CASE SERIES

Mid-term results of displaced acetabulum fractures surgically treated using anterior intra-pelvic approach (modified Stoppa)

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ABSTRACT

BACKGROUND: This study aims to evaluate the radiological and clinical mid-term results of the patients with displaced acetabular fractures surgically treated with open reduction and internal fixation using an anterior intra-pelvic approach (AIP).

METHODS: In this study, we retrospectively reviewed 12 patients with displaced acetabular fractures treated surgically via the AIP approach. Patients were analyzed for Letournel's acetabular fracture classification, associated injuries, time to surgery, additional surgical procedures needed, perioperative and postoperative complications, radiologic and functional results.

RESULTS: Of the 12 patients, the male/female ratio was 1/2; the mean age was 40.5±16.2 (16–64) years. The mean follow-up time was 59.8±32.2 (12–124) months. Seven patients had both column fractures, three patients had anterior column + posterior hemitransverse fractures, one patient had transverse + posterior wall and one patient had anterior column fracture. The mean time to surgery was 6.6±4.4 (2–16) days. The mean intraoperative blood transfusion was 830 (300–2000) ml. Intra-operative and post-operative complications were noted in eight patients. The mean Merle d'Aubigné and Postel score was 14.5±2.7 (10–18). Six patients with an anatomical reduction of the fracture showed excellent/good functional and radiologic outcomes. Three patients with a non-anatomic reduction developed post-traumatic arthrosis that was treated with total hip arthroplasty.

CONCLUSION: AIP approach provides a satisfactory exposure for the surgical treatment of displaced anterior wall/column and both column acetabular fractures. Clinical outcome is directly related to the reduction quality. Patients with poor reduction are most likely to develop mid-term complications, such as hip joint arthrosis.

Keywords: Acetabulum fracture; anterior column; anterior intra-pelvic approach; anterior wall; both column; modified Stoppa approach.

INTRODUCTION

The aims for the treatment of acetabular fractures are to restore the normal anatomy, prevent secondary arthrosis and gain the pre-injury functional levels. The reduction quality is of paramount importance for satisfactory clinical outcomes.[1] The ilioinguinal approach was widely used for the surgical treatment of the anterior column and both column fractures. However, exploration and retraction of the femoral artery, vein and nerve may cause potential catastrophic complications. Iatrogenic injury of these structures and compression symptoms that arise from fibrosis around the inguinal canal may occur.[2–5] The recent trend is towards using the anterior intra-pelvic approach (AIP), which is the modification of the Stoppa approach with an additional lateral iliac wing window. Stoppa approach was first described in 1975 by Rene Stoppa[6] for inguinal hernia repair surgery. Later in 1994, Cole et al.[7] published the modification of the Stoppa approach (AIP) for

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acetabular fracture surgery. AIP approach provides direct exposure to pubis, posterior surface of the pubic ramus, quadrilateral surface, infra-pectineal surface, sciatic notch and anterior sacroiliac joint.[8] AIP approach has advantages over the ilioinguinal approach. AIP necessitates less surgical exposure and possibly decreases the risk of infection, bleeding and heterotopic ossification. Avoiding the use of the second window of the inguinal approach decreases the risk of femoral bundle injuries. Technically, AIP allows the reduction of superomedial roof impaction and medial to lateral reduction maneuvers of `central dislocations. Visualization of vital structures allows safe and effective reduction of clamp positioning. Additionally, it allows the utilization of plating configurations and screw trajectories not possible with an extrapelvic approach or difficult through the ilioinguinal approach. AIP approach facilitates a safe anterior approach for the patients with prior inguinal hernia repair.[8,9]

This study aims to identify the usefulness of the AIP approach for open reduction and internal fixation of acetabular fractures and demonstrate our mid-term clinical results both radiologically and functionally.

