



Surgical outcomes of acute acetabular transverse fracture using ilioinguinal and Stoppa approach

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ABSTRACT

Objective: To compare surgical outcomes of acute acetabular transverse fracture using ilioinguinal and Stoppa approach. **Methods:** Twenty five patients who managed with ilioinguinal approach (group A) at a mean follow-up of (32.3±4.6) mo and 30 patients who managed with Stoppa approach (group B) at a mean follow-up of (29.7±3.8) mo were prospectively reviewed. The study was approved by the hospital ethical review committee (IRB approval no: 0189-2007). Patients were called for routine follow up and follow-up durations were set. End points of the study were: (1) blood loss was measured intraoperatively by measuring the blood loss in the suction drain and counting blood stained gauze and postoperatively by assessing hemoglobin after 6 h of surgery; (2) functional outcome was demonstrated using the Harris hip score; (3) reduction quality and radiological results were demonstrated by Matta scoring system. **Results:** Mean blood loss (intraoperatively + postoperatively) was (1 175.8±310.2) mL and (1 115.7±285.1) mL in patients operated with ilioinguinal and Stoppa approach, respectively. Mean operative time was (242.3±60.8) min and (198.9±50.3) min in patients operated with ilioinguinal and Stoppa approach, respectively. Functional outcome, radiological outcome and reduction quality showed no significant difference between two approaches. Complication rate was 36.0% in group A (9 patients) and 13.3% in group B (4 patients). **Conclusions:** Our study concludes that Stoppa approach allows less blood loss and operative time with fewer complications.

1. Introduction

Fractures of the acetabulum are challenging and complex injuries that require trained and expert orthopedic surgeons. Acetabular surgeries were performed using different approaches and decisions were mainly based upon fracture configuration and surgeon skills or knowledge in that particular approach as well. Both surgical skills and knowledge of particular acetabular fracture influence the outcome[1,2]. In addition, the definitive approach used by surgeon also depends on general wellbeing of the patient and merits and demerits of that particular approach[3]. The approaches to the

acetabulum are categorized as either limited (basic) or extensile depending on the degree of exposure required, and anterior or posterior depending on particular exposure of that region required[4]. The gold standard approach for anterior column fixation is ilioinguinal[5,6], whereas the Kocher-Langenbeck is the gold standard for posterior access[5].

Currently ilioinguinal[5] or Stoppa approach[7,8] are used as anterior approaches. Stoppa approach is an intrapelvic approach

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used initially for surgery of inguinal hernia by Rives *et al*[9] and Stoppa *et al*[8] in the early 1990's. Cole and Bolhofner[10] and Hirvensalo *et al*[11] introduced a technique for approaching the anterior acetabulum and pelvic bone via Stoppa approach.

Therefore, we performed a case control study to determine:

1) If the Stoppa approach is better than ilioinguinal approach in terms of blood loss and operative time.

2) If functional outcome following ilioinguinal approach is superior to that of Stoppa approach.

3) If reduction quality and radiological results following ilioinguinal approach is better than that of Stoppa approach.

4) If number of complications is more following ilioinguinal approach than Stoppa approach.

Our hypothesis is that intra-pelvic or Stoppa approach allows less blood loss and operative time with fewer complication rates as compared to ilioinguinal approach with good functional and radiological outcome.

2. Materials and methods

Total of 65 patients of both gender with fractures of the acetabulum were enrolled from the emergency. Patients with fractures of the acetabulum were included in a randomized trial to compare the results of both approaches. This study performed at department of orthopedic surgery in Liaquat national hospital (Karachi, Pakistan), a tertiary care hospital with approval of institutional review board (IRB approval no: 0189-2007).

The sampling technique was consecutive non-probability technique with patients being enrolled from January 2008 to January 2012.

Inclusion criteria:

- 1) Patients aging between 18 and 65.
- 2) Transverse and isolated anterior column and wall fractures of acetabulum in which ilioinguinal and Stoppa (intra-pelvic) approach applied.
- 3) Patients, who had finished at least 1 year follow-up period, had a normal joint prior injury.

