J Orthop Spine Trauma. 2025 June; 11(2): 69-72. DOI: 10.18502/jost.v11i2.18885
Case Report

Educational Insights on Acetabular Percutaneous Screw Fixation: Posterior and Anterior Column Management in Prone Position

Sepand Heidari[1], Negar Hosseinaei[2], Mohammadamin Choobdar Omrani[1], Seyed Hadi Kalantar[3,*]

[1] Resident, Department of Orthopedic Surgery, Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran
[2] General Practitioner, Department of Orthopedic Surgery, Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran
[3] Assistant Professor, Department of Orthopedic Surgery, Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran

[*]Corresponding author: Seyed Hadi Kalantar; Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran. Tel: +98-2161192767; Email: hadikalantar4@gmail.com

Received: 09 November 2024; **Revised:** 26 January 2025; **Accepted:** 21 February 2025

Abstract

Background: Open reduction and internal fixation (ORIF) of acetabular fractures, while effective, carries significant morbidity. Percutaneous techniques offer reduced soft-tissue damage and blood loss, but require precise radiographic guidance. This study explores the safety and efficacy of prone positioning for percutaneous fixation of both acetabular columns, addressing the lack of data on this approach.
Case Report: A 59-year-old man with a transverse acetabular fracture, classified by Letournel-Judet, underwent percutaneous fixation in the prone position. The procedure involved retrograde posterior column screw placement and antegrade anterior column screw placement. Fluoroscopic imaging was crucial for accurate guide pin and screw insertion, with specific attention to anatomical landmarks and neurovascular structures. The surgical technique details the steps for each screw placement, including fluoroscopic views and potential complications.
Conclusion: Prone positioning for percutaneous acetabular fracture fixation provides excellent surgical access and reliable imaging, and facilitates conversion to open surgery if needed. While prone positioning has limitations, including potential cardiovascular and pulmonary effects, this minimally-invasive technique demonstrated safety and reliability for treating specific acetabular fracture patterns. Preoperative planning and intraoperative imaging are critical for successful outcomes.

Keywords: Bone Screws; Minimally Invasive Surgical Procedures; Pelvic Bones; Injuries

Citation: Heidari S, Hosseinaei N, Choobdar Omrani M, Kalantar SH. **Educational Insights on Acetabular Percutaneous Screw Fixation: Posterior and Anterior Column Management in Prone Position.** *J Orthop Spine Trauma* 2025; 11(2): 69-72.

Background

Acetabular fracture treatment is based on anatomical reduction and internal fixation of fractures (1). To achieve a satisfactory clinical outcome, fractures must be reduced to a displacement of 2 mm or less, ensuring congruent alignment of the femoral head with the weight-bearing dome of the acetabulum (2). Open reduction and internal fixation (ORIF) is widely regarded as the preferred treatment for most acetabular fractures. However, this approach can lead to morbidity, including neurovascular injury, significant blood loss, heterotopic ossification, wound infection, and complications with wound healing (3, 4). As described by several authors in the late 1990s (5, 6), the percutaneous surgical technique offers numerous benefits, including limited soft-tissue dissection, minimized intraoperative blood loss, reduced procedure duration, and facilitated earlier patient mobilization (7).

This technique necessitates multiple radiographic exposures to position the guide pins and screws accurately. The surgeon must comprehend the radiographic images and the pertinent anatomical landmarks they reveal and must proficiently identify the dynamic landmarks of the anterior and posterior columns to ensure the safe placement of the cannulated screw (8). In recent years, computer-assisted orthopedic surgery has been utilized to enhance the precision of percutaneous acetabular screw placement. Numerous well-documented corridors for fixation placement are available in the pelvis and acetabulum (8). Our technique involves positioning the patient in a prone position to ensure stability, facilitating the acquisition of consistent fluoroscopic images essential for precise bone preparation and implant placement. Data on the outcomes of prone positioning for percutaneous fixation of both columns are lacking (8).