MATERIALS AND METHODS

We retrospectively reviewed 115 patients with displaced acetabular fractures surgically treated at our institution by staff trauma team between the years of 2003–2012. Patients with isolated posterior wall and/or column fractures surgically treated using the Kocher-Langenbeck approach, patients with anterior wall and/or column fractures treated using the ilioinguinal approach and patients treated with percutaneous fixation were excluded from this study. Twelve patients who were surgically treated with open reduction and internal fixation using AIP approach were included in this study. Preoperative radiographs and computerized tomography images were analyzed by two separate trauma surgeons and a third observer included when there was a disagreement between the two observers (Fig. 1). Fracture types were classified according to the Leteournel classification.[1,2] Patients were evaluated for associated injuries, time to surgery, the need

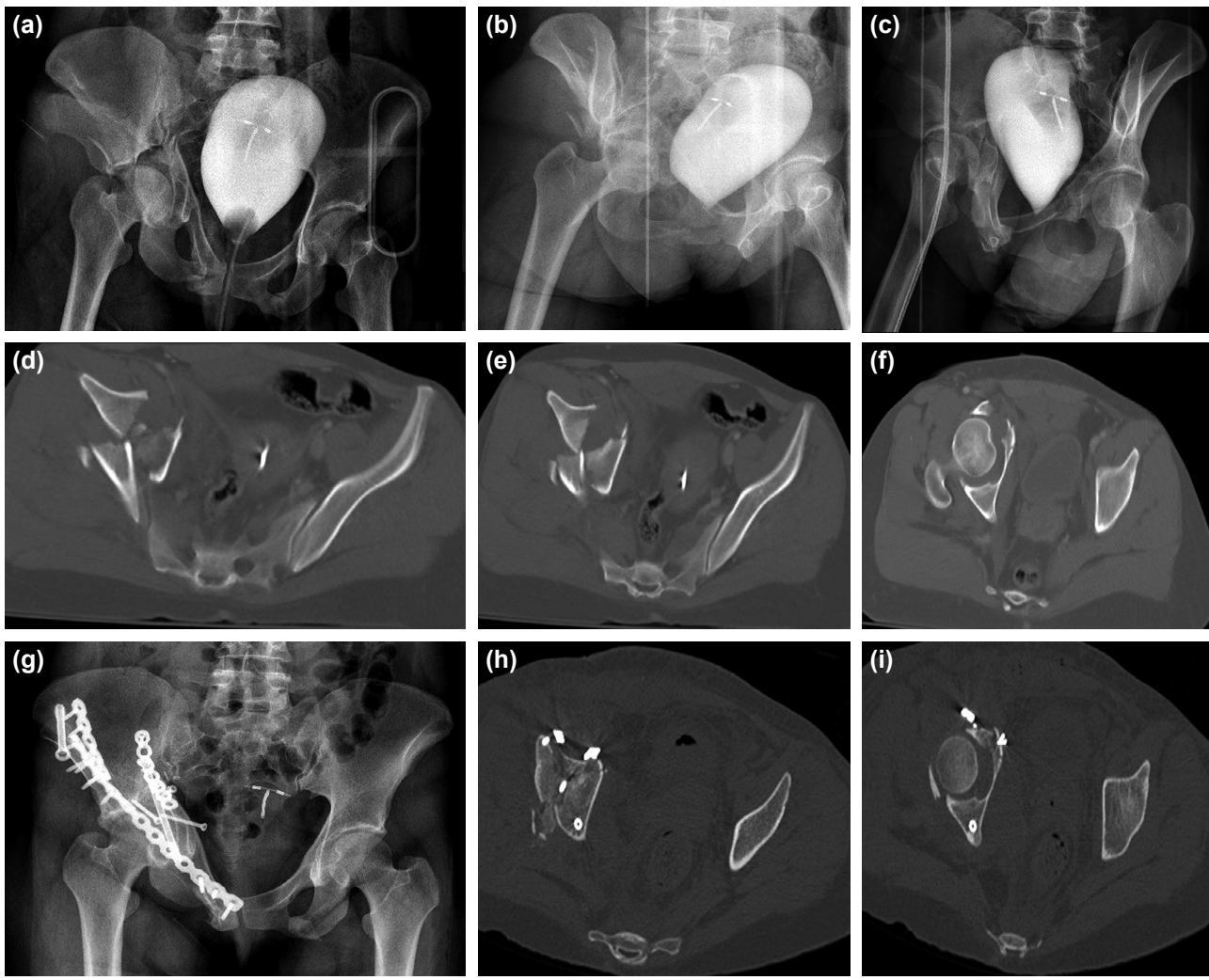

Figure 1. 25 years-old female, motor vehicle accident. A-P pelvis **(a)** and Judet views **(b, c)**. Preoperative computerized tomography scan shows both column fracture **(d–f)**. Post-operative x-ray **(g)** and computerized tomography scan **(h, i)** show anatomical restoration of fracture.

Table 1. Reduction criteria for acetabular fractures described by Matta et al.

Displacement	Reduction quality
<1 millimeter	Anatomical
2–3 millimeters	Imperfect
>3 millimeters	Poor

Table 2. Matta radiological criteria at follow-up

Radiographic appearance	Result
• Normal appearance of the hip	Excellent
• Mild changes, small osteophytes	
• Moderate (1 mm) narrowing of joint & minimum sclerosis	Good
• Intermediate changes, moderate osteophytes	
• Moderate (<50%) narrowing of joint and moderate sclerosis	Fair
• Advanced changes, large osteophytes	
• Severe (>50%) narrowing of the joint, collapse or wear of the femoral head, and acetabular wear	Poor