Exclusion criteria:

- 1) Those who were without at least 1 year follow-up period.
- 2) Patients presented with other than anterior column and transverse fractures.
- 3) Patients apply other approaches other than ilioinguinal and Stoppa.
- 4) Open fractures and those who require prolonged intensive care unit stay due to associated injuries.

The mean age of patients operated with ilioinguinal was (52.10±4.28) years while mean age of patients operated with

Stoppa was (49.30±3.92) years. All patients were operated by a single surgeon who was trained in pelvis and acetabulum surgeries. Patients were split into two groups. The choice of choosing a particular technique was at a random using 'chit method' as both had the same indications.

Patients who had undergone surgery with ilioinguinal approach are in group A whereas those who had undergone surgery with Stoppa approach are in group B. Total 65 patients were prospectively evaluated. Out of 65 patients, 30 patients operated with ilioinguinal approach are in group A, whereas 35 patients operated with Stoppa approach are in group B. Five patients of each group were lost to follow up and were excluded in our study. In both groups, males were more than females.

First-generation cephalosporin (3 mg/kg) used as a prophylactic antibiotic in both groups. Informed consents were taken from all patients who had undergone surgery. Pre-operatively, we performed X-ray pelvis antero-posterior (AP) view and computed tomography (CT scan) with 3-dimensional (3D) reconstruction to further delineate fracture pattern and pre-operative planning as well.

Pfannenstiell incision was used in Stoppa approach, which was made 1-2 cm above the pubic symphysis. Dissection was carried down through skin and subcutaneous tissue to the level of rectus fascia. The uncovered musculus rectus abdominis was separated along the linea alba to approach the inner aspect of the pelvis. Subperitoneal dissection was performed along the pelvic brim to expose the fracture fragments. A pointed Hohman retractor may be placed over pubic tubercle to reflect the rectus musculature. As dissection was approaching towards acetabulum, a large hand-held retractor was used to preserve and lift the external iliac vessels and iliopsoas muscle. A large hand-held retractor may be placed under iliopsoas muscle to preserve the external iliac vessels. The anastomosis between external iliac and obturator vessels, *i.e.* corona mortis, run over the superior ramus sailing towards the obturator foramen. These vessels were ligated to advance the dissection farther along the pelvic brim. Iliopectineal fascia was separated over the anterior column and the dome of acetabulum. Dissection was then advanced in direction of sacroiliac joint to introduce entire pelvic brim. In the Stoppa approach, surgeon positioned contradictory to fracture pathology. Once the fracture site was exposed, reduction was attempted and internal fixation was performed. If the isolated Stoppa approach was inadequate for reduction and internal fixation, a lateral window was made along the superior opening of the pelvis to fix the high anterior column fracture (exiting the iliac crest) or to fix the posterior column with a lag screw.

On the other hand, we used a rounded incision beginning behind to gluteus medius pillar and extend past the midline 2 cm above

the symphysis in ilioinguinal approach. This approach created 3 windows that provide access to the anterior acetabulum. The first or lateral window contributed access to the internal iliac fossa and sacroiliac joint. The second or middle window contributed access to the pelvic brim by releasing the iliopectineal fascia. The third or medial window was medial to the femoral vessels and contributed access to superior pubic ramus and prevesical space. In the ilioinguinal approach, surgeon stood on the side of fracture, and working down and into the pelvis from higher. Once fracture site was exposed, the anterior column reduction can be performed through middle window using a downward directed vector with a spiked pusher. As femoral head was frequently medialized, lateral traction applied to the femur can assist the anterior column reduction. Provisional fixation can then be obtained with superior-to-inferior K wires or definitive lag screws if the posterior column didn't require reduction.

In either technique, retropubic vascular communication must be ligated with either vessel clips or suture. This vascular leash, which was most commonly venous, was found on retro pubic surface of superior pubic ramus approximately 6 cm from the symphysis. With ilioinguinal approach, anastomosis was frequently identified with development of medial window whereas in Stoppa approach it was usually seen during the retro-ramus dissection.

