Surgical Treatment of Associated Patterns of Fracture Acetabulum with New Trends

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Abstract

Background: Associated patterns acetabular fractures are challenging injuries to manage. The complex surgical approaches and the technical difficulty in achieving anatomical reduction imply that the learning curve to achieve high-quality care of patients with such challenging injuries is extremely steep.

Aim of the work: evaluation of the clinical and radiological results of surgical treatment of associated patterns of fracture acetabulum (Letournel and Judet classification) and new trends in surgical treatment.

Materials and Methods: This prospective study was conducted between January 2011 and January 2014. Only 50 patients were available for this study. Follow up was at least for 1 year. Evaluation of patient was done clinically and radiologically. We adopted in this study in addition to standard methods of surgical treatment of open reduction and internal fixation: (modified Stoppa approach) as new trend in the surgical exposures in 4 patients (8%) and (antegrade posterior column screw) as new trend in the methods of fixation in 3 patients (6%).

Results: Radiographic evaluation was done according to the Matta's criteria (1986) (11) and included 15(30%) anatomic reductions, 26 (52%) satisfactory reductions and 9 (18%) unsatisfactory reductions. clinical assessments of (50) patients based on modified Merle d'Aubigné and Postel score include