CASE REPORT

Innovative Technique for Posterior Fixation of Vertically Unstable Pelvic Ring Fracture: A Case Report

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Abstract

An obese 57-year-old woman with known hypertension and diabetes mellitus sustained multiple injuries during an accident, which caused anterior-posterior fracture-dislocation of the pelvic ring. Due to the drawbacks of conventional stabilizing methods for anterior-posterior fracture-dislocations of the hip in this setting, such as the inability to visualize anatomical landmarks fluoroscopically for the iliosacral screw technique and the compromised L5 pedicle preventing lumbopelvic fixation, the patient underwent an innovative Hula Hoop technique described here. Using the Hula Hoop technique, a technique that has rarely been studied in humans, we avoided an invasive open procedure, decreased anesthesia time, reduced the size and number of incisions, and minimized bleeding. After three months of routine physiotherapy and occupational therapy, the patient was able to walk with a walker and an ankle-foot orthosis.

Level of evidence: V

Keywords: Fracture dislocation, Fracture fixation, Minimal invasive, Multiple injuries, Pelvis, Unstable pelvic injuries

Introduction

Anterior-posterior fracture-dislocations of the pelvic ring are commonly observed in multiply-injured patients with concomitant injuries, such as internal organ rapture and spinal injuries.[1] When accompanied by other injuries, the anterior-posterior fracture-dislocation could be problematic if not fixated.[2] As such, early fixation of these fractures is desirable to avoid further complications.[3] Usual stabilizing methods include the iliosacral screw (ISS), plating, and lumbopelvic fixation.[4]

Currently, ISS is the standard method for stabilizing anterior-posterior fractures or dislocations.[5] However, implementing this technique may not always be feasible.[6] If the fracture is displaced or there is nerve root involvement, an open reduction using a posterior approach is required.[7] Furthermore, the limited view provided by intraoperative fluoroscopy imaging might not be able to visualize landmarks, which makes deciding the trajectory of the screw extremely difficult, if not impossible.[7-9] To avoid iatrogenic injury, fluoroscopic visualization of the pelvis is critical.[10,11] Due to obesity and soft tissue problems, adequate imaging is not possible, and the procedure should be converted to an open reduction and internal fixation, which causes more soft tissue dissection and makes wound care in multiply-injured patients problematic.[12-14]

An alternative method, osteosynthesis, causes severe comminution, osteoporosis, or disruption of the L5-S1 facet joint. An immediate consequence of the lumbopelvic fixation is loss of motion at the lumbosacral junction. Furthermore, although the common choice of proximal spinal fixation is the L5 pedicle, an increase in L5 transverse process and L4 pedicle avulsion have been suggested, which lead to higher degrees of loss of motion.[14]

Due to the drawbacks of conventional methods in multiply-injured patients, the use of minimally invasive procedures for the fixation of anterior-posterior fracture dislocations has been encouraged. Inspired by the In-Fix method, we conceptualized an innovative method for this purpose.[12] Looking for a reliable and stable boney structure to host screws, we chose posterior superior iliac spine for

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screw insertion.[15] Therefore, two iliac screws are inserted from PSIS down to the supra-acetabular bone, connected with a small rod to stabilize the anterior-posterior fracture-dislocation. In a biomechanical study, the method has led to favorable stability[13]; however, the technique has rarely been studied in humans.[16,17]

Herein, we report on the implementation of the aforementioned technique in a morbidly obese multiply-injured woman. In this case, the anatomical landmarks for the ISS technique could not be visualized fluoroscopically, and the L5 pedicle was compromised, preventing lumbopelvic fixation.[14]