Fracture union was evaluated using AP view of hip until union was achieved. Postoperative protocol was identical for both group A and B. Patients were asked to follow up in out-patient department at 2 wk, 6 wk, 3 mo, 6 mo and 12 mo. Mean follow up time was (32.3±4.6) mo and (29.7±3.8) mo for patients operated with ilioinguinal and Stoppa, respectively. Stitches were removed at 2 wk. Weight bearing was not permitted for first 6 wk. Partial weight bearing with the help of walker was allowed after 6 wk followed by full weight bearing at 3 mo. Both active and passive range of motion exercises were started in the early postoperative period. Functional and radiological outcome was made after one year postoperatively with the help of Harris hip score (HHS) and Matta radiological criteria.

Factors observed in both groups were age, gender, mechanism of injury, time between trauma and surgery, mean follow up period, fracture type, operative time and blood loss were recorded. Intra-operative bleeding was calculated from wound suction plus the estimated amount of blood in the gauze. We use 4 × 4 sponge in our study which had an average capacity of (10±2) cc. Number of completely soaked sponges was counted at the end of the procedure and multiplied it by 10. Hemoglobin was checked after 6 h of surgery.

Twenty five patients were managed with ilioinguinal approach with a total follow up of 32.3 mo (group A) and 30 patients were managed with Stoppa approach with a total follow up of 29.7 mo.

Fractures classified according to Letournel-Judet classification system[12]. In group A, the fracture type was anterior column in 17 patients (68%), and transverse type in 3 patients (12%). In group B, the fracture type was anterior column in 18 patients (60.0%) whereas transverse type in 5 patients (16.7%). To determine functional outcomes, patients were divided into three levels including excellent (HHS, 91-100), good (HHS, 81-90), and fair (HHS, 71-80). We also graded reduction on radiographs by using Matta scoring system[13]. Reduction was graded on AP view of pelvis postoperatively. Any displacement greater than 3 mm indicated unsatisfactory reduction. Displacement of 3 mm or less indicated satisfactory reduction. Displacement of 1 mm indicated anatomical reduction. Radiological results at final follow up were also classified into 4 grades: excellent, indicating a normal appearance of the hip; good, indicating mild changes, small osteophytes, moderate (1 mm) narrowing of the joint, and minimum sclerosis; fair, indicating intermediate changes, moderate osteophytes, moderate (less than 50%) narrowing of the joint and moderate sclerosis; and poor, indicating advanced changes, large osteophyte, (more than 50%) narrowing of the joint and collapse of the femoral head[14]. We also observed complications at the end of follow-up period, which included infection (both superficial and deep), heterotopic ossification[15], delayed union, screw penetration, lateral femoral cutaneous nerve injury, traumatic arthritis[16] and sciatic nerve injury.

Statistical analysis of the data was performed using SPSS version 13.0 statistical software. Independent student's *t* test was used for quantitative variables. Categorical variables were analyzed by Pearson's *chi*-square test or one way ANOVA test where appropriate. *P* value <0.05 was considered significant with confidence interval of 95%.

3. Results

Mean time between trauma and surgery was (3.86±1.36) d and (3.50±1.84) d for patients operated with ilioinguinal and Stoppa, respectively. Mean blood loss was (1 175.8±310.2) mL and (1 115.7±285.1) mL in patients operated with ilioinguinal and Stoppa approaches, respectively (*P*=0.042). Mean operative time was (242.3±60.8) min and (198.9±50.3) min in patients operated with ilioinguinal and Stoppa approaches, respectively (*P*=0.038). Significant differences were found in blood loss and operative time.

One way ANOVA test was applied to analyze data of Harris hip scores. Table 1 showed that there were no significant differences between two groups.

Table 1

Harris hip score of patients.

