

Research Article

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Percutaneous Fixation with Screws in Fractures of the Pelvic and Acetabulum

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ABSTRACT

Background: Percutaneous fixation offers advantages over open reduction in fractures of the pelvis and acetabulum. The aim of this study is to describe the safety of percutaneous screw surgery in patients with pelvic and acetabulum fractures.

Methods: An observational, retrospective, longitudinal and descriptive study was performed. The records of adult patients with pelvic and acetabulum fractures with less than 3mm displacement, who underwent percutaneous surgery from 2009 to 2018 were reviewed. The mechanism of injury, associated injuries, type of fracture, days of in-hospital stay, in-hospital death, trans-surgical or post-surgical complications and degree of bone healing were studied.

Results: 531 patients were recorded, 454 met the inclusion criteria. The average age was 41.7, the mechanism of high energy injury had a higher prevalence, 52% of patients had some associated injury, the most frequent being fractures in pelvic limbs. The most common fracture was type AO61B2 fracture at 38.1%. The average in-hospital stay was 10.7 days. 15 patients (3.3%) had some complication, the main one being mal positioning of the osteosynthesis material. Two patients died in-hospital due to associated injuries. 100% of the patients presented bone consolidation grade 3-4 in the Montoya classification.

Conclusions: Percutaneous surgery in pelvis and acetabulum fractures is a safe surgical procedure, since it is associated with low in-hospital mortality, has a low percentage of complications, decreases in-hospital stay and has a high rate of bone consolidation. It is a procedure that requires special training and a long learning curve.

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Introduction

Pelvic ring fractures represent approximately 3% of all fractures with an incidence between 20 and 35 cases per 100,000 inhabitants, according to different population-based studies. The current social requirement imposes a perfect restoration in fractures of the pelvis and acetabulum, even after severe trauma. The anatomical restoration of the articular surfaces is the most important objective.

Percutaneous osteosynthesis of the pelvis and acetabulum encompasses a set of bone fixation techniques through minimally invasive approaches, introducing small implants, like cannulated screws, through incisions of less than 1 cm. Within the variety of percutaneous fixation it is possible to find: iliosacral screws, screws in the anterior column of the acetabulum (anterograde and retrograde), in the posterior column of the acetabulum (ilioischial screw), magic screw, and screw to the iliopubic branches (retrograde) [1].

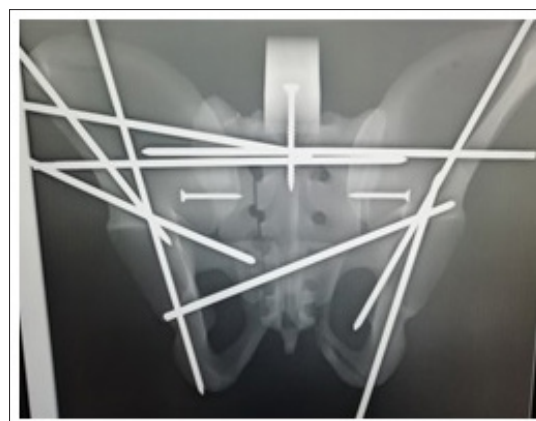


Image 1: Configuration of Percutaneous Fixation in Pelvis and Acetabulum

The percutaneous approach is associated with fewer complications than open techniques, since it offers a shorter operative time, reduces the dangers related to surgical exposure, decreases blood loss, there is less soft tissue injury and is associated with a shorter hospital stay. Soft tissue planes remain undamaged, which would subsequently facilitate total hip arthroplasty if necessary [2,3]. However, acetabular geometry makes percutaneous screw insertion a difficult procedure [4].



Image 2: Preparation for Percutaneous Anterograde Screw Placement in the Anterior Column of the Acetabulum



Image 3: Placement of iliosacral screw



Image 4: Patient position for percutaneous screw placement in the posterior column of the acetabulum

Indications for Percutaneous Fixation Are Still Under Debate, But Would Include

Fractures without displacement or with displacement of less than 3 mm or that are reduced with closed reduction maneuvers but are potentially unstable [5]. Polytraumatized patient, with significant soft tissue damage, open fractures, which would complicate or avoid open techniques [5-7]. It can be used as an adjunct to open reduction in complex fracture patterns [6,7].

