An unusual transverse sacral fracture treated with early decompression

Case report

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The authors describe the case of a patient who sustained a transverse sacral fracture (TSF) associated with a depressed laminar fracture in a personal watercraft accident. The patient underwent early surgery, which allowed a quick recovery. To the best of the authors' knowledge, the mechanism of injury and type of fracture have not been previously described or classified in cases of TSF.

**KEY WORDS** • fracture • sacrum • decompression surgery

Transverse sacral fractures are uncommon sacral fractures and occur in 2 to 5% of total sacral fractures.\(^3,8\) They are caused by falls and pedestrian or passenger motor vehicle accidents.\(^4,6,8,10,12,21,23,25\) They have been classified by Roy-Camille, et al.,\(^15\) and by Strange-Vognsen and Lebech.\(^20\)

We report a rare case in which the TSF was sustained during a PWC accident and in which the patient underwent early surgery.

**Case Report**

**History.** This 23-year-old woman on vacation was riding a PWC in the ocean, jumped a wave, lost control of the vehicle, fell backward, and struck her lower back on the vehicle. She experienced severe pain and difficulty moving her legs. After being taken to the shore she was brought to the hospital.

**Examination.** The patient’s only complaint was severe low-back pain. Her vital signs were normal. Neurologically she was alert and oriented, and examination of cranial nerve function demonstrated intact responses. We observed normal upper- and lower-extremity strength, sensation, and reflexes. Initially the patient’s genital and perineal areas were not examined neurologically. The sacral region was extremely painful to palpation; inspection revealed an area of ecchymosis in the sacral region.

Analgesic agents were administered. Plain lateral radiography showed a sacral angulated fracture located between S-2 and S-3 (Fig. 1). Because of the radiographic findings, a CT scan was obtained, and neurological examination was repeated, this time focusing on the function of the sacral nerve roots. The patient’s lumbosacral pain had improved. The S-1 motor and sensation functions were normal, saddle anesthesia was present, perianal sensation and anocutaneous reflex were absent, and rectal tone was poor. To evaluate bladder control, a bolus of saline solution was administered intravenously and the patient was not able to void her bladder, instead exhibiting urinary retention; the bladder was catheterized.

Axial CT scanning revealed a depressed laminar S2–3 fracture with significant narrowing of the sacral canal (Fig. 2); on a sagittal CT reconstruction (Fig. 3) we observed mild sacral angulation and significant sacral canal stenosis caused posteriorly by the depressed laminar fracture.

Because of the degree of canal narrowing and clinical findings and because the patient’s condition was optimal for surgery, we decided that the best treatment option was decompression of the sacral nerve roots.

**Operation.** The patient underwent surgery 5 hours after sustaining the injury. After the fracture site was identified on fluoroscopy, decompression was performed. The depressed bone fragments of laminae were excised; we could see the termination of the thecal sac, but it was not compressed. The nerve roots beneath the fracture were edematous and hyperemic, whereas the dura mater covering those roots was intact. The nerve roots were decompressed.

**Postoperative Course.** The day after the surgery, the patient’s urinary catheter was kept closed. The patient experienced sensation during micturition 24 hours after the
surgery. During the 2 subsequent days, she began to recover genital and perianal sensation, and the anocutaneous reflex was present. One week after surgery the urinary catheter was removed. One month after surgery, bladder and bowel control functions were normal. At the last follow-up examination, the patient was experiencing mild paresthesia in the genital area, which was progressively improving.

Discussion

Personal watercrafts, also known as jet skis or wave runners, are self-propelled aquatic vehicles capable of traveling at speeds exceeding 60 mph. Because of their speed, accidents result in high-energy injuries. Most of the spinal injuries sustained during PWC accidents are thoracolumbar and less frequently cervical.\(^1,11,16,19\)

Sacral fractures were classified by Denis, et al.\(^2\) into three types: Zone I, II, and III fractures. Zone III fractures include vertical shear injuries, high and low transverse fractures, and traumatic L5–S1 spondylolisthesis.\(^18\) They are located in the spinal canal, and because of this, the incidence of neurological dysfunction is high compared with the other two fracture types. Transverse sacral fractures are a special type of Zone III fracture, occurring in 2% of cases in the review published by Denis, et al. Transverse sacral fractures often occur at the S2–3 level because the upper two segments of the sacrum are stabilized by the sacroiliac joint, and the coccyx may act as a lever arm on the sacral body at the S2–3 level, where the apex of normal sacral kyphosis is located.\(^7\)

