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CASE REPORT

Isolated Anterior Intrapelvic Approach for Operative Reduction and Fixation of an Anterior Column Acetabulum Fracture With Superior Impaction

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Summary: Displaced fractures of the acetabulum in an aging population present unique challenges for the treating surgeon. Traditional extensile exposures and reduction techniques may be ill advised because of patient-related factors including previous surgeries and medical comorbidities; yet, limited approaches may not permit adequate visualization of fracture fragments, reduction, or access for placement of internal fixation. Poor bone quality often results in atypical fracture patterns with central dislocation of the femoral head that can frequently be associated with superior dome and/or femoral head impaction. In this report, we present a case of operative reduction and fixation performed through an isolated anterior intrapelvic approach in an elderly patient with a displaced anterior column acetabulum fracture with superior dome impaction.

Key Words: Acetabular Fracture, Dome Impaction, Anterior Intrapelvic Approach

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INTRODUCTION

Asthe world population ages, orthopaedic trauma surgeons are faced with an increasing number of osteoporotic acetabulum fractures.[1] These injuries can be challenging because of poor bone quality and the presence of underlying medical comorbidities that make delayed management and prolonged surgical time suboptimal. Operative intervention in this patient population has been thought to result in inferior clinical outcomes and fixation failure.[2–4] However, recent data would suggest that surgical management of displaced acetabulum fractures in an elderly population results in not only acceptable clinical outcomes but also comparable results to younger healthier patients.[5–11]

In an effort to limit immobility and associated complications and the morbidity associated with extensile surgical exposures and prolonged operative times, less invasive reduction and fixation techniques have been described.[12–21] Although percutaneous fixation with substantially lower surgical morbidity may be appealing in this patient population, significantly displaced fractures are not always amenable to such techniques, particularly in less experienced hands. The ilioinguinal and anterior intrapelvic (AIP) approaches can provide excellent visualization of the pelvic brim and quadrilateral surface.[15,18,19,22,23] Although indications and clinical outcomes for these approaches have been described previously,[15–17,19,24] recent reports on the AIP have focused on expanding its use in specific fracture patterns and clinical situations in the elderly patient with central dislocation and comminution of the quadrilateral surface.[10,11,13,25,26] In this report, we present the treatment of an anterior column acetabulum fracture with superior articular impaction and quadrilateral surface medialization through an isolated AIP approach.

CASE REPORT AND SURGICAL TECHNIQUE

Patient Information

An 84-year-old male with a medical history of Parkinson disease sustained in an injury to his left acetabulum after a ground-level fall.