Complications of percutaneous pelvic fixation are varied and are divided into surgeon-, technique- and patient-related errors. [6]. Percutaneous treatment of unstable pelvic ring injuries is a technically demanding procedure with a steep learning curve. A thorough understanding of the pelvic, vascular, and neurological anatomy is vital to prevent serious complications. Percutaneous screw placement in pelvic and acetabular fractures can present complications such as screw mispositioning, poor fracture reduction, infection, risk of neurological, vascular damage and insufficient stability which can lead to non-union or un-anchoring of the osteosynthesis material and be associated with revision surgeries [8].

The purpose of this study is to describe the safety of percutaneous screw surgery in patients with pelvis and acetabulum fractures at the Dr. Victorio de la Fuente Narváez Hospital of Traumatology.



Image 5: Patient with fracture of both acetabular columns who underwent percutaneous fixation

Material and Methods

An observational, retrospective, longitudinal and descriptive study was carried out. The record of adult patients with pelvis and acetabulum fractures of the hip, pelvis, and acetabulum service with electronic or complete physical record of the “Dr. Victorio de la Fuente Narváez” Traumatology Hospital from January 2009 to December 2018 was reviewed; the people who met the following inclusion criteria from January 2009 to December 2018: patients with a diagnosis of non-displaced, minimally displaced (up to 3mm) pelvis and/or acetabulum fracture reduced with closed reduction maneuvers, patients aged 18 or older, with complete clinical record who were followed up by outpatient clinic for up to 1 year. Patients under 18 years of age, with incomplete clinical records and who did not have outpatient follow-up were excluded.

The total number of patients admitted to the hip and pelvis service of the “Dr. Victorio de la Fuente Narváez” Traumatology Hospital between January 2009 and December 2018 who underwent percutaneous surgery was taken as the sample size

The present study evaluated the variables sex, age, days of hospital stay, in-hospital death, type of pelvis and acetabulum fracture based on the new AO 2018 classification, mechanism of injury, which was divided into low-energy mechanism, which refers to a fall from its supporting plane or less than 2 meters in height, and high-energy mechanism, which includes: car accidents, motorcycle accidents, run over, falls greater than 2 meters in height, and crushing injuries. Another variable to be studied were the injuries associated with fractures of the pelvis and acetabulum, among which injuries to the skull or neck, injuries to the thorax, abdomen, thoracic limbs, pelvic limbs, spinal trauma, and injuries to the genitourinary system are described. The percentage of trans-surgical and post-surgical complications was also recorded. Finally, the degree of bone consolidation was assessed based on the x-rays assessed in the outpatient follow-up up to at least 1 year using the Montoya classification to determine the degree of bone consolidation.

Statistical Method

The results obtained were entered into an Excel database and statistical analysis was performed with the SPSS v.25 program. For the statistical analysis of quantitative variables, measures of central tendency were used and for qualitative variables, absolute and relative frequencies were used.

Results

In this study, information was found on 531 patients who underwent some type of percutaneous surgery for pelvis and/or acetabulum fractures at the Dr. Victorio de la Fuente Narváez Traumatology Hospital, from January 2009 to December 2018, out of which 454 met the established inclusion criteria. Of the 454 patients studied, the average age was 41.7, with a minimum age of 18 and a maximum age of 92. There were 311 male patients (68.5%) and 143 female patients (31.5%).

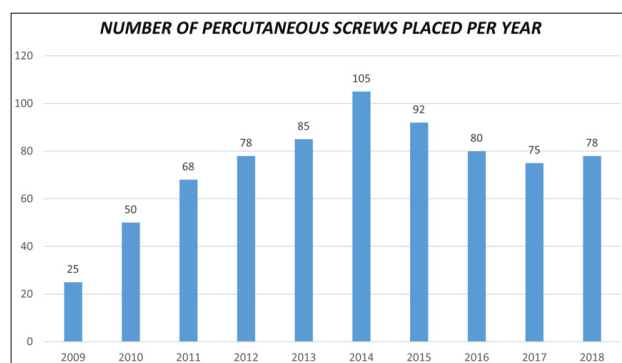


Image 6: Number of percutaneous screws placed at the Dr. Victorio de la Fuente Narváez Traumatology Hospital, in the hip and pelvis service annually, from 2009 to 2018