for additional surgeries, perioperative complications, radiographic and functional outcomes. Reduction quality was assessed by Matta's acetabular fracture reduction criteria (Table 1). Matta's radiological classification system was used to assess post-operative osteoarthritis (Table 2). "Merle d'Aubigné and Postel scoring system" was used to determine functional results (Table 3).

Surgical Technique

The patient is positioned in the supine position on a radiolucent table; anterior-posterior and Judet pelvis radiographs are obtained. Antibiotic prophylaxis is done 20 minutes before skin incision. Ipsilateral hip and knee are flexed to release tension over iliopsoas muscle and external iliac vessels. A Foley catheter is placed to observe the urine output and protect the bladder from iatrogenic injury. A transverse "Pfannenstiel" skin incision is done 2 cm proximal to the pubic symphysis. Skin and subcutaneous tissue are incised, and rectus fascia is incised parallel to the rectus muscle fibers. Transversals fascia is opened just proximal to the pubic symphysis. Superficial dissection lateral to the rectus abdominis is avoided to prevent iatrogenic injury to spermatic cord inguinal ligament. Retzius' space is bluntly exposed, packed with laparotomy sponges, and the bladder is retracted. Then, subperiosteally dissection is performed from the posterior pubis and advanced to the iliac fossa. A Hohmann retractor is placed over the pubic tubercle and rectus abdominis is retracted. External iliac vessels and iliopsoas are protected and retracted by a Deaver retractor. "Corona-mortis", the anastomoses between external iliac and obturator arteries, located over the superior pubic ramus, is ligated and dissection is advanced to quadrilateral surface. Iliopectineal fascia is elevated over the anterior column, and the exposure is expanded to the anterior sacroiliac joint. A retractor is placed on the sciatic notch to protect and retract obturator neurovascular structures. A lateral traction pin is placed to the femoral head to ease the reduction and release the tension over the obturator neurovascular structures. The lateral window of the ilioinguinal approach is used, especially for anterior column reduction.

