma facility with diagnoses including hemopneumothorax, a left femur fracture, and a severe pelvic injury. The patient's neurological status was not well documented prior to her initial surgery. The patient underwent retrograde intramedullary nailing of the left femur, open reduction and internal fixation (ORIF) with plate fixation of the anterior pelvis via a Pfannenstiel approach, and placement of two percutaneous iliosacral screws on the left. She was then transferred to an outside facility to begin rehabilitation. The patient's rehabilitation progressed slowly, and she was very limited in her physical therapy participation owing to severe pain. The pain radiated from her left buttock down the posterior aspect of her leg and into the dorsolateral aspect of her foot and her two lateral toes with any attempted movement. The patient also experienced some foot numbness in addition to difficulty with plantarflexion and dorsiflexion of her great toe.

The patient was transferred to our Level I trauma facility, continuing to note severe left pelvic and radicular pain. Her examination revealed limited motor testing of the hip flexors, quadriceps, and hamstrings secondary to pelvic pain. Left plantarflexion strength was 0/5, with 2/5 ankle dorsiflexion and extensor hallucis longus (EHL). The patient exhibited marked numbness to the S1 distribution and to a lesser extent the L5 distribution, and absent Achilles reflex on the left. The remainder of the physical examination was normal, and all incisions from the previous surgery were well healed without signs of infection.

Radiography (Figure 1) and computed tomography (CT) (Figure 2) of the pelvic region were performed. Radiography showed a 13-mm posterior displacement and an 8-mm cephalad displacement of the

pelvis. CT revealed a comminuted sacral fracture with the posterior-superior iliosacral screw breaching the integrity of the spinal canal. Revision surgery was recommended because of continued symptoms, malposition of the iliosacral screw, and continued pelvic displacement.

Surgical Technique

After informed consent was obtained, the patient was brought to the operating room, approximately 2 weeks after her initial surgery. The patient was placed in the supine position and the previous Pfannenstiel incision was utilized to expose and remove the anterior fixation. The anterior implants were removed prior to posterior revision surgery in order avoid hindering the posterior reduction. The patient was then placed into the prone position and a posterior midline exposure was performed from L3-S3. An inferior laminotomy of L5 was performed, with removal of the ligamentum flavum and S1 lamina. The left superior facet of S1 was freely movable and facetectomy was performed. Compression of the L5 nerve root by the displaced sacral ala was noted. With exposure of the canal, the posterior-superior iliosacral screw was seen to traverse the S1 pedicle and entered the spinal canal ventral to the thecal sac (Figure 3).

The S1 nerve root stump was identified at the site of avulsion off the thecal sac, and some portion of the distal nerve root was identified (Figure 4). Through a separate lateral incision, the iliosacral screws were accessed and the screws removed without difficulty while the thecal sac was directly observed. With removal of the iliosacral screws, motion at the fracture site was present upon lateral compression stressing.

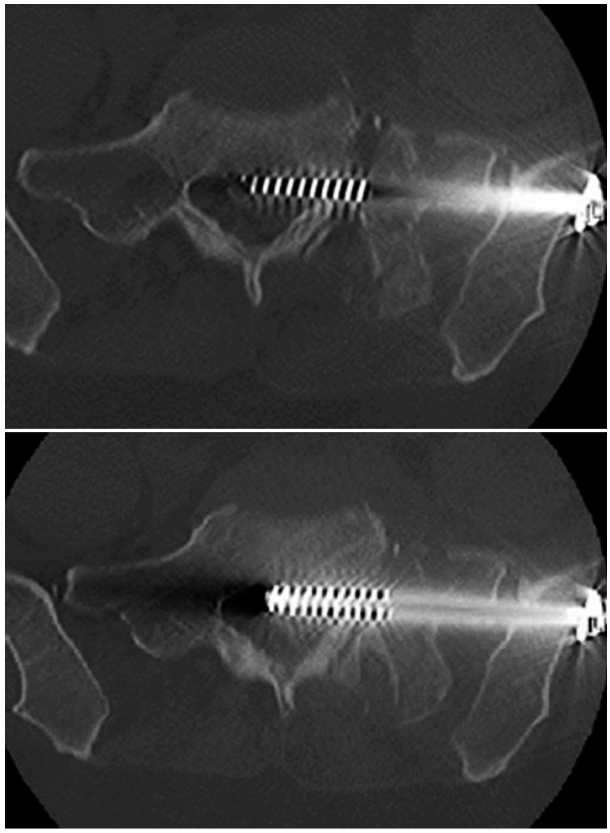

Figure 2. Axial CT scan of spinal canal showing the iliosacral screws breaching the integrity of the spinal canal.