This study aims to demonstrate that this minimally-invasive technique is both safe and reliable and to provide some tips to facilitate the surgery.

Case Report

A 59-year-old man was admitted to the emergency department of the Imam Khomeini Hospital Complex, Tehran, Iran, with right hip pain and weight-bearing disability following a motorcycle accident. Physical examination revealed no neurovascular changes. The patient had no associated conditions such as spinal, chest, head, or abdominal injuries.

The patient underwent imaging studies for further evaluation and preoperative planning. X-ray radiographs were taken in anteroposterior (AP), obturator, and iliac views, with radiographic landmarks noted (Figure 1).

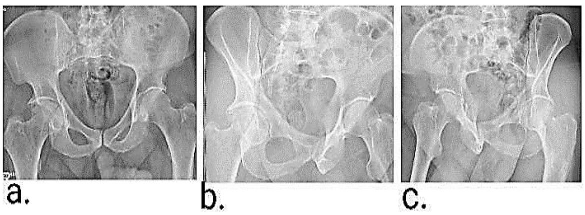

Figure 1. Radiographic images of transverse fracture pattern in both columns from our case; a) Anteroposterior (AP) view; b) Obturator oblique view; c) Iliac oblique view

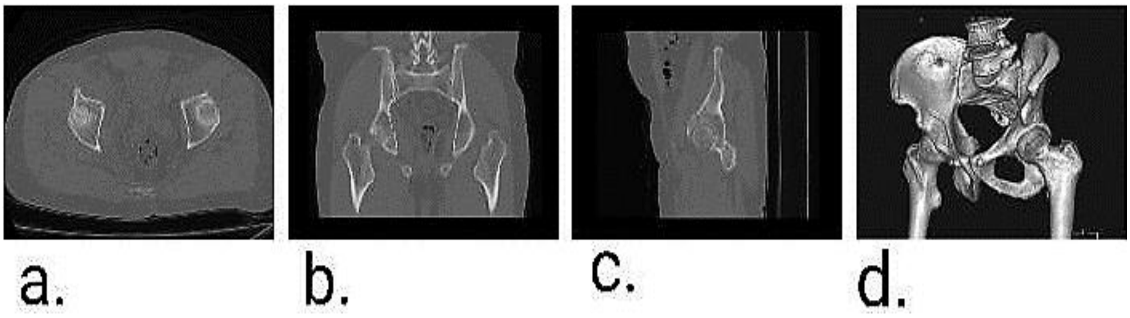

Figure 2. Computed tomography (CT) scan images from our case showing no loose body and minimal articular step-off with an extending fracture line in the cephalad of the anterior column; a) Axial view; b) Coronal view; c) Sagittal view; d) Three-dimensional (3D) CT scan

A pelvis computed tomography (CT) scan was performed, with reconstruction in three planes and 2 mm fine cuts on the axial view (Figure 2).

Preoperative Planning: The findings included the orientation of the fracture pattern and minimal marginal impaction. No loose bodies were observed. In this case, the patient presented with an acetabular fracture, classified as a transverse type according to the Letournel-Judet classification system (9). In cases of transverse acetabular fractures, it is imperative to achieve stabilization across both acetabular columns. At a minimum, fixation of the posterior column is essential to ensure structural integrity and optimal patient outcomes (Figure 1) (10).

Patient Management and Surgical Consideration: The patient was selected for surgery due to the minimally-invasive nature of the procedure, which provides effective pain relief and facilitates earlier weight-bearing. Given the minimally-displaced fracture pattern, percutaneous fixation was deemed appropriate for stabilizing both the anterior and posterior columns (11).

For the posterior column, percutaneous fixation can be performed using either an antegrade or retrograde approach. Antegrade posterior column screws, while effective, are not truly percutaneous as they require a lateral window incision. Therefore, we opted for the retrograde approach to maintain the minimally-invasive nature of the procedure (8).

