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Educational Corner

Diagnosis and Management of Spinopelvic Dissociation

Morteza Bidaki[1], Farzad Vosoughi[1], Mohammad Zarei[2,*], Seyed Hadi Kalantar[2]

[1] Resident, Department of Orthopedic Surgery, Joint Reconstruction Research Center, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran
[2] Assistant Professor, Department of Orthopedic Surgery, Joint Reconstruction Research Center, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

[*]Corresponding author: Mohammad Zarei; Department of Orthopedic Surgery, Joint Reconstruction Research Center, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98-2166581586, Email: zarei_mohammad78@yahoo.com

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Background

Traumatic spinopelvic dissociation (SPD) is a devastating clinical condition that mostly coincides with other major injuries, resulting in worse prognosis and complicated diagnosis (1). In a significant number of cases, the patient needs primary endotracheal intubation that makes the history taking and clinical examination nearly impossible. Therefore, a high index of suspicion should be maintained in any patient with multiple trauma (1).

Although the exact epidemiology of SPD is still unknown, previous studies have demonstrated that almost 2.9% of pelvic ring fractures are accompanied by SPD (2). One of the most common mechanisms of injury is falling from a high altitude in suicide victims. Thus, many orthopedists name this injury “suicidal jumper fracture” (3).

The diagnosis of SPD is difficult, due to obscurity in routine radiographic views, low incidence, and its coincidence with other traumatic injuries. Given the difficulties in diagnosis and the heterogeneity of its nature, the best way of management is still a topic of debate. This study aims to discuss the main principles and the basis of the management of SPD (4).

Diagnosis

In the trauma bay, patients with multiple trauma should be assessed according to the principles of Advanced Trauma Life Support (ATLS). A history of falling from height is common. The patient may have back pain, especially in the lower lumbosacral area. In the examination, attention must be paid to the perineum, digital rectal exam, and vaginal exam in female individuals to rule out any laceration or open fracture. Besides, a neurological examination should be performed. A decreased rectal tone in association with disrupted perineal sensation and bladder incontinence is suggestive for the cauda equina syndrome (CES) (5). Additionally, foot drop may be a symptom of the L5 root injury.

X-ray views, including posteroanterior (PA), lateral, and inlet/outlet views are needed. The paradoxical inlet view in the PA pelvic view (due to sacral kyphotic deformity) or a step ladder sign is strongly suggestive of SPD. Asymmetry or disruption in the sacral foramina is another possible finding. Further evaluation with fine-cut (< 5 mm) multi-slice spiral computed tomography (CT) scan with coronal and sagittal reconstruction delineates the fracture characteristics and helps the surgeon for preoperative planning (1). As the transverse sacral fracture can be missed in axial CT cuts, sagittal CT reconstruction is of paramount importance.

Classification

In SPD, sacral fractures can be categorized based on the shape of the fracture (e.g. H type, U type, Y type, and T type; Figure 1) (1, 6).

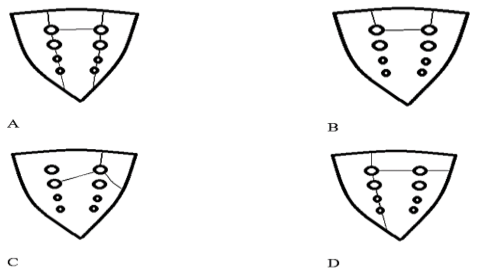

Figure 1. Categorization of the spinopelvic dissociation (SPD) based on the fracture morphology: H type (A), U type (B), λ type (C), and T type (D)

Roy-Camille et al. have classified the SPD according to the relation between proximal and distal sacral fractures. In this classification, type 1 refers to fractures with minimal translation. Type 2 and 3 are translocation of the fractured distal sacral fragment to the anterior and posterior, respectively (3, 5). Finally, a type 4 fracture is defined by the comminution of the proximal sacral fragment (Figure 2).

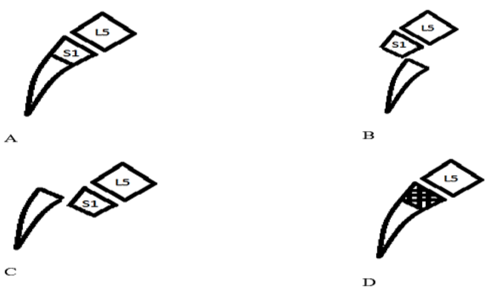

Figure 2. Classification of the spinopelvic dissociation (SPD) according to the comminution and translation (Roy-Camille classification): Type 1 with minimal displacement (A), Type 2 with anterior displacement of distal sacral fragment (B), Type 3 with posterior displacement of distal sacral fragment (C), and type 4 with comminution of the proximal sacral fragment (D).

Lehman et al. proposed the lumbosacral injury classification system (LSICS) based on the morphology, lumbosacral ligamentous status, and neurological examination. Having a score of at least 5 makes surgery mandatory for the patient. On the contrary, a score of 4 or lower can be managed nonoperatively according to this criterion (Table 1) (7).