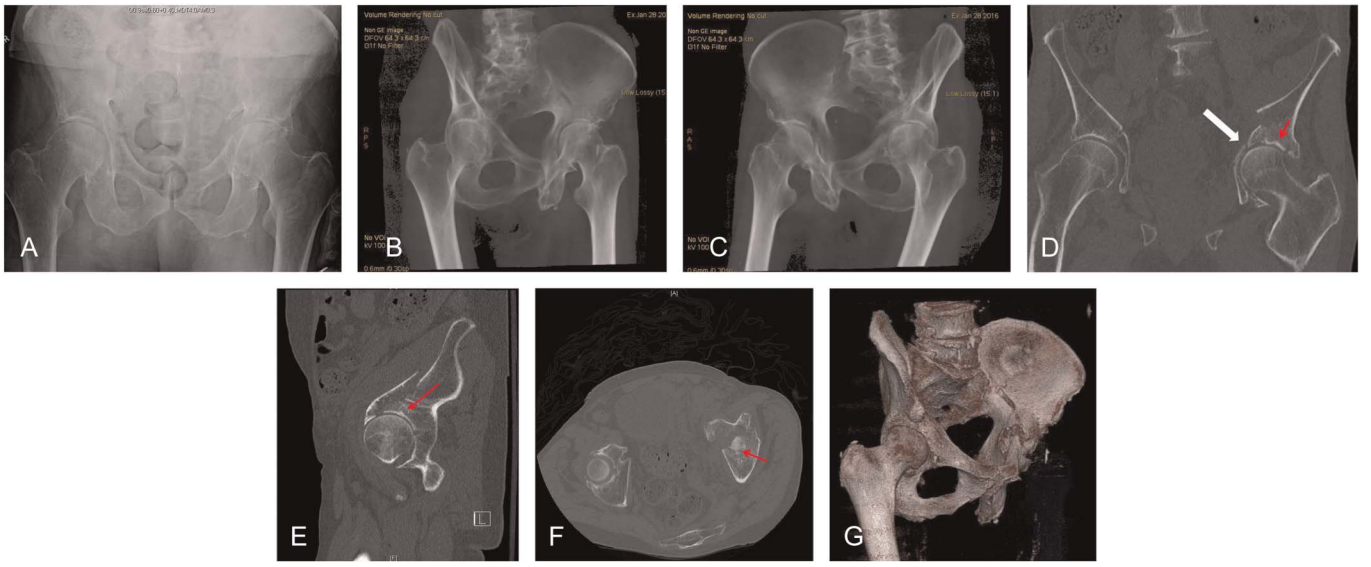

FIGURE 1. A, Injured anteroposterior pelvis radiograph. B, Injured left iliac oblique radiograph volume-rendered reconstruction. C, Injured left obturator oblique radiograph volume-rendered reconstruction. D, Injured coronal reformats of computed tomography scan demonstrating medialization of the femoral head and comminuted quadrilateral surface (white arrow) with superior dome impaction (red arrow). E, Injured sagittal reformatted computed tomography demonstrating the displaced anterior column and impacted dome segment (arrow). F, Injured axial computed tomographic image demonstrating the anterior column fracture line and impacted articular segment involving the dome (arrow). G, Injured surface-rendered computed tomographic image demonstrating the disrupted anterior column and quadrilateral surface with intact posterior column.

At baseline, he ambulates with the use of a walker and lives independently. Radiographs and a computed tomography scan demonstrated a left-sided anterior column acetabulum fracture with superior dome impaction and medialization of the femoral head and quadrilateral surface (Fig. 1). There was no significant injury to the femoral head. Fifteen pounds of distal femoral skeletal traction was placed in the emergency department, and he was admitted to the Trauma Intensive Care Unit for monitoring of an associated pelvic hematoma and for serial hematocrits. Enoxaparin, 30 mg injected subcutaneously twice a day, was initiated on the night of admission and continued throughout hospitalization without interruption for venous thromboembolism prophylaxis. On hospital day 2, the patient was deemed stable for operative fixation of his acetabulum fracture. An isolated AIP approach (without use of the lateral window) was chosen to maximize exposure of the pelvic brim and quadrilateral surface[22] while minimizing the morbidity associated with more extensile exposures. Furthermore, this approach has recently been shown to permit indirect access to areas of superior dome impaction.[26]

Surgical Technique

The patient was positioned supine on a radiolucent table with the operative extremity draped free into the surgical field. The knee and hip were flexed with the use of a padded triangle beneath the knee to increase surgical exposure by permitting relaxation of the iliopsoas muscle, external iliac vessels, and the femoral nerve. A Foley catheter was placed at the time of admission and served to decompress the bladder. The femoral head was retracted laterally in line with the femoral neck with a 5.0-mm Schanz pin inserted just below the vastus ridge into the femoral neck. The Schanz pin was then attached to a continuous adjustable hands-free lateral traction setup. This reduced the central dislocation tendency of the femoral head and helped to indirectly reduce the displacement through the quadrilateral surface and anterior column (Fig. 2). An AIP approach was performed as previously described.[15,18,27]

