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Sacroplasty for Zone III Sacral Insufficiency Fracture: A Case Report Utilizing a Midline Approach and Articulating Osteotome

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Background: Sacral insufficiency fractures can be a debilitating cause of low back pain in the elderly population. While sacroplasty is recommended for the treatment of persistent pain from sacral insufficiency fractures, the anatomical location of Zone III fractures can put patients at a higher risk of neurological complications during repair.

Case Report: We present a case of a 71-year-old woman with a Denis Zone III sacral insufficiency fracture who underwent percutaneous sacroplasty. The procedure was performed by utilizing an articulating osteotome in the long-axis approach along the curvature of the sacrum. The use of an articulating osteotome allowed for small trajectory adjustments, thereby lowering the procedural risks of cement extravasation and erroneous cannulation.

Conclusions: The patient reported significant pain relief and no immediate complications following the procedure. Fluoroscopically guided percutaneous sacroplasty using an articulating osteotome is a safe and effective method for treating sacral insufficiency fractures.

Key words: Sacrum, bone fracture, sacroplasty, back pain, case report

BACKGROUND

Sacral insufficiency fractures are an underdiagnosed cause of low back pain and limited mobility in the elderly population (1). These fractures are typically found in the sacral ala or S2 vertebrae and often occur in the setting of osteoporosis in women (1). Other common causes are overuse injuries in athletes, osteopenia secondary to chronic corticosteroid use, radiation therapy, and cancer metastasis (2). Sacral insufficiency fractures typically present as nonspecific low back pain originating from the sacral or buttock region (1). Screening radiographs lack sensitivity and can lead to underdiagnosis. Thus, magnetic resonance imaging (MRI) of the pelvis remains the gold standard image for diagnosis (3,4). Treatment options for fractures include conservative measures, minimally invasive treatment, and invasive repair. Conservative treatment involves bed rest, physical therapy, and pharmacologic therapy (2). On the other hand, minimally invasive therapy includes sacroplasty, while a more invasive treatment is spinopelvic fixation. It is important to note that spinopelvic fixation is normally not a valid option for insufficiency fractures in the osteoporotic patient population (2).

The Denis system has been used to classify sacral fractures and separates the sacrum into 3 zones. Zone I is limited to the sacral ala and is the most common site of sacral insufficiency fractures. Zone II includes the sacral foramina and is the second most common

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fracture location. Lastly, Zone III fractures include the sacral bodies and canal, which pose the highest risk for neurologic injury (Fig. 1) (5).

Sacroplasty is a minimally invasive procedure that involves percutaneous injection of polymethyl methacrylate cement into the fracture location under fluoroscopy or computed tomography (CT) guidance (2). Initially, the procedure was utilized for the treatment of painful pathologic fractures secondary to metastases, but has now subsequently been expanded to include the treatment of traumatic and sacral insufficiency fractures (3). The sacroplasty procedure has been shown to improve early mobility and significantly reduce pain in patients with insufficiency fractures when compared to conservative management alone (6,7). Treating sacral insufficiency fractures with sacroplasty is normally limited to fractures found in Zone I due to the increased risk of cement spreading into the foramina or canal when treating Zone II or III fractures (8).

Current literature (3) describes 3 common approaches to the sacrum: long axis, short axis, and transiliac. In the long-axis approach, the needle is placed in a caudaL-cephalic direction along the sacral ala. The short-axis approach involves needle entry in a posterior-to-anterior direction. Both approaches have shown similar effectiveness in treating pain as well as safety profiles. The transiliac approach involves the needle entering the iliac bone and the sacroiliac joint, and it is mostly utilized in sacral body lesions (3).

Fig. 1. Image depicting Denis classification of sacral fractures:
1. Zone I fracture through the sacral ala;
2. Zone II fracture including sacral foramina; and
3. Zone III fracture including sacral bodies and canal.

Although multiple case reports exist on sacroplasty, sparse literature exists on utilization of articulating osteotomes for appropriate sacral access in Zone III fractures, where there is a higher risk of neurologic injury. We present the case of a 71-year-old woman with multiple comorbidities who presented with back pain after a fall. A Zone III sacral insufficiency fracture was confirmed on imaging and the patient underwent sacroplasty via the long-axis approach, using an articulating osteotome for safety and sufficient access. The manuscript adheres to the applicable Enhancing the Quality and Transparency of Health Research guidelines. The Health Insurance Portability and Accountability Act authorization was obtained from the patient to publish this case report.