Table 3. Merle d' Aubigne and Postel criteria

Criteria	Score
Pain	
None	6
Slight or intermittent	5
After walking but resolves	4
Moderately severe but the patient is able to walk	3
Severe, prevents walking	2
Walking	
Normal	6
No cane but slight limp	5
Long-distance with cane/crutch	4
Limited even with support	3
Very limited	2
Unable to walk	1
Range of motion	
95–100%	6
80–94%	5
70–79%	4
60–69%	3
50–59%	2
<50%	1
Clinical grade	
Excellent	18
Good	15–17
Fair	13–14
Poor	<13

RESULTS

The patients' age, associated injuries, acetabular fracture types according to Letournel's classification, the amount of blood transfused, the need for additional surgeries, perioperative complications, the quality of reduction, follow-up times, radiological and functional scores at the final follow-up were demonstrated in Table 4.

Table 4. Summary of results in the study group

Patient no	Age (years)	Fracture type	Time to surgery (day)	Associated injuries	Blood transfusion. (ml)	Follow-up time (months)	Reduction quality	Radiologic score	Functional score	Complications	Functional ability
1	17	Both column	15	Traumatic mid-humeral amputation	600	65	Anatomic	Excellent	17	–	Normal walking
2	64	Anterior column	6	Liver laceration	500	62	Imperfect	Poor	12	Arthrosis	Total hip replacement
3	16	Both column	7	Aort aneurism	1500	77	Imperfect	Fair	13	Superficial wound infection	No support but limping
4	51	Anterior column + posterior hemitransverse	8	Vertically unstable pelvic fracture	800	64	Anatomic	Good	16	Decubitus ulcer	No support but limping
5	60	Both column	4	Proximal humerus fracture	700	96	Anatomic	Excellent	15	–	No support but limping
6	36	Anterior column + posterior hemitransverse	6	Tibia diaphysis fracture	600	124	Imperfect	Fair	13	–	Short distance with a cane
7	49	Both column	2	–	400	34	Anatomic	Excellent	17	Sciatic nerve irritation	Normal walking
8	25	Both column	4	–	300	12	Anatomic	Excellent	18	–	Normal walking
9	39	Anterior column + posterior hemitransverse	16	Frontal bone fracture	1000	26	Poor	Poor	11	Arthrosis	Total hip replacement
10	54	Both column	4	–	2000	67	Imperfect	Good	14	Intra-op iliac vein injury	Short distance with a cane
11	29	Both column	3	Aort aneurism	1000	69	Anatomic	Excellent	18	Incisional hernia	Normal walking
12	47	Transverse + posterior wall	5	Hip dislocation	600	22	Poor	Poor	10	Arthrosis	Total hip replacement

The female/male ratio was 1/2. The mean age was 40±16 (16–64) years. The mean time for fracture fixation surgery was 6.6±4.4 (2–16) days. The mean intraoperative blood transfusion was 830 (300–2000) ml.

The surgical treatment was performed using a combined AIP + Kocher-Langenbeck approach in one patient with a transverse + posterior wall fracture-dislocation. Although AIP alone is sufficient exposure for both columnar fractures, an additional posterior approach (Kocher-Langenbeck) was added to the surgery to address posterior wall fracture-dislocation. The patient was placed in a lateral decubitus position, and posterior wall fracture was treated using the Kocher-Langenbeck approach than the patient flipped to the supine position, and the AIP approach was performed with open reduction and internal fixation of the transverse fracture at the same surgery. The mean follow-up time was 59.8±32.2 (12–124) months, and the mean Merle d'Aubigné and Postel scores were 14.5±2.7 (10–18) at the final follow-up.

Complications were noted in eight patients. Iliac vein injury that arose from retraction occurred in one patient that was primarily repaired intra-operatively. Superficial wound infection occurred in one patient that was treated with intra-venous antibiotics. One patient had an incisional hernia, and one patient had a decubitus ulcer. One patient suffered from sciatic nerve irritation symptoms due to implants. This patient went on sciatic nerve exploration, and implants were partially removed on the 26th months post-operatively. One patient with associated hip dislocation and two patients with poor reduction developed post-traumatic hip arthrosis and undergone total hip replacement surgery.