One of the primary concerns with the retrograde posterior column screw placement is the risk to surrounding neurological structures, including the sciatic nerve, posterior cutaneous nerve of the thigh, and cluneal nerve branches. Recent research has demonstrated that maintaining a safe distance from these neurovascular bundles is achievable by carefully planning the guide pin and screw trajectory (12).

Anterior column screw fixation can be performed using either a retrograde or antegrade trajectory, each with its risk profile in trajectory placement. We prefer the antegrade trajectory because the retrograde anterior column screw cannot be used in the prone position. However, the retrograde approach is routinely chosen if the fracture is closer to the pubic symphysis.

The risk profile of retrograde anterior column screw fixation differs between men and women. In women, structures at risk include the clitoral glans and the clitoral body, as well as small nerves that innervate these structures (13).

There is a high rate of chronic dyspareunia and clitorodynia following the reduction and fixation of pelvic ring injuries. However, it remains unclear whether these injuries occur at the time of the initial trauma or as a result of iatrogenic injury (14). In men, the spermatic cord and corpora cavernosa are at risk during retrograde anterior column screw trajectory. Similar to the clitoris in women, intraoperative injury to the spermatic cord and corpora cavernosa may go unnoticed unless an atypically large incision is used and the structures are directly visualized (13).

There have been no studies investigating the soft tissue risks associated with the antegrade anterior column screw insertion trajectory, and it does not result in clinical problems for most patients (15).

Surgical Technique: The patient is positioned prone on a radiolucent table, with comfort chest roll and pelvic roll to support the body and padding to protect all dependent bony prominences. Care is taken to avoid pressure on the eyes, and the arms and elbows are abducted and flexed to 90 degrees. A pelvic roll is positioned on both anterior superior iliac spines to avoid disrupting any neurovascular bundles to ensure access to the ischial tuberosity; this roll achieves some hip flexion.

The sterile field is draped to encompass the ischium, the lateral aspect of the iliac crest, and the abductor region on the operative side. The image intensifier is positioned on the side opposite to the operative side.

An AP fluoroscopic image of the pelvis, illustrating the ischial tuberosity with the wire aligned on the skin, can be utilized to determine the optimal insertion point for the wire accurately.

After identifying the most distal point of the ischium, a stab skin incision is made at the appropriate location, and blunt dissection is toward the bone. A 2.0 mm Kirschner wire (K-wire) is then inserted to establish the starting point. The obturator outlet view is obtained to confirm that the guide pin remains within the posterior column. For this view, the patient is prone, with the image intensifier of the C-arm rotated 45 degrees towards the uninjured side and angled 30 degrees cephalad (Figure 3).

This positioning is the reciprocal of that used for a supine patient. We recommend inserting the wire as medially as possible within the posterior column to maximize the distance from the sciatic nerve. Upon confirmation of the appropriate starting point on both the AP and obturator oblique views, the guide wire is advanced 5 mm by tapping with a surgical mallet. An iliac oblique view is then obtained to ensure the wire is centrally positioned in the AP plane at the ischial tuberosity, avoiding penetration of the acetabular articulation or sciatic foramina. After confirming the guide pin trajectory within the fixation corridor, a slow oscillatory drill is used to advance the guide pin past the greater sciatic notch in the iliac view. Throughout this process, the surgeon should feel consistent resistance as the drill bit advances.