CASE PRESENTATION

A 71-year-old woman with a past medical history of systemic lupus erythematosus, rheumatoid arthritis, pulmonary hypertension, chronic hypoxic respiratory failure, atrial fibrillation, non-ST-elevation myocardial infarction, drug-eluding stent, heart failure with preserved ejection fraction, mitral regurgitation, hypertension, hyperlipidemia, and bilateral avascular necrosis of the femoral heads was admitted after presenting to the emergency department for a fall that resulted in back pain and difficulty with ambulation. Interventional pain was consulted on day 1 of her hospital stay for back pain assessment. She noted constant aching pain to the "tailbone" when interviewed, and intermittent radiating pain down the anterior portion of her lower extremities, up to the knee. The patient denied bowel and bladder dysfunction and stated that the pain started the previous day after a fall, landing on her buttocks. On physical exam, she had tenderness to palpation of the coccyx with bilateral lumbar paraspinal tenderness. She had minimal lateral back and hip tenderness. Sensation was intact in the lower extremities bilaterally, and straight leg raise was negative. Strength was 4/5 to hip flexion bilaterally and 3/5 on the Medical Research Council (MRC) scale for muscle strength to knee extension bilaterally with no other deficits. Because of her history and physical exam findings, a sacrum/coccyx plain film along with an MRI L-spine were obtained. Plain film of the sacrum and coccyx showed slight cortical offsetting along the anterior sacrum in lateral view at the S1-S2 level, suspicious for sacral fracture

(Fig. 2). The MRI showed an acute-to-subacute sacral insufficiency fracture with cortical disruption and minor angulation of the S1 and S2 segments. There was also diffuse marrow edema and enhancement throughout the S1-S2 bodies extending to the sacral ala (Figs. 3 and 4). Additionally, minor disc bulging and facet arthrosis were seen throughout the lumbar spine with mild right foraminal stenosis at L2-L3. No central stenosis was noted. In addition, a CT abdomen/pelvis taken at admission showed lobar consolidation bilaterally, and a positive COVID-19 test confirmed suspicion of COVID-19 pneumonia. Her clinical course was complicated by acute delirium and fracture intervention was held until clinical stability, noted on day 15 of her hospital course. An intake and physical exam were repeated on day 15, which showed improvement in symptoms of radiculopathy with persistent aching pain in the sacrum. Inpatient low-molecular-weight heparin prophylaxis was held 12 hours prior to her procedure.

The patient was brought into the procedure room and placed in the prone position on the fluoroscopy table. Standard monitors were placed, and vital signs were monitored throughout the procedure. The sacrum was prepped with ChloraPrep and draped in a sterile manner. Cefazolin 2 mg intravenously was given for antibiotic prophylaxis. Using an inferior-caudal approach, the tip of the sacrum was anesthetized with 10 cc of 1% lidocaine. An 11G access cannula was inserted into the inferior sacral tip. The cannula was advanced in the anterior-posterior and lateral projection to maintain anterior positioning of the cannula within the inferior sacrum (Figs. 5 and 6). Once the S2 segment was accessed, an articulating osteotome was advanced beyond the cannula and the cavity was created within the S1-S3 segments (Figs. 7 and 8). The osteotome was removed and 3 mL of contrast-enhanced cement was injected within the fractured segments (Fig. 9). Adequate fill was noted within the anterior margins of the S2 segment with no extravasation (Figs. 10 and 11). She was kept prone in the room for 15 minutes postprocedure

Fig. 2. Lateral plain film of the sacrum and coccyx showing slight cortical offsetting along the anterior sacrum at the S1-S2 level, suspicious for sacral fracture.

Fig. 3. Sagittal T2 MRI showing an acute-to-subacute sacral insufficiency fracture with cortical disruption and minor angulation of the S1 and S2 segments. MRI, magnetic resonance imaging.

Fig. 4. Sagittal STIR MRI showing diffuse marrow edema and enhancement throughout the S1-S2 bodies. STIR, short tau inversion recovery; MRI, magnetic resonance imaging.