DISCUSSION

The goals of the treatment of displaced and unstable acetabular fractures are to avoid post-operative arthrosis and gain pre-injury functional activity level. Thus, open reduction and internal fixation are indicated in this type of fractures.[2] Letournel and Judet's acetabular fracture classification system, based on the anatomic configuration of the fracture, is most widely used.[1] Various surgical approaches have been identified for the surgical treatment of acetabular fractures regarding the anatomic configuration of the fracture. Generally, the Kocher-Langenbeck approach was used for the surgical treatment of posterior wall and/or column fractures, and the ilioinguinal approach was used for the anterior wall and/or column fractures.[3–5] However, the recent trend for the surgical treatment of anterior wall/column, both column fractures involving the quadrilateral surface, is towards using the AIP approach for open reduction and internal fixation. Cole et al.[7] published successful outcomes on 55 patients with displaced isolated anterior wall/column or both column fractures treated with open reduction and internal fixation using AIP. AIP approach is indicated for anterior wall/column fractures, anterior column + posterior hemitransverse fractures, both column fractures, transverse fractures and fractures of the quadrilateral surface associated with medial dislocation of the femoral head.[10–12] In our series, seven patients had both columns, three patients had anterior column + posterior hemitransverse, one patient had transverse + posterior wall, and one patient had isolated anterior column fractures.

AIP approach is contraindicated for the patients with a history of cesarean-section, prostate, uterus, or bladder surgery because of the high risk of bladder injury and bleeding.[8,12] In a cadaver study Kacra et al.[9] identified that obturator vessels and iliolumbar vessels are primarily at risk during the AIP approach. The presence of an inguinal hernia or previous hernia surgery is not considered as a contraindication for the AIP approach. The main advantages of AIP approach are direct visualization of entire pelvic brim from pubic body to anterior aspect of sacroiliac joint and ease of implant placement to the quadrilateral surface, direct visualization and access to the posterior column from the greater sciatic notch to the ischial spine allowing for reduction and plating, protection of femoral neurovascular bundle and spermatic cord thus lower risk for neurovascular injury and shorter surgical time.[12–14]

In a prospective randomized study comparing AIP and ilioinguinal approaches, Shazar et al.[15] demonstrated that the AIP approach showed better reduction quality. The complication rates showed no statistically significant difference between the two approaches. Ma et al.[16] have stated that the AIP approach is associated with shorter surgical time and a lower need for blood transfusion. AIP approach has been recommended for acetabular fracture if an anterior approach is needed. In this series, our results were comparable with the current literature. We experienced that AIP provided excellent surgical exposure for open reduction and internal fixation of fractures of the quadrilateral surface and both column fractures. We were able to obtain an excellent or good reduction in 75% of the cases with this technique. Additionally, fracture reduction and implant placement could be obtained successfully. However, due to the heterogeneity of our patient group with different comorbidities, we could not conclude on intra-operative blood loss in this study.

At the final follow-up (mean of 5 years), clinical outcome scoring using the Merle d'Aubigné and Postel system showed that 50% of the patients were rated good or excellent, and 25% of them rated moderate. These functional scores were found to be lower than the 1-year follow-up clinical scores reported in the literature with the same scoring system.[15,16] Therefore, the long term complications, such as hip joint arthrosis, occur progressively; these findings may be attributed to our longer follow-up times.

Three complications related directly to the surgical approach occurred in three patients: 1 of an iliac vein injury, superficial wound infection and a direct inguinal hernia.

Surgical reduction quality for acetabular fracture surgery is directly related to radiological results.[17] We found that good clinical and radiological results were directly correlated with the reduction quality. All patients with an anatomical reduction showed excellent/good functional and radiological scores. Bastian et al.[18] have shown that the inability to obtain an anatomic reduction of acetabular fractures is associated with a high risk of hip joint arthrosis that needed joint replacement surgery in midterm follow-up. In our series, patients who had residual fracture displacement less than 1 mm showed better clinic and functional outcomes. Three patients with 2 mm or more residual displacement developed hip joint arthrosis and underwent joint replacement surgery.