Table 1. Lumbosacral injury classification

Items in the lumbosacral injury classification system	Score
Characteristics of the lumbosacral fracture:	
With 20 degrees or less kyphosis	1
With more than 20 degrees kyphosis	2
Axial compression without canal/ sacral foramina involvement	2
Axial compression with canal/sacral foramina involvement	3
Horizontal translation of the sacrum	3
Lumbosacral facet injury	3
Vertical translation	3
Bone loss or fracture dislocation	4
Posterior lumbosacral ligaments:	
Intact	0
Suspicious	1
Injured	2
Neurological condition:	
No focal neurologic deficit	0
Paresthesia	1
Motor weakness	2
Bladder/bowel involvement	3
Progressive neurologic sequel	4

A score of at least 5 indicates surgery as the appropriate management. Cases with score of less than 4 can be managed nonoperatively. The management of patients with score of 4 should be individualized based on the surgeon's clinical decision.

Gibbons et al. proposed a classification for neurological examination, designed specifically for patients with sacral fracture. According to this classification, participants with an intact neurological examination are grouped as stage one. Those with sensory impairment and motor weakness are categorized as stage two and three, respectively. Finally, those with bladder or bowel dysfunction are classified as stage four (8).

Management

Previously, nonoperative management was the treatment of choice for SPD (9). However, with improvement in surgical techniques and orthopedic equipment, surgical treatment is preferable. Therefore, the nonoperative treatment is now reserved for patients with medical comorbidities who cannot tolerate surgery, those with nondisplaced sacral fracture (Denis stage 2 or 1), or stable pelvic ring without any neurological sequel (1). The appropriate timing for surgical intervention is within 1-2 weeks in general, and within 24 hours in those with CES (5).

Neurological Decompression

As neurological decompression may have postoperative complications like fistula or dura injury, it is not performed routinely in SPD. Only those with progressive neurological exacerbation are indicated to undergo urgent neurological decompression, which is performed by spinal laminectomy. Moreover, if a fracture fragment is detected in the sacral foramina in imaging, direct decompression is a must, even before the reduction of the fracture (4).

Reduction

Fractures with Roy-Camille classification of stage 2 to 4 should be reduced primarily before definite management. Cases with an injury duration of less than 72 hours may be reduced closely (4). In the close reduction, the patient is placed in prone position. The sacral area of the patient is pushed downward while flexing the knee to 90 degrees, extending the hip, and applying mild traction to the lower limb (Figure 3) (10). However, for comminuted fractures or delayed referral, percutaneous or open reduction using Schanz pin as a joystick is recommended (4, 11).

Surgical Options

Iliosacral Screws (ISSs): For minimally displaced sacral fractures without neurological deficit, percutaneous sacroiliac screw placement may be used alone for fixation. In the presence of a poor bone quality or fracture comminution, full threaded screws are used. However, if the bone quality is appropriate and the fracture is not comminuted, partially threaded screws can be used (12).

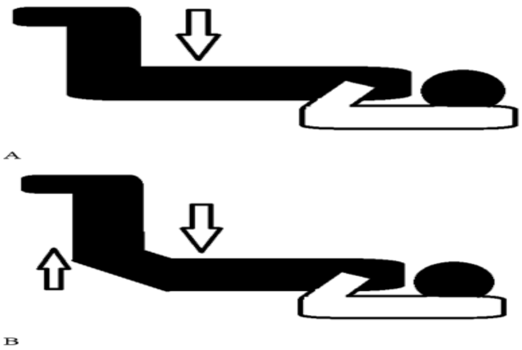

Figure 3. Closed reduction of the spinopelvic dissociation (SPD). The patient is placed in a prone position. The knee is flexed to 90 degrees (A). Under fixed traction to the lower limb, the pelvis is extended to reduce the kyphotic deformity of the sacrum (B).

Plating

The ISS is not a suitable option for sacral fixation in the presence of a comminuted fracture or transverse fracture in the upper sacral area. On these occasions, plate fixation may be applied. When the fracture spares the anterior sacral cortex and the sacral plate is placed in the posterior sacral side, the plate acts as a tension band. On the contrary, if the fracture involves both the anterior and posterior sacral cortices, it mainly acts as a bridging plate. The plate fixation enables the surgeon to decompress the spinal roots if clinically indicated. It also gives surgeons the opportunity to reduce the fractures under direct observation. However, if the soft tissue condition of the operation site has poor quality, plate fixation may be associated with a high rate of surgical site infection (5).

Currently, percutaneous plate fixation has been introduced for spinopelvic fractures, with growing popularity. Despite the fact that the injury to the soft tissue in this method is decreased, it has the drawback of having limited capacity for fracture reduction or spinal root decompression (5).

Triangular Osteosynthesis

For displaced SPD, one of the most appropriate approaches is the triangular osteosynthesis (Figure 4).