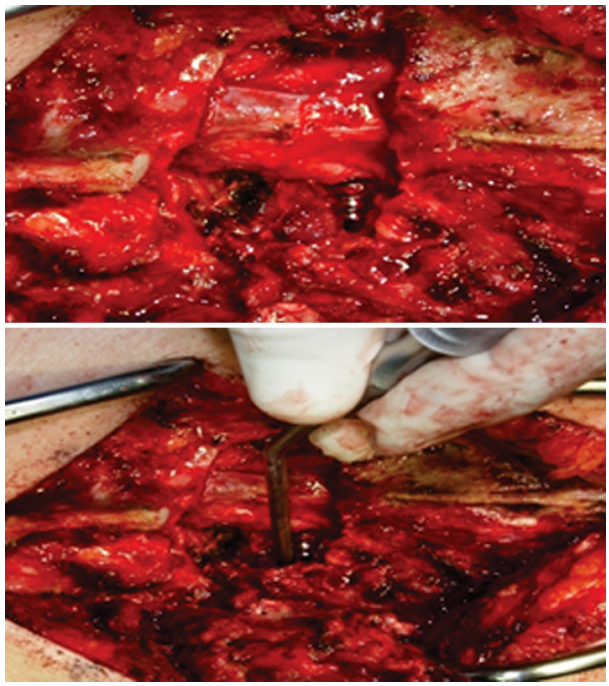

Figure 3. Intraoperative photographs revealing decompression of the upper sacrum and the iliosacral screw traversing through the area of the S1 pedicle and root.

The hemipelvis was then reduced and fixated with spinopelvic fixation extending distally from L4 (Figure 5). Following reduction, the L5 nerve root was well decompressed. After spinopelvic fixation, the anterior pelvic ring was manually stressed and deemed stable. Therefore, no anterior pelvic fixation was performed.

The patient noted immediate improvement in pain following surgery. At last follow-up, 3-years postoperative, evaluation

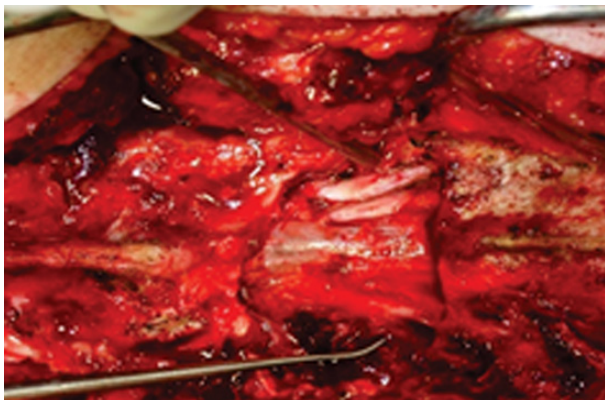

Figure 4. A probe points to absence of the S1 nerve root on the left (bottom); and to normal S1 and S2 on the right (top).

revealed continued difficulties with pain and weakness. Manual motor strength testing revealed 4/5 ankle plantar and dorsiflexion. She continued with L5 and S1 dermatomal numbness and pain, subjectively improved. Radiography revealed a healed fracture without displacement (Figure 6). Her symptoms are significant enough that she is considering evaluation for dorsal column stimulator placement.

DISCUSSION

Sacral fractures occur in nearly one half of all pelvic fractures, with most of them due to motor vehicle collisions, and approximately 25% are associated with some form of neurological injury (1). Neurological deficit following vertically unstable pelvic fractures is not unusual, with rates ranging from 24% to 60% depending on the location of the fracture, and it is a common cause of long-term disability following the disruption of the pelvic ring (2-6).