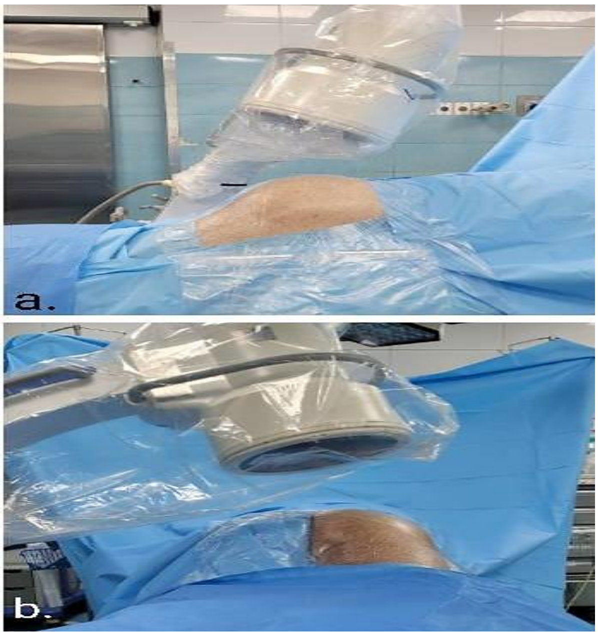

Figure 3. Obturator outlet view of C-arm positioning in a prone patient; a) The image intensifier angled 30 degrees cephalad; b) The image intensifier rotated 45 degrees towards the injured side

Once an appropriate trajectory is confirmed on both the iliac oblique and obturator outlet views, the pin is advanced until it reaches the pelvic brim. At this point, the surgeon will feel resistance against the corridor pin, which is confirmed approximately with the obturator outlet view.

In our technique, if the advanced pin has an incorrect trajectory in any radiographic view or if inconsistent resistance is felt during advancement, the pin is maintained as a guide for the main corridor pin.

The length of a similar wire is measured from the entry point at the ischial tuberosity to the distal end of the corridor pin and subtracted from the wire length. A soft tissue protector sleeve is then inserted over the corridor pin, followed by the advancement of a self-drilling and self-tapping partially threaded 7.3 mm screw of appropriate length through the guide wire. The final position is checked using iliac oblique and obturator outlet views (Figures 4, 5).

Figure 4. Obturator outlet view after screw advanced till the pelvic brim

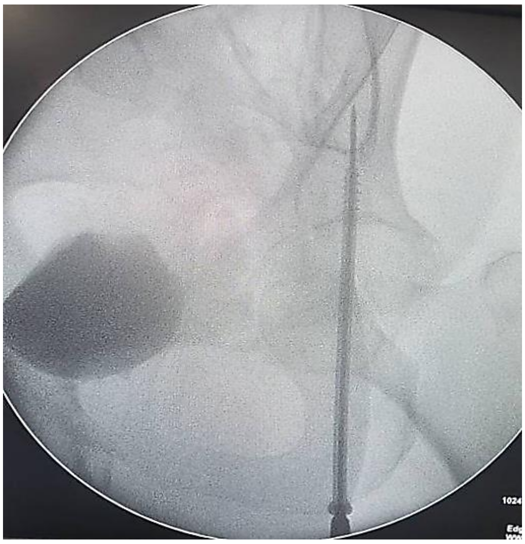

Figure 5. Iliac oblique view after screw insertion

Antegrade Anterior Column Fixation Technique: The starting point for antegrade anterior column fixation is retro-acetabular and lateral to the sciatic notch. The skin incision is minimal, beginning at the intersection of a perpendicular line from the anterior superior iliac spine to the table and an extended line from the femoral shaft. The guide pin trajectory is directed towards the symphysis. Initially, the guide pin trajectory is verified using the obturator outlet view to ensure it is outside the acetabulum. The fluted pin is then tapped 5 mm into the bone.

Subsequent verification is performed with the iliac inlet view, positioning the image intensifier 45 degrees rolled towards the injured side and 20-45 degrees caudal, confirming the pin is within the ramus. An oscillator drill is installed and operated at a slow speed along the established trajectory.

Upon passing the fracture site, the surgeon should feel resistance on the opposite side. The appropriate length of a 7.3 mm self-drilling and self-tapping screw is then selected and inserted, with final confirmation achieved through both views (Figure 6).