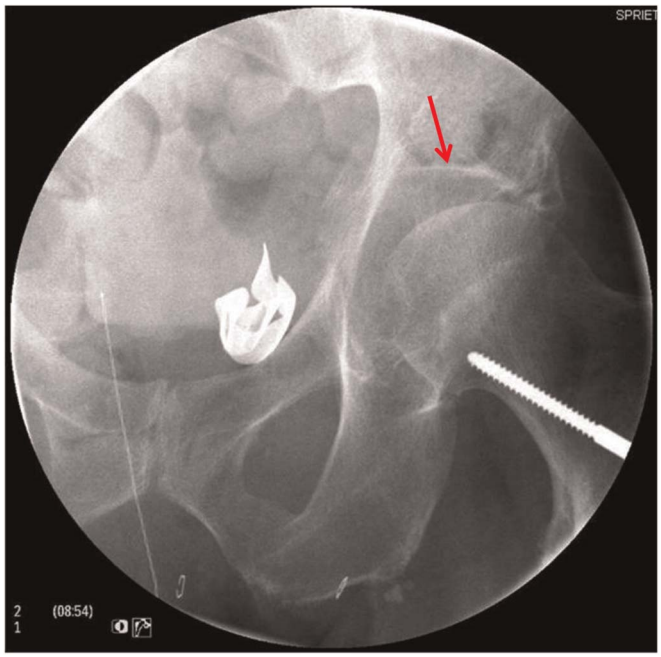

FIGURE 2. Intraoperative anteroposterior projection with the femoral head laterally retracted. The anterior column and quadrilateral surface are in better alignment, and the dome impaction is much more readily visualized (arrow).

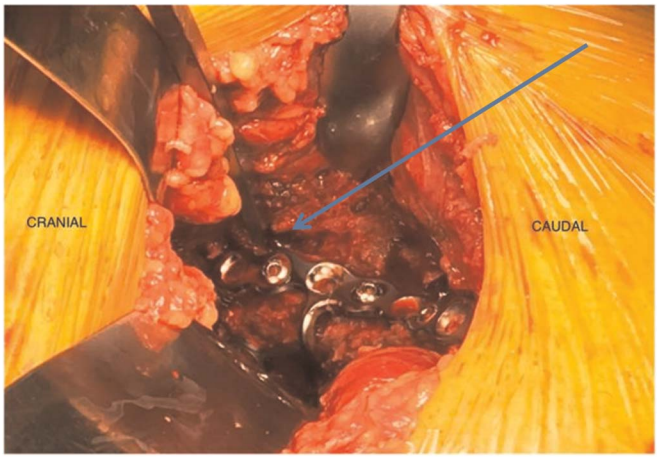

FIGURE 3. Intraoperative visualization through AIP approach demonstrating plate position along the pelvic brim and flange extending into true pelvis along quadrilateral surface. Arrow demonstrates osteotome through cortical window lateral to the brim plate.

A small anastomotic communication between the internal and external iliac vessels was encountered and ligated during surgical exposure. The obturator nerve and vessels were identified and protected throughout the case.

Reduction and Instrumentation

The use of continuous lateral femoral traction served as a reduction tool and lateralized the quadrilateral surface before surgical incision, and early operative intervention permitted easy mobilization of the anterior column fragment. After evacuation of fracture hematoma and removal of the overlying periosteum and iliopectineal fascia, a pointed reduction clamp was placed along the posterior aspect of the anterior column. The anterior column fracture fragment was reduced to the intact posterior column and ilium, and the reduction was held with 2.0 mm Kirschner wires (K-wires). The quadrilateral surface fragments were lateralized with a ball spike pusher and held in place with K-wires. With anterior column and quadrilateral surface reduction confirmed fluoroscopically, a 3.5-mm lag screw was placed from anteromedial to posterolateral to compress across the anterior column in the supra-acetabular region. Clamps and wires were then removed, and a precontoured suprapectineal plate with a quadrilateral surface buttress was chosen (Stryker, Mahwah, NJ). The plate design serves to simultaneously buttress the anterior column and the quadrilateral surface preventing superior and medial subluxation of the femoral head (Fig. 3). Plate fixation was achieved anteriorly and posteriorly, followed by the placement of a screw crossing the quadrilateral surface into the posterior column.

After anterior column fixation and lateralization of the quadrilateral surface, the preoperatively identified superior articular dome impaction was localized using fluoroscopy. A one-fourth inch straight osteotome was used to create a small cortical window just lateral to the pelvic brim immediately cephalad to the dome. Under fluoroscopic guidance using the obturator oblique and anteroposterior projections, the osteotome was advanced to rest just cranial to the impacted articular segment. Lateral traction was released incrementally until the femoral head came to rest in its native position relative to the medial wall and intact dome; then the fragment was levered down against the cranial portion of the femoral head (Fig. 4). The void was filled with a mixture of cancellous bone graft and injectable calcium phosphate to add structural support. A 3.5-mm rafting screw was placed through the plate to further support and prevent cranial migration of the impacted fragment (Fig. 5). Final radiographs demonstrated a congruent joint surface with appropriate lateralization of the femoral head (Fig. 6). Total operative time was approximately 150 minutes, and estimated blood loss was 300 mL.