Several studies reported the outcomes of acetabular fractures treated with the AIP approach. To our knowledge, the current literature is lack of mid-term and long-term clinical results of AIP approach on anterior-sided acetabular injuries. Our results with a mean follow-up of five years are a useful addition to the literature. Therefore, we demonstrated mid-term complications like hip arthrosis and implant irritation that needed surgical treatment.

There are a few drawbacks of our study. Firstly, this study is a retrospective case series. Prospective randomized controlled studies are needed to come out with a stronger conclusion. Secondly, our sample size is relatively small, with 12 patients.

In conclusion, the AIP approach is an effective approach for the treatment of acetabular fracture surgery when anterior exposure of acetabulum is required, especially for both column fractures. Additionally, the surgeon should be aware of mid-term complications in patients with a non-anatomical reduction like hip joint arthrosis.

Informed Consent: Written informed consent was obtained from the patients for the publication of the case report and the accompanying images.

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OLGU SERİSİ - *ÖZET*

Anteriyor intra-pelvik yaklaşımla (modifiye Stoppa) tedavi edilen deplase asetabulum kırıklarının orta dönem sonuçları

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AMAÇ: Bu çalışmanın amacı deplase asetubulum kırıklarının cerrahi tedavisinde anteriyor-intra pelvik (AİP) yaklaşımla açık redüksiyon ve içten tespitin etkinliğini, orta dönem klinik ve radyolojik sonuçlarını ortaya koymaktır.

GEREÇ VE YÖNTEM: Deplase asetabulum kırığı tanısıyla başvuran hastalardan AİP yaklaşım ile açık yerleştirme ve içten tespit uygulanan 12 hasta geriye dönük olarak incelendi. Hastalar, kırık tipi, ek yaralanma varlığı, ameliyata kadar geçen süre, ek cerrahi girişim ihtiyacı, perioperatif komplikasyonlar, radyografik ve fonksiyonel sonuçlar açısından değerlendirildi.

BULGULAR: Erkek/kadın oranı 1/2 idi. Ortalama yaş 40.5±16.2 (16-64) yıldı. Ortalama takip süresi 59.8±32.2 (12–124) aydı. Yedi hastada çift kolon, üç hastada anteriyor kolon+posteriyor hemitransvers, bir hastada transvers+posterior duvar ve bir hastada anteriyor kolon kırık paterni mevcuttu. Hastalar, ortalama 6.6±4.4'üncü (2–16) günde ameliyat edildi. Amaliyat sırasında kan transfüzyonu ortalama 830 (300–2000) mL idi. Sekiz hastada ameliyatta ve ameliyat sonrası komplikasyonlar gözlemlendi. Ortalama Merle d'Aubigné and Postel skoru 14.5±2.7 (10–18) idi. Anatomik redüksiyon elde edilen altı olguda mükemmel/iyi fonksiyonel ve radyolojik sonuç gözlemlendi. Anatomik olmayan redüksiyon elde edilen üç hastada orta dönemde post-travmatik kalça artrozu gelişti ve total kalça replasmanı ile tedavi edildi.

TARTIŞMA: AİP yaklaşım, asetabulumun deplase anteriyor duvar/kolon ve özellikle çift kolon kırıklarının cerrahi tedavisinde yeterli açılımı sağlar. Klinik sonuçlar, redüksiyon kalitesiyle doğrudan ilişkilidir. Anatomik olmayan redüksiyon elde edilen hastalarda orta-dönemde kalça eklem artrozu açısından dikkatli olunmalıdır.

Anahtar sözcükler: Anterior duvar; anterior intra-pelvik yaklaşım; anteriyor kolon; asetabulum kırığı; çift kolon; modifiye Stoppa.

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