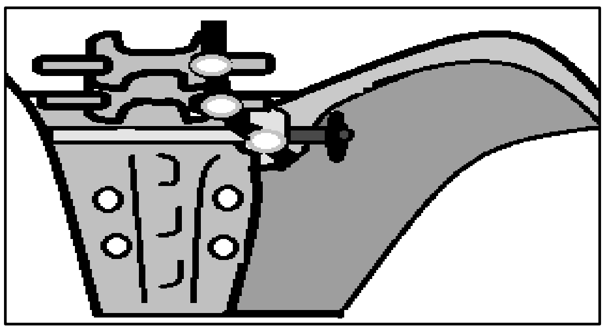

Figure 4. Triangular osteosynthesis. The pedicular screws are place at L4 and L5, and are connected to each other and the iliac screw by a rod. A sacroiliac screw stabilizes the sacroiliac joint and prevents upward displacement of the iliac screw during weight-bearing.

Triangular osteosynthesis was originally designed for the vertically unstable transforaminal sacral fractures (Figure 5).

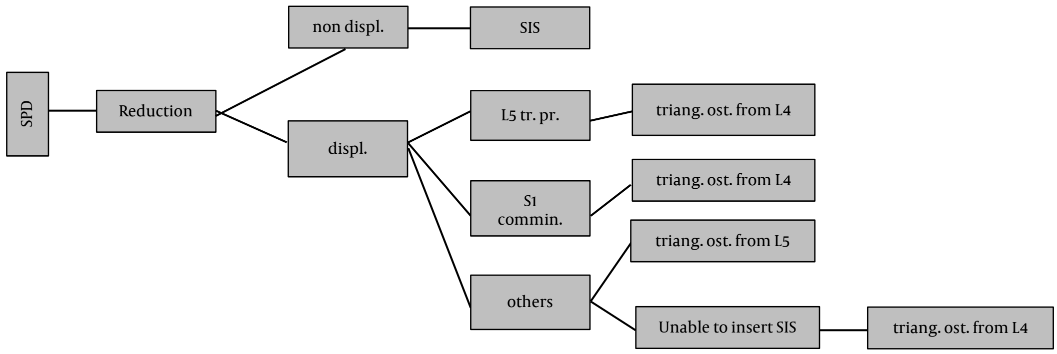

Figure 6. The proposed algorithm for the management of the spinopelvic dissociation (SPD)
displ: Displaced; SIS: Sacroiliac screw; tr. Pr.: Transverse process fracture; commin.: Fracture comminution; triang. ost.: Triangular osteosynthesis

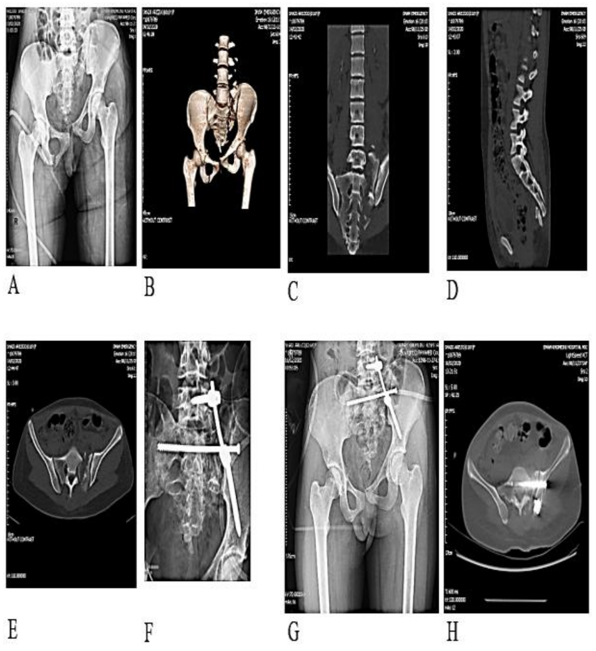

Figure 5. A vertically unstable transforaminal sacral fracture treated with triangular osteosynthesis. The patient was referred to the Imam Khomeini Hospital, Tehran, Iran, with a complaint of lower back pain and inability to bear weight following a fall from height as a suicide attempt.
A-E: Preoperative plain X-rays and computed tomography (CT) scan of the patient showed a vertical shear fracture with a Denis type 2 transforaminal sacral fracture.
F-H: The patient was managed with triangular osteosynthesis and the pain was improved significantly following the surgery.

After obtaining adequate reduction, percutaneous or open ISS placement is used to stabilize the iliosacral joints. Then, in the prone position, a midline incision is created in the lumbosacral area. A pedicular screw is placed in the L5 with or without L4 vertebra. In the next step, an iliac screw is inserted medial to the posterior superior iliac spine in a ventral caudal direction. Finally, the vertebral and iliac screws are connected by a rod. This technique transfers the body weight from the axial skeleton to the pelvis and lower limb, bypassing the unstable and injured sacrum. This method results in fracture union and decreases the time needed for weight-bearing (4).

If it is not feasible to place sacroiliac screws due to sacral dysmorphism or fracture comminution, it is recommended to perform spinopelvic fixation from the L4 vertebra. Furthermore, if the insertion of the L5 pedicular screw is not possible due to a transverse L5 fracture, it may be appropriate to place the screw in the L4 vertebra, instead (Figure 6) (4, 5).

In previous studies, this technique has shown appropriate results with regards to the maintenance of reduction and allowing for early mobilization (13).

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgments

None.

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