Case Presentation

A morbidly obese 57-year-old woman who was a known case of hypertension and diabetes mellitus sustained multiple injuries during a rollover car accident. At arrival, the patient's blood pressure was 80/60 mmHg, and pulse rate was 110 beats/min with a Glasgow Coma Scale of 15. The patient could not move lower limbs because of an open fracture in the right lower limb, there was pain and tenderness in the lumbar vertebrae and pelvis during the initial evaluation. The patient had suffered anterior fractures of the 3rd, 4th, and 5th right ribs, anterior and posterior fractures of the 6th, 7th, 8th, and 9th right ribs that caused right pneumo-hemothorax, L3-L5 and L1 compression fracture, pelvic ring fracture including a vertical shear fracture in the right side and bilateral anterior-posterior dislocation and straddle injuries (comminuted fracture of right and left upper and lower rami of the pubis). Fracture of the transverse process of the L5 vertebrae indicates a vertical shearing mechanism of injury **[Figure 1]**. Additionally, she had a right adrenal hematoma and a trimalleolar open fracture of the right ankle.

The anterior of the pelvic ring was fixed by the in-fix method as described in the literature [Figure 2],[17,18] and for the posterior fracture and dislocation, we decided to use the innovative technique recently described.[16]

Two symmetrical 3-cm incisions were performed on each side, approximately 2.5 cm distal and lateral to the anterior inferior iliac spine (AIIS). In most patients, the landmarks can be confirmed by fluoroscopic imaging obtained with the "teardrop" view. Soft-tissue dissection was performed laterally to the inguinal ligament at the interval between the tensor fascia lata and the Sartorius's muscle, taking precautions to avoid injury to the lateral femoral cutaneous nerve. Fluoroscopic imaging was done to visualize the safe supraacetabular corridor. One pedicle screw was placed at the AIIS (6.5 mm), with 15 mm of distance to the bone, to avoid impingement over the soft tissues. Then a subcutaneous tunnel was made at the bikini area on each side, and a rod (5 mm) was placed, palpated subcutaneously, and extracted from the contralateral side. An adequate anterior reduction was achieved using specific screwdrivers and lateral compression. The rod was connected to the pedicle screws, and the anterior fixation was completed after cutting the redundant segments of the rod.

The sacroiliac (SI) Joints were then explored carefully to avoid further injury to the posterior SI ligaments. However, all posterior SI ligaments were found to be disrupted. The posterior superior iliac spine was then located bilaterally. The entry point for the pedicle screws was on the medial side of the dorsal iliac crest, 1–2 cm cranial to the PSIS.[19] To ensure the least possible implant prominence, a bone block of 1.5 × 1.5 cm was removed from PSIS so that the screw head only protruded minimally from the surface of the bone. This reduces the risk of tissue irritation and prevents the concentration of stress caused by the screw head on the bone.[20] once the entry point was decided, a bone awl was used for making the entrance. Next, a pedicle finder was used to create a tunnel between the outer and inner iliac cortices. Care was taken to avoid penetrating the opposite cortex at the AIIS, as well as the sciatic notch. The trajectory was aimed at the supraacetabular bone. The contralateral corridor was prepared in the same fashion. The screw was positioned approximately 15° laterally in the axial plane and 20° caudally in the sagittal plane.[15] A feeler was used to make sure that there were no breaches in the corridor. We sounded the canal to 85 mm, then two 7 mm polyaxial pedicle screws were inserted. Using inlet and outlet views, the appropriate position of screws was confirmed fluoroscopically. Two screws were connected using the small rod as a crossbar, and the SI joints were reduced by compressing two screws toward each other. After complete hemostasis was assured, the wound was irrigated and sutured in layers without drainage **[Figure 2]**. Operation time was about 30 min, and blood loss was less than 150 ml.