Transverse sacral fractures are subdivided into two groups—high and low transverse fractures.\(^24\) High TSFs result from severe traumatic flexion of the upper body on the fixed pelvis. The most common pattern of this type of fracture is an S1–2 displacement–angulation. Low TSFs are caused by a hard blow to the coccyx, which itself acts as a levering mechanism fracturing the sacrum in its kyphotic curve.\(^7\) This injury can occur when an individual falls on his or her buttocks. Low TSFs are stable injuries if the superior sacroiliac joints remain intact.\(^12\) Initially TSFs were classified into three types by Roy-Camille, et al.\(^15\) A new type of fracture (Type IV) was added to this classification.\(^20\) A Type IV fracture is very uncommon. Transverse sacral fractures are classified as follows: a Type I injury is angulated but not translated, Type II is angulated and translated, Type III shows complete translational displacement of the cephalad and caudal parts of the sacrum, and Type IV is segmentally comminuted as a result of axial impaction. These classifications are focused on the findings of angulation, translation, and comminution of the S-1 vertebral body, but a true depressed laminar fracture, which was present in our patient, has not been described or included in these schemes.

Neurological dysfunction, very common in TSFs, can be the result of transection, contusion, and compression and traction of sacral nerve roots. Nerve root injury secondary to fracture translation, angulation, or direct compression is associated with a chance of recovery.\(^22\) Neuro-

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**Fig. 1.** Left: Anteroposterior radiograph showing the fracture line (arrows). Right: Lateral radiograph demonstrating a sacral angulation at the S2–3 level (arrow).

**Fig. 2.** Axial CT scan showing that the spinal canal is significantly narrowed secondary to the depression of the lamina, which has invaginated into the canal.

**Fig. 3.** Sagittal CT reconstruction revealing a TSF at the S2–3 level. The fracture is angulated (long arrow), but the narrowing of the spinal canal and neural compression are secondary to the lamellar fracture, which has protruded into the canal (short arrow).
Sagittally reconstructed CT scans are essential for decompression in TSF and the associated depressed laminar fracture (Fig. 4). Transverse sacral fractures are difficult to detect, especially in cases in which neurological deficits are absent. The saddle anesthesia, loss of bladder function, and loss of rectal sphincter tone may be unrecognized during the initial treatment of severe trauma or may somehow be overlooked because of the presence of associated severe pain. Sagittally reconstructed CT scans are essential for the diagnosis and evaluation of TSFs.

Currently, the treatment of TSFs with associated neurological dysfunction remains controversial. Whereas some authors advocate conservative treatment, others encourage undertaking decompressive surgery. Decompression in TSF is easier to perform in the acute phase. Because of the anatomical characteristics of the lower sacral region, stabilization procedures should be considered in patients with high-region TSF, especially those associated with a vertical fracture (an H-type fracture); in low-region TSF stabilization is not necessary because the involved portion of sacrum is not part of the weight transmission from the lower limbs to the spine.

Neurological recovery in these types of fractures is slow, usually taking months to resolve. Ebraheim, et al., reported on four patients with neurological dysfunction who underwent surgery 1 to 16 days after the injury (mean 6.2 days); neurological recovery began to occur 6 weeks in most patients and plateaued at approximately 6 months. The early neurological recovery in our patient suggests that expeditious decompression of the sacral nerve roots in cases of TSF leads to earlier recovery than conservative treatment.

Our case presents the following unique characteristics. 1) The cause of the neurological deficit was not the fracture’s angulation or translation itself but the depressed laminar fracture; this finding was corroborated by the neurological improvement that occurred after the posterior decompression. 2) The mechanism of injury and characteristics of fracture have not been previously reported in TSF. 3) The early decompression of sacral nerve roots resulted in early improvement of the patient’s neurological function.

Conclusions

A previously unreported type of TSF is presented and the injury pattern is also unusual. The patient’s neurological outcome after expeditious decompressive surgery underscores the importance of an early diagnosis and treatment in patients with these injuries.

References

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Early decompression in transverse sacral fracture


Manuscript received May 18, 2005. Accepted in final form August 28, 2006.
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