Postoperative Management

One deep surgical drain was placed and removed on postoperative day 3 (when less than 30 mL over a shift). Continuous passive motion was started on the operative extremity in the recovery room with initial settings of 0–30 degrees and advanced as tolerated. Physical therapy was initiated on postoperative day 1

FIGURE 4. A, Intraoperative fluoroscopy (obturator oblique) demonstrating residual displacement of the dome with anterior column and quadrilateral surface reduced. B, Intraoperative fluoroscopy (obturator oblique) demonstrating localization of the impacted segment with fluoroscopic guidance and an osteotome. C, Intraoperative fluoroscopy (obturator oblique) demonstrating reduction of the impacted articular segment up against the femoral head.

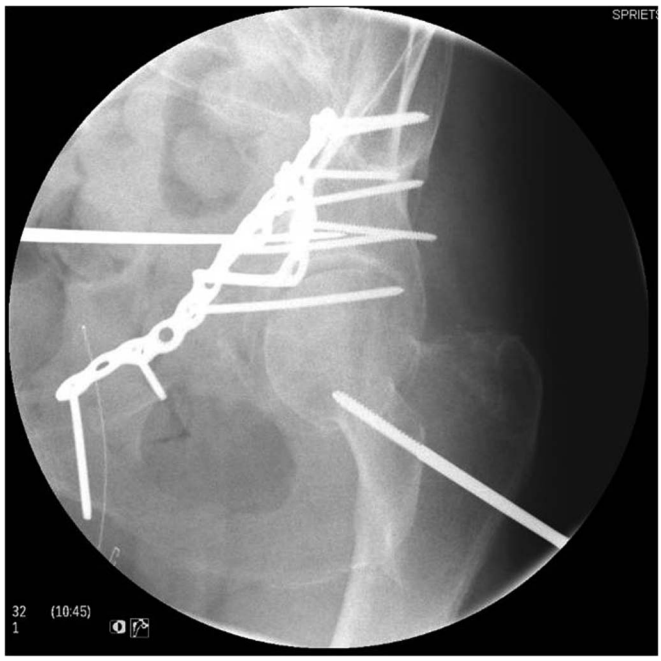

FIGURE 5. Intraoperative fluoroscopy demonstrating maintenance of reduction with osteotome and placement of rafter screw along subchondral bone.

with weight-bearing restrictions described as "weight of leg, foot flat" (WOLFF) to limit the joint reaction forces across the hip. There were no restrictions on range of motion. Enoxaparin, 30 mg injected subcutaneously, was continued for 6 weeks postoperatively. The patient had an uneventful postoperative course and was stable for discharge to a skilled nursing facility on postoperative day 4. Reduction of the articular surface was maintained at the six month mark.

DISCUSSION

The use and evolution of the AIP approach (also known as Stoppa or modified Rives-Stoppa) recently chronicled by Guy[17] for acetabular fractures began in the early 1990s after reports by Hirvensalo[27] and Cole and Bolhofner.[18] Its use provides direct visualization and access to approximately 80% of the true pelvis including the majority of the quadrilateral surface and the pelvic brim, along with access into the caudal iliac fossa, the psoas gutter, and the pubic eminence.[19,22] For these reasons, indications for its use both in isolation and in conjunction with a traditional lateral window continue to expand with clinical results demonstrating quality outcomes and the potential for improved articular reduction.[10,11,13,15,16,19,23,25,26,28,29]

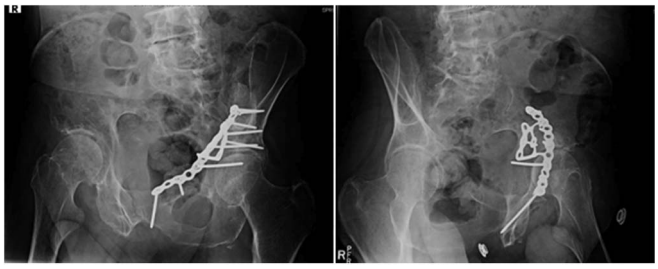

FIGURE 6. A, Six month follow up radiograph obturator oblique. B, Six month follow up radiograph iliac oblique.