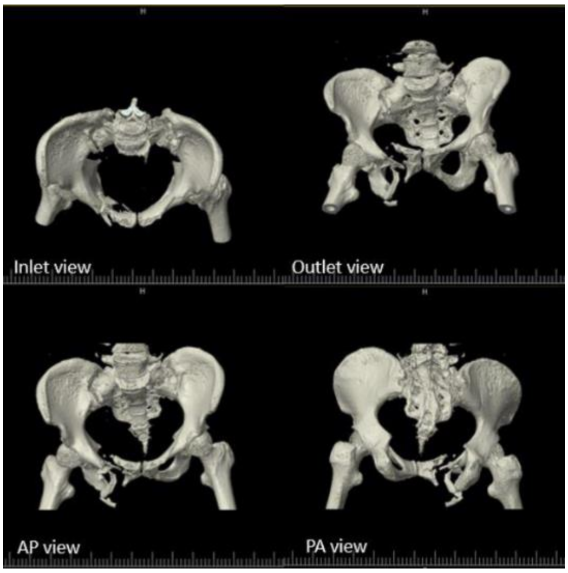

Figure 1. Pre-operation 3D CT-scan

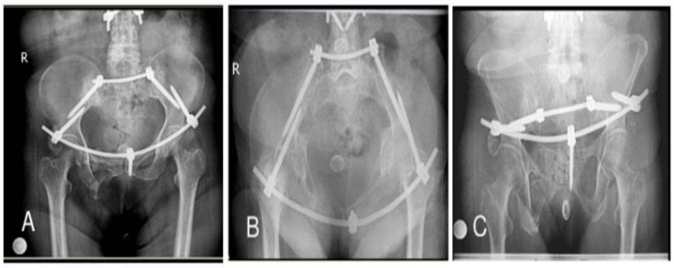

Figure 2. Post-operation control X-Rays. A: AP view. B: Inlet view. C: Outlet view

After a 7-day observation period, she was discharged and followed on a biweekly basis for three months with physiotherapy and occupational therapy. In the third month, the patient was pain-free and able to walk with a walker and ankle-foot orthosis **[video 1]**. The X-ray one year after the surgery shows excellent union **[Figure 3]**.

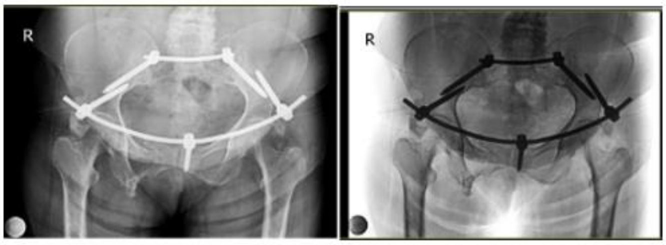

Figure 3. Follow-up x-ray one year after surgery

Discussion

Herein, we described the application of an innovative Hula Hoop technique which avoids invasive open procedures, decreases anesthesia time, reduces the size and the number of incisions, and minimizes bleeding.[17]

The transiliac internal fixation using an internal screw-rod system is a minimally invasive procedure to stabilize an unstable posterior pelvic ring fracture.[21]

Füchtmeier et al. suggested perforating the iliac crest with a pedicle finder and inserting an ilium screw with a diameter of 7 mm and a length of up to 60 mm in the craniocaudal direction parallel to the posterior gluteal line.[21] To account for the fragility of fractures of the pelvis, Schmitz et al. modified this procedure by starting at the posterior inferior iliac spine and heading the screw towards the AIIS. They stated that posterior superior iliac spine should not be taken down as this can affect the stability.[22]

Schildhauer described a pelvic bone corridor in the supraacetabular iliac bone with a length of 140 mm and a width of 8 mm. It has been shown that inter-individual diversity in terms of trajectory is negligible. Schmitz et al. observed consistency in the angulation of the supraacetabular corridor to the axial and the sagittal plane.[15] As such, the current method is a viable alternative when landmarks cannot be visualized fluoroscopically.

The biomechanical properties of the current method have been investigated, and considering stability and resistance to weight-bearing, the results are promising.[16] Due to the inefficiency of available methods in conditions such as obesity, we conceptualized an innovative, minimally invasive method using spine instruments to stabilize vertical shearing anterior-posterior fracture-dislocations in multiply-injured patients for whom other standard methods cannot be optimally used.

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