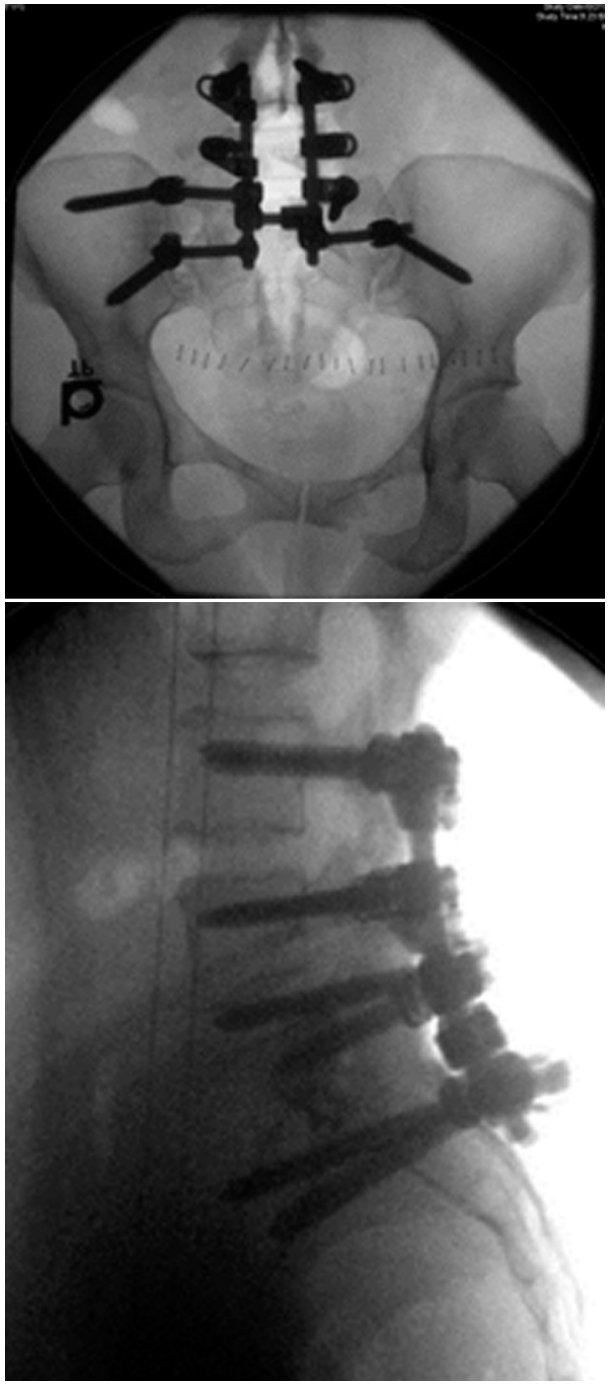

Figure 5. Intraoperative X-rays showing improved pelvic alignment following revision surgery with spinopelvic fixation and removal of IS screws and anterior plate.

The type of neurological injury associated with sacral fractures is related to fracture type. The Denis classification of sacral fractures (1) categorizes them into zones I, II, and III. A zone I sacral fracture is characterized by a fracture lateral to the neural foramina, and results in a 6% chance of neurological injury, usually due to damage to the L5 nerve root from the vertically displaced sacral ala (1-6). A zone II fracture is one through the neural foramina, and results in a 28% chance of neurological injury due to damage to the L5, S1, or S2 nerve root (1). A zone III fracture is the most severe, as it involves the spinal canal, and carries with it a 57% chance of neurological injury (1). Additionally, bowel/bladder and/or sexual dysfunction are found in 76% of zone III fractures (1). Various methods of stabilization can be used to treat sacral fractures with associated pelvic instability (1). Spinopelvic fixation is the most stable biomechanical construct as it effectively "skips" the comminuted sacral region and transmits weight from the spine to the ilium (1). However, compared with other methods, this method is much more invasive, can lead to a higher incidence of wound complications, and carries a higher risk for infection. Iliosacral screws are often utilized in the treatment of these injuries, especially if there is significant soft tissue or bowel injury. If utilized, attention should first be directed toward management and stabilization of any anterior pelvic ring disruptions (7). Contraindications include failure to reduce the posterior displacement and inability to fluoroscopically visualize the posterior and lateral sacrum (7). Sacral fracture comminution is a relative contraindication as it may lead to iliosacral fixation failure.

The proper placement of iliosacral screws is technically demanding, and certain situations make it even more difficult. Vertical shear sacral fractures are associated with a higher rate of fixation failure when iliosacral screws are used. Disparities in the quality of bone available for screw purchase as well as the inability to compress at the fracture site for fear of nerve damage are reasons for this increase in failure. A retrospective review done by Griffin et al. (8) revealed a 13% rate of fixation failure when iliosacral screws were used in the presence of a vertical sacral fracture. However, this review found iliosacral screws to be useful in the management of vertically unstable pelvic fractures. Additionally, residual fracture displacement can greatly compromise the space available for safe screw placement, placing intracanal and sacral root nerve structures at risk (9). The L5 nerve root is also at risk with anterior placement of the iliosacral screw. In a study by Reilly et al. (9), the available area for safe placement of iliosacral screws decreased as the degree of displacement in the fracture increased.

Figure 6. Anteroposterior view of the pelvis 3 years postoperative fixation.

The study revealed that nine screws could be placed safely in a nondisplaced fracture, while only three screws could be placed in a fracture displaced by 10 mm (9). Fractures with a displacement of greater than 10 mm led to greatly compromised available screw space (9).

In our patient, it is uncertain whether the fractures were reduced prior to iliosacral screw placement because preoperative, intraoperative, and immediate postoperative radiographic studies were not available for review.

CONCLUSIONS

While percutaneous iliosacral screws can be very useful in the treatment of certain pelvic injuries, complications can occur with their use. Preoperative evaluation of the patient's pelvis morphology is imperative for a successful outcome. Equally important is an adequate reduction with stable fixation. We present a case in which stabilization was achieved using spinopelvic fixation with improved neurological recovery.

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