Currently, only one randomized study exists evaluating 60 consecutive patients with fractures considered amenable to treatment through an isolated AIP approach and comparing results with the use of the traditional ilioinguinal approach.[29] This study, although limited with regard to radiographic and clinical follow-up, suggests that the use of an isolated AIP approach decreases operative time, blood loss, need for blood transfusion, and the incidence of postoperative wound complications. Initial criticisms of the AIP focused on inadequate exposure/access to the posterior column and superior dome impaction. However, recent publications by Kistler and Sagi described the reduction of the posterior column through this approach,[13] and both Collinge and Laflamme have discussed how to address superior dome impaction.[25] This report provides a nice clinical example of how superior dome impaction can be reduced and stabilized through the AIP, corroborating the report by Collinge.

As with all surgical procedures, preoperative planning and setup are essential. The case presented herein highlights many techniques that can be employed during the AIP approach to limit perioperative complications, improve surgical access, and shorten operative time. Hip flexion is essential to provide relaxation of structures traversing the anterior aspect of the acetabulum including the iliopsoas muscle, femoral nerve, and iliac vessels such that adequate exposure of the acetabulum can be achieved without placing undue tension on those structures. A well-padded bump or padded triangle under the knee that can be adjusted intraoperatively provides hip flexion while limiting the possibility of peroneal nerve palsy during prolonged procedures.

A radiolucent table that permits attachment of continuous femoral traction in line with the axis of the femoral neck can be helpful in eliminating the deforming force of the femoral head. Its use results in lateralization of the quadrilateral surface and posterior column and an easier reduction of the anterior column.[19] In the case presented, the entire quadrilateral surface lateralized into an anatomic position before initiating the surgical approach, which likely decreased operative time and blood loss by limiting the need for increased surgical dissection. It should be noted, however, that this was also made possible by early intervention, which may not always be possible or advisable depending on the overall health and physiologic status of the patient. If this setup is not readily available, traction can be achieved manually with the aid of an assistant.

Lastly, recognition of superior dome impaction, seen as the "Gull Sign" on preoperative imaging, is essential. In elderly patients, this has been associated with inferior clinical outcomes and fixation failure.[4] In the presented case, this was recognized preoperatively and addressed to prevent superior migration of the impacted fragment. The following question, however, bears some discussion: "What is the best strategy for accurate reduction of the impacted dome fragment?" The surgeon has 2 options. One option is to reduce the columns to get the femoral head in the correct position in 3-dimensional space and then use the femoral head as a template to reduce the impacted joint segment against. The second option is to work through the displaced anterior column and quadrilateral surface to reduce the impacted dome segment and then reduce the columns afterward.

The advantage of reducing the columns first is that the surgeon can be more confident that the femoral head rests in the correct position and that the joint reduction is therefore more accurate and congruent with the femoral head. The disadvantage with this track is that having the columns and quadrilateral surface reduced inherently limits access to the impacted dome fragment and necessitates a cortical window and fluoroscopic guidance to locate and reduce it. The advantage of working through nonreduced fracture planes is that the surgeon can get direct access to visualize and manipulate the impacted segment into position. The disadvantage is, however, the femoral head needs to be retracted laterally and may not be in the correct position to use as a template to reduce the depressed segment against. Therefore, the impacted segment may be reduced inaccurately leading to incongruency between the acetabular and femoral joint surfaces.

CONCLUSIONS

In this report, we present the successful treatment of a displaced acetabulum fracture with anterior column and quadrilateral surface involvement and superior articular impaction through an isolated AIP surgical approach. As our knowledge and experience with these injuries increase, such selective approaches may provide a safe and efficient method of treatment while decreasing surgical morbidity and perioperative complications.

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