In relation to the type of fracture, the most frequently found fracture that underwent percutaneous surgery was the AO 61B2 type fracture with a total of 173 patients (38.1%), the second most frequent fracture was the pelvis fracture associated with acetabulum fracture with 61 patients (13.4%). In third place was AO 61B1 fracture with 49 patients (10.8%), in fourth place was AO 61C1 fracture with 37 patients (8.1%) and in fifth place was AO 61B3 fracture with 36 patients (7.9%). In relation to the pure acetabulum fractures which underwent this type of procedure, the most frequent fractures subjected to this procedure were AO 62A3 fractures with 21 patients (4.6%) and in second place were AO 62B1 fractures with 15 patients (3.3%). The high-energy mechanism of injury was present in 412 patients (90.75%) and the low-energy mechanism of injury was present in 42 patients (9.25%). As for the number of days of in-hospital stay, a minimum of 1 day and a maximum of 70 days were recorded. The average in-hospital stay was 10.8 days. Of the 454 patients who underwent percutaneous surgery, 15 patients (3.3%) presented the following complications: mispositioning of osteosynthesis material in 8 patients (1.8%), un-anchoring or intolerance of osteosynthesis material in 5 patients (1.1%) and infection of the surgical site in 2 patients (0.4%).

In relation to injuries associated with pelvis and acetabulum fractures, 218 patients (48%) had no injuries associated with their pelvis or acetabulum fracture, while 236 patients (52%) had one or more associated injuries in various organs or body systems. Of these, there were a total of 393 associated injuries, the most frequent being pelvic limb injuries with 89 (23%), including fractures or dislocations of the same limb as well as Morel-Lavallée hematoma; In second place were injuries to the thoracic limbs with 72 (18%) also including fractures or dislocations of this limb; in third place

in frequency were injuries to the thorax with 61 (16%) including closed chest trauma, hemothorax or pneumothorax, rib fractures and unstable thorax; In fourth place are injuries to the skull or neck with 55 (14%) where there was cranioencephalic trauma, facial and ocular trauma, in fifth place in frequency we observe injuries to the abdomen 51 (13%) as closed trauma to the abdomen and any injury to an organ or intraabdominal hollow viscera that required some surgical procedure for its repair, spinal injuries were in sixth place with 39 (10%), including spinal cord trauma and fracture and/or dislocation of any vertebra, and finally injuries to the genitourinary system with 26 (7%), mainly involving bladder or urethral injuries.

In-hospital death only occurred in 2 patients (0.44%) who underwent percutaneous surgery for pelvis and/or acetabulum fractures, since these patients had multiple associated injuries that were incompatible with life. The remaining 452 (99.56%) patients had a hospital discharge and outpatient follow-up, of which 100% had a degree of bone consolidation 3 and 4 based on the Montoya scale.



Image 7: Patient with AO 61B2.1*b pelvis fracture, post-surgical percutaneous fixation with iliosacral screw and retrograde screw to both iliopubic branches



Image 8: Patient with post-surgical iliac fracture after percutaneous fixation

Discussion

Percutaneous surgery performed in fractures of the pelvis and acetabulum in the “Dr. Victorio de la Fuente Narváez” Traumatology Hospital of the UMAE Magdalena de las Salinas, has increased in recent years due to a higher incidence of this type of injuries that require an alternative management to open surgery of the pelvis and acetabulum. In this study we found that the most frequent

fracture to which percutaneous surgery was performed was the AO 61B2 type fracture (38.1%), lateral compression fractures (AO 61B1, 61B2, 61B3) was the largest group to which this procedure was performed with 56.74%. The second most frequent type of fracture was pelvis fracture associated with acetabulum fracture (13.4%). In relation to pure acetabulum fractures that underwent this type of procedure, it was found that the most frequent fracture subjected to this procedure were AO 62A3 fractures (4.6%). Qoreishi et al. in a study similar to ours of percutaneous surgery used the Young-Burgess classification and mentioned that the most frequent type of fracture to which they performed percutaneous surgery was the fracture with lateral compression mechanism with 28.7%, followed by isolated fractures of the acetabulum with 21.7% of these the most frequent was the transverse fracture, then pelvic fractures with anteroposterior compression combined with acetabulum with 20.3% [9].

The most frequent mechanism of injury in our study was the high energy mechanism with 90.75%, the rest were low energy injuries with 9.25%, which included injuries from falls of less than 2 meters in height. Boudissa et al. in a retrospective study of pelvis and acetabulum fractures over 10 years found that the most frequent mechanism of injury was high energy with 75%, while the low energy mechanism was present in 25% of cases, similar to our study where it is observed that the highest frequency of injuries is by high energy mechanisms [10].