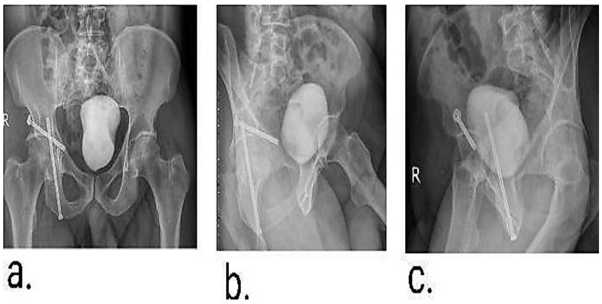

Figure 6. Early post-operative Judet views demonstrating stable fixation and fixation through bony corridors; a) Anteroposterior (AP) view; b) Obturator view; c) Iliac view

Discussion

This case report highlights the advantages of modern minimally invasive techniques for managing acetabular fractures, offering effective stabilization while reducing surgical morbidity. Traditional techniques, though effective for fracture reduction, are often associated with significant soft-tissue disruption, blood loss, and extended recovery times. In contrast, the approach described here demonstrates the potential of a percutaneous technique to achieve favorable outcomes with minimized operative trauma.

Prone positioning, as used in this case, allowed superior fluoroscopic visualization, which is critical for precise screw placement. The retrograde posterior column fixation minimized risks to neurovascular structures, while the antegrade anterior column fixation complemented the construct, aligning with the minimally invasive objectives. Detailed preoperative imaging and meticulous planning were pivotal in ensuring accurate screw trajectories and successful fracture stabilization.

While this case underscores the utility and safety of percutaneous fixation in a specific clinical scenario, it is important to acknowledge the limitations of case reports in establishing broader clinical guidelines. Further research, including larger studies and comparative analyses, is necessary to validate these findings and assess their applicability across diverse patient populations. Nonetheless, this report contributes valuable insights into the potential benefits of minimally invasive techniques in acetabular fracture management.

Conclusion

Prone positioning offers excellent access to the ischial tuberosity and ensures consistent, reliable imaging. It also eliminates the need for an assistant to manage hip and knee flexion against gravity, which is particularly beneficial for obese or polytraumatized patients with additional lower extremity injuries. Additionally, the prone position allows for a transition to an open posterior approach if percutaneous reduction and fixation proves insufficient.

However, prone positioning has several limitations, including cardiovascular and pulmonary changes in patients with multiple organ damage. It can cause hyperextension in certain spinal conditions and presents challenges for achieving an anterior approach to the pelvis and acetabulum, such as when percutaneous retrograde anterior column screw placement or ORIF is necessary (16).

Minimally-invasive intramedullary fixation is a procedure with low morbidity that can be utilized for various acetabular fractures. Preoperative planning, including patient positioning and intraoperative imaging, is crucial and should be tailored to the chosen surgical technique. Additionally, the fracture pattern and any associated conditions may necessitate adjustments to the surgical approach.

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgements

The authors thank the patient for his cooperation in publishing the study. This study received no external funding.

All ethical guidelines were strictly observed.