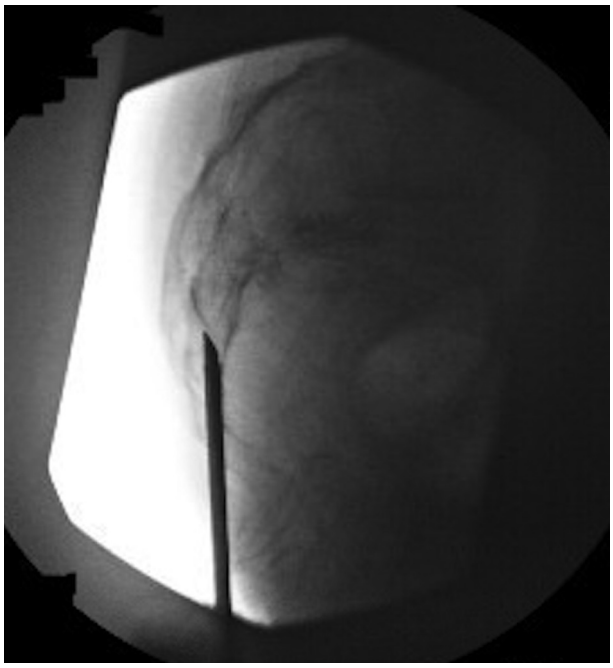

Fig. 5. Cannula advancement in the lateral projection within the inferior sacrum.

prior to transfer to recovery. The patient tolerated the procedure well with no immediate complications. At follow-up, she had 70% improvement in pain at 48 hours postsacroplasty, with pain improving from a 10/10 to 3/10 on the Numeric Rating Scale. At her 6-week follow-up appointment, her sacral and coccyx pain were resolved (Fig. 12).

CONCLUSIONS

Sacral insufficiency fractures remain an underdiagnosed cause of low back and pelvic pain in the elderly population. Current treatments include conservative management, percutaneous intervention, and surgical fixation. Sacroplasty involves injecting cement into the fracture location using fluoroscopy or CT. While many case reports exist on the logistics of the procedure, few case reports exist on treatment of Zone III sacral insufficiency fractures with articulating osteotome usage for proper anatomical access. In this case, the patient had a presentation of severe sacrum and coccyx pain with radiculopathy and mild neurologic weakness in the knees. She had minimal pain laterally, which is why Zone III only was pursued over dual cannulation at Zones I and III of the sacrum. Our goal was to improve pain, neurologic function, and mobility. Of note, Zone III treatment historically includes a small window of error, as cement extravasation or erroneous cannulation

Fig. 6. Cannula advancement in the anterior-posterior projection within the inferior sacrum.

Fig. 7. Articulating osteotome initiation through the cannula and cavity creation within the S1-S3 segments.

Fig. 8. Articulating osteotome advancement through the cannula and cavity creation within the S1-S3 segments.

Fig. 9. Cement injection within the created sacral cavity.

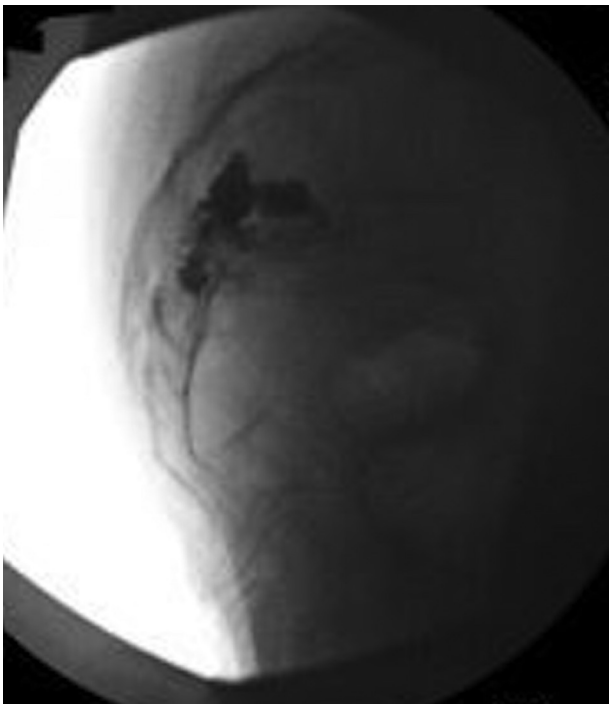

Fig. 10. Final lateral projection of completed sacroplasty.

Fig. 11. Final anterior-posterior projection of completed sacroplasty.

can lead to neurologic consequences for the patient. Use of an articulating osteotome to create preferential paths for targeted cement delivery allowed small adjustments in trajectory to be made along the curvature of the sacrum. Furthermore, this technique increased the reliability of cavity location and reduced the risk of adverse events during the procedure. Based on this result, it would be reasonable to consider the use of articulating osteotomes that allow modification of the trajectory in future sacroplasty procedures that necessitate meticulous movements for appropriate patient outcomes.

Fig. 12. Sagittal CT abdomen and pelvis obtained at 6-week follow-up appointment showing intact sacral repair. CT, computed tomography.

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