Parameters	Excellent (%)	Good (%)	Fair (%)
Group A (n=25)	16 (64)	7 (28.0)	2 (8.0)
Group B (n=30)	18 (60)	11 (36.7)	1 (3.3)
F value	12.55		
P value	0.073		

Reduction quality was measured by Matta radiological grading including unsatisfactory, satisfactory and anatomical. *Chi* square test was applied to analyzed data, and there was no significant differences between two groups (Table 2). The postoperative radiographic reduction quality was also shown in Figure 1 and Figure 2. A 52 year-old male patient with transverse type left acetabular fracture was observed (Figure 1). The ilioinguinal approach was applied, and it was considered anatomical reduction according to Matta’s radiological reduction criteria. While in Figure 2, we used the Stoppa approach to fix the fracture of the patient and we considered this reduction as unsatisfactory reduction according to Matta’s radiological reduction criteria.

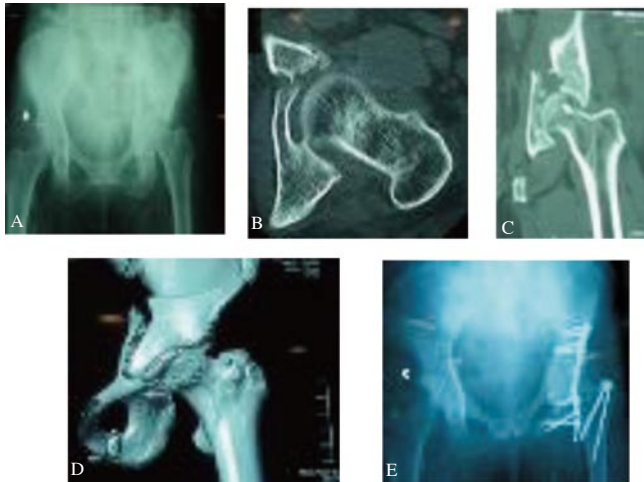


Figure 1. Postoperative radiographic reduction quality of a 52 year-old male patient applying ilioinguinal approach.

(A) X-ray pelvis (AP) view of skeletally mature; (B) axial view of CT scan showing transverse variety of acetabular fracture; (C) coronal view showing the same configuration of fracture; (D) excellent pre-operative 3D CT scan; (E) post-operative X-ray pelvis (AP) view showing fracture reduction with reconstruction plate and screw.

Table 2

Reduction quality and radiological results.

Parameters	Reduction quality			Radiological results			
	Unsatisfactory	Satisfactory	Anatomical	Excellent	Good	Fair	Poor
Group A (n=25)	5 (20.0%)	16 (64.0%)	4 (16.0%)	10 (40.0%)	8 (32.0%)	4 (16.0%)	3 (12.0%)
Group B (n=30)	4 (13.3%)	20 (66.7%)	6 (20.0%)	13 (43.3%)	10 (33.3%)	4 (13.3%)	3 (10.0%)
F value	14.25			10.40			
P value	0.781			0.617			

Table 3

Complication rate and fracture pattern of patients.

Parameters	Complication rate								Fracture pattern	
	Superficial infection	Deep infection	Heterotopic ossification	Delayed union	Screw penetration	Lateral femoral cutaneous nerve injury	Traumatic arthritis	Sciatic nerve injury	Anterior column	Transverse type
Group A	2	1	1	-	-	2	3	-	17 (68%)	8 (32%)
Group B	1	-	-	-	-	-	3	-	18 (60%)	12 (40%)

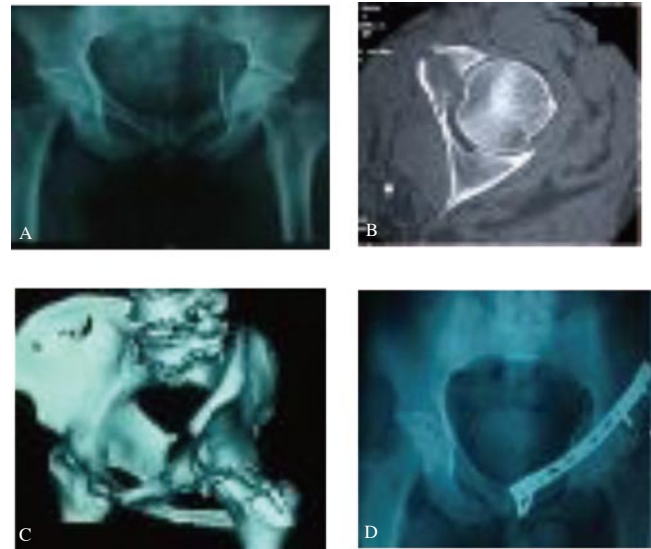


Figure 2. Postoperative radiographic reduction quality of a patient applying Stoppa approach.