In relation to in-hospital stay, we obtained an average of 10.8 days. Qoreishi et al. in their study of percutaneous surgery in fractures of the pelvis and acetabulum in 143 patients, had an in-hospital stay of 4+- 2 days, a lower average than that observed in our study. Ghosh et al recorded an average of 14.4 days in their epidemiological study, where they included conservative treatment and any type of surgery for pelvis and acetabulum fractures [11]. In our study, the percutaneous surgery performed could be combined with open surgery at a site other than the pelvis and/or acetabulum, so the average number of days of in-hospital stay increased and is not close to the figure reported by Qoreishi et al. where they used pure percutaneous surgery of the pelvis and acetabulum. In addition, in our study 52% of the patients had other associated injuries, which prolonged the in-hospital stay due to their treatment. Of the associated injuries, the most frequent were pelvic limb injuries with 23%, followed by thoracic limb injuries with 18%, in third place were thoracic injuries with 16%, in fourth place were cranial or neck injuries with 14%, abdominal injuries with 13%, spinal injuries with 10%, and finally genitourinary system injuries with 7%. Gosh et al. report associated injuries to the pelvic limbs in 29%, injuries to the abdomen 28%, injuries to the skull 22.7%, urogenital injuries 22.7%, injuries to the thorax 10%, and injuries to the genitourinary system 10%. Of these injuries reported by Gosh et al., in our study there is a similar percentage in the most frequent associated injury which are pelvic limb injuries, the other associated injuries may vary because the sample in their study is smaller compared to ours, in addition to the fact that in their study Gosh et al. included open surgery which can modify the type of fracture and be related to another type of associated injury. Yang et al. in a 10-year epidemiological study in Taiwan found that the most frequent injury associated with fractures of the pelvis and acetabulum were injuries to the pelvic limbs with 21.5%, in second place were injuries to the thorax and spine with 20.9%, followed by injuries to the upper limbs with 18%, injuries to the skull with 17% and injuries to the abdomen with 11% [12].

In our study only 15 patients (3.3%) presented some trans-surgical and post-surgical complication, among which we found: misposition of osteosynthesis material in 8 patients (1.8%), un-anchoring or intolerance of osteosynthesis material in 5 patients (1.1%) and surgical site infection in 2 patients (0.4%), Qoreishi et al, only reported one patient with mispositioning of the osteosynthesis material and one patient with surgical site infection, a total of 1.4% of complications in their 143 patients and did not report neurological lesions, percentages similar to those described in our study. Eckardt et al, had a rate of trans-surgical complications of 4% (1 patient with vascular injury and another with neurological injury), in their study of 50 patients, they also report in the follow-up of their patients that they had 18% of patients with loosening of osteosynthesis material that required surgical reinterventions, Osterhoff et al, in their study of 38 patients who underwent percutaneous fixation to posterior pelvic ring injuries report screw mispositioning in 10.5%, nerve injury in 5.3% and non-union in 2.6%, figures well above those reported in our study. Zwingmann et al in a meta-analysis determines that the percentage of misposition with conventional fluoroscopy technique is 2.6%, similar to the figure obtained by us 1.8% [13-15].

In relation to mortality in pelvic ring injuries, the literature presents rates with wide variation, and the authors always emphasize the association of these rates with associated injuries and the severity of the ring injury. In this study, there was a mortality rate of 0.44%, only 2 patients died during their in-hospital stay, these patients died because they had multiple associated injuries and data of septic shock. Yoshihara, in an epidemiological study on this type of injury, reported a hospital mortality rate in patients with unstable pelvic fracture of 8.3%. Pereira et al report a 3% mortality rate associated with high energy mechanisms. It is considered that the most important factor in the low mortality rate observed in the present study was the high number of cases of AO 61B1, AO 61B2, AO 61B3 fractures, which generally do not have as many associated injuries or complications [16,17].

In the present study, 100% of the patients had grade III and IV bone consolidation on the Montoya scale at the 1-year follow-up by the outpatient hip, pelvis and acetabulum service. Qoreishi et al mentioned that 100% of their patients presented bone consolidation at 3 months of follow-up and could perform full support of the extremities at their last follow-up visit, a figure equal to that shown in our study.

In conclusion, percutaneous surgery in fractures of the pelvis and acetabulum is a safe surgical procedure for patients with non-displaced or minimally displaced fractures, since it is associated with less morbidity, has a high percentage of bone healing, can be used as a complement to an open reduction and internal fixation in another segment of the pelvis and acetabulum, or as definitive treatment in patients with multiple comorbidities to provide stability to the pelvic ring. It is a procedure that requires special training, a long learning curve, adequate preoperative planning and has a high rate of radiation exposure for the surgeon.

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