References

1. Caviglia H, Mejail A, Landro ME, Vatani N. Percutaneous fixation of acetabular fractures. *EFORT Open Rev*. 2018;3(5):326-34. doi: 10.1302/2058-5241.3.170054. [PubMed: 29951272]. [PubMed Central: PMC5994628].
2. Matta JM, Anderson LM, Epstein HC, Hendricks P. Fractures of the acetabulum. A retrospective analysis. *Clin Orthop Relat Res*. 1986(205):230-40. [PubMed: 3698382].
3. Dailey SK, Archdeacon MT. Open reduction and internal fixation of acetabulum fractures: does timing of surgery affect blood loss and OR time? *J Orthop Trauma*. 2014;28(9):497-501. doi: 10.1097/bot.0000000000000153. [PubMed: 24824098].
4. Magnussen RA, Tressler MA, Obremskey WT, Kregor PJ. Predicting blood loss in isolated pelvic and acetabular high-energy trauma. *J Orthop Trauma*. 2007;21(9):603-7. doi: 10.1097/BOT.0b013e3181599c27. [PubMed: 17921834].
5. Parker PJ, Copeland C. Percutaneous fluoroscopic screw fixation of acetabular fractures. *Injury*. 1997;28(9-10):597-600. doi: 10.1016/s0020-1383(97)00097-1. [PubMed: 9624336].
6. Starr AJ, Reinert CM, Jones AL. Percutaneous fixation of the columns of the acetabulum: A new technique. *J Orthop Trauma*. 1998;12(1):51-8. doi: 10.1097/00005131-199801000-00009. [PubMed: 9447519].
7. Starr AJ, Jones AL, Reinert CM, Borer DS. Preliminary results and complications following limited open reduction and percutaneous screw fixation of displaced fractures of the acetabulum. *Injury*. 2001;32 Suppl 1:Sa45-50. doi: 10.1016/s0020-1383(01)00060-2. [PubMed: 11521706].
8. Banaszek D, Starr AJ, Lefaivre KA. Technical Considerations and Fluoroscopy in Percutaneous Fixation of the Pelvis and Acetabulum. *J Am Acad Orthop Surg*. 2019;27(24):899-908. doi: 10.5435/jaaos-d-18-00102. [PubMed: 31192885].
9. Butler BA, Lawton CD, Hashmi SZ, Stover MD. The Relevance of the Judet and Letournel Acetabular Fracture Classification System in the Modern Era: A Review. *J Orthop Trauma*. 2019;33(Suppl 2):S3-S7. doi: 10.1097/bot.0000000000001401. [PubMed: 30688852].
10. Giordano V, do Amaral NP, Pallottino A, Pires e Albuquerque R, Franklin CE, Labronici PJ. Operative treatment of transverse acetabular fractures: is it really necessary to fix both columns? *Int J Med Sci*. 2009;6(4):192-9. doi: 10.7150/ijms.6.192. [PubMed: 19652723]. [PubMed Central: PMC2719284].
11. Alsheikh KA, Alzahrani AM, Alshehri AS, Alzahrani FA, Alqahtani YS, Alhumaidan MI, et al. Clinical outcomes of percutaneous screw fixation of acetabular fracture: A minimally invasive procedure. *J Taibah Univ Med Sci*. 2023;18(2):279-86. doi: 10.1016/j.jtumed.2022.09.015. [PubMed: 36817219]. [PubMed Central: PMC9926199].
12. Hadeed M, Heare A, Parry J, Mauffrey C. Anatomical Considerations in Percutaneous Fixation of the Pelvis and Acetabulum. *J Am Acad Orthop Surg*. 2021;29(19):811-9. doi: 10.5435/jaaos-d-21-00066. [PubMed: 34478415].
13. Luksameearunothai K, Amin RM, Shafiq B, Hasenboehler EA. Distance Between Reproductive Structures and the Insertion Point of the Retrograde Pubic Ramus Screw. *J Orthop Trauma*. 2020;34(11):578-82. doi: 10.1097/bot.0000000000001804. [PubMed: 33065657].
14. Sipski ML, Alexander CJ, Rosen R. Sexual arousal and orgasm in women: effects of spinal cord injury. *Ann Neurol*. 2001;49(1):35-44. doi: 10.1002/1531-8249(200101)49:1<35::aid-ana8>3.0.co;2-j. [PubMed: 11198294].
15. Haidukewych GJ, Kumar S, Prpa B. Placement of half-pins for supra-acetabular external fixation: an anatomic study. *Clin Orthop Relat Res*. 2003(411):269-73. doi: 10.1097/01.blo.0000069899.31220.d7. [PubMed: 12782884].
16. Kwee MM, Ho YH, Rozen WM. The prone position during surgery and its complications: a systematic review and evidence-based guidelines. *Int Surg*. 2015;100(2):292-303. doi: 10.9738/intsurg-d-13-00256.1. [PubMed: 25692433]. [PubMed Central: PMC4337445].