(A) X-ray pelvis (AP) view of skeletally mature showing anterior column fracture of left acetabulum; (B) axial slice of CT scan showing anterior column fracture; (C) excellent pre-operative 3D CT scan showing the same fracture configuration; (D) postoperative X-ray pelvis (AP) view of skeletally mature patient showing acetabular reconstruction with plate and screws.

Radiological results at the end of follow-up was shown in Table 3. *Chi* square test was applied to analyzed the data and there was no significant differences between two groups.

The complication rate was 36.0% in Group A (9 patients) and 13.3% in Group B (4 patients). Complications of both groups presented in Table 3. Two patients from group A and one patient from group B had superficial infection which was treated by removal of sutures with drainage of pus, debridement and open wound care by daily dressings followed by delayed primary or secondary suturing of the wound. Only one patient had deep infection in group A which was treated by temporary placement of antibiotic beads. Culture specific antibiotics were given for 1 wk in case of superficial infection and 6 wk in case of deep infection. Fracture patterns were also shown in Table 3. *Chi* square test was applied to analyzed the data and no significant difference was found.

One patient developed heterotopic ossification in group A but didn't complaint of pain or limitation of motion. There was loss of sensation on outer aspect of thigh in two patients in group A who was not recovered. Three patients from each group developed traumatic arthritis at final follow-up period based on the criteria for radiographic arthritis described by Letournel[6]. Two patients from each group graded as type 1 or type 2 and one patient from each group graded as type 3, which was surgically treated with total hip replacement later.

4. Discussion

Acetabular fractures are complex fractures that require trained and expert orthopedic surgeon[17]. Although assessment of radiographs must be required before planning surgical approach. One of the aims of this study was to observe complication rate and amount of blood loss to determine which approach was better for future application. There are studies available that measure the amount of bleeding between these two approaches[18-20]. In the present study, the mean blood loss in group A was reported as (1 175.8±310.2) mL whereas in group B was as (1 115.7±285.1) mL ($P=0.042$). Elmadag *et al*[18] recorded a mean blood loss of 1 170 mL (with range of 750-2 150 mL) for the ilioinguinal approach and 1 110 mL (with range of 450-2 000 mL) for the Stoppa approach, and no statistically significant difference was found between them. In a randomized study of Ma *et al*[19], of 60 acetabulum fractures, there was less intraoperative bleeding with the Stoppa approach because of reduced wound drainage and a shorter operative time. In a study conducted by Fan *et al*[20], mean blood loss with the modified Stoppa approach was 320 mL (with range of 100-1 200 mL). These studies reflected a range of results related to bleeding. Our study also showed that there was a significant difference between these two approaches in respect of blood loss. The reason behind this was that middle window of the ilioinguinal approach was not encountered during Stoppa approach resulting in less dissection in inguinal canal, femoral nerve and external iliac vessels.

We also compared the functional outcomes with the help of Harris hip score between these two approaches and no significant difference was found. Elmadag *et al*[21] reported that satisfactory outcomes with stoppa approach in 29 (80.5%) patients with a mean Harris Hip Score of 77.9. Hirvensalo *et al*[11] observed anatomical reduction in 84.1% of cases with Harris hip score greater than 80 in 75.0% of the 164 patients with an acetabular fracture.

We also compared these two approaches in terms of reduction quality and final radiological results at the end of follow-up. Meena *et al*[22] reported that fractures achieving anatomical reduction were significantly higher in Stoppa group than in ilioinguinal group ($P=0.02$). Stoppa approach is also suitable for cancellous bone grafting, fixation of fractures without lateral extra pelvic exposures and without dislocating the joint[22]. In a randomized study conducted by Ma *et al*[19], no significant difference was found in terms of reduction quality and final radiological results at the end of follow-up. Our study also demonstrated no significant difference in respect of reduction quality and final radiological

results. While Shazar *et al*[23] observed a 79.4% anatomical reduction rate.

Complications that can accompany acetabular fractures include infection in both superficial and deep, heterotopic ossification, delayed union, intra-articular screw penetration, lateral femoral cutaneous nerve injury, traumatic arthritis and sciatic nerve injury[24]. Regarding the complications, we found that 36.0% of the patients in group A developed complications in our study whereas it was 13.3% in group B. Lateral femoral cutaneous nerve is the most commonly injured nerve with the ilioinguinal approach[5]. In the current study, we also found that two of the patients from group A also suffered from this complication. This could be due to excessive trauma to the surgical window. In this study, we found no nerve injury associated with group B as middle window was not encountered during Stoppa approach, which decreased the chance of injury to the vessels. To prevent severe bleeding during Stoppa approach, we identified and ligated corona mortis first along with subperiosteal dissection was done to expose the fracture fragments.

In group A, two patients had superficial infection whereas one patient had deep infection. Only one patient had superficial infection in group B. It was concluded that 3% of surgical wound infection after surgical management of acetabular fractures using ilioinguinal approach[14]. The reason for systemic infection in our study might be uncontrolled diabetes, which was then managed by diabetic control by taking endocrine team on board. The reason for deep infection might be prolonged operative time in ilioinguinal approach.

One patient in group A also developed heterotopic ossification. Kim *et al*[25] found 3 episodes of ectopic bone formation in the buttock area that were not approached posteriorly through the Stoppa approach in which the large muscles are not dissected in comparison to the classic ilioinguinal approach. None of the patient in our study developed heterotopic ossification using Stoppa approach.

We followed 25 patients managed with ilioinguinal approach for about 32.3 mo, and 30 patients managed with Stoppa approach for about 29.7 mo. In the present study, only four hips developed traumatic arthritis. Two of the patients had type 3 arthritis whereas four of the patients had type 1 or 2 arthritis. The reason behind traumatic arthritis was imperfect reduction. This was a short term follow-up study which was one of the drawbacks of this study, therefore we couldn't find out the exact occurrence of traumatic arthritis in the present study. Different authors demonstrate the occurrence of traumatic arthritis quite variably such as 17% by Letournel *et al*[16] to 57% by Pennal *et al*[26]. It was concluded that 50% of the patients developed traumatic arthritis with anatomical reduction in 10-25 years whereas 80% of the patients who had imperfect reduction develop traumatic arthritis in less than 10 years[16].

Although both approaches can be used, most surgeon develop their surgical technique with either the ilioinguinal or Stoppa approach, thus the purpose of this study was to clarify the pros and cons of each approach for future application.

The pros of stoppa approach is that neurovascular structures

are better visualized, time sparing approach with short operative time, allows easy access to both sides of the pelvis, avoids middle window, less complications and reduced wound drainage. The cons of stoppa approach are iatrogenic damage to peritoneum while repositioning the fracture fragments, retraction of anterior abdominal wall causes tension on the femoral vessels, need of two experienced pelvis and acetabulum surgeons at the same time. The pros of ilioinguinal approach is that it allows access to entire internal iliac fossa and pelvic brim whereas the cons of this approach is that it is an extra-articular approach with reduction almost entirely by indirect means and performed through three windows, time consuming, damage to femoral or other vessels, high complication rate with increase wound drainage and operative time.

The main drawback of this study is about less number of patients in each of two groups. The reason behind this is that we only included patients presenting with anterior column as well as transverse type fractures and we exclude posterior column, posterior wall and bicolunar fractures in our study.

Our study concludes that Stoppa approach provides excellent reduction of anterior column and wall fractures and can be used as substitute to the ilioinguinal approach. As compared to ilioinguinal approach, Stoppa approach allows less blood loss and operative time with fewer complications.

Conflict of interest statement

The authors declare that there is no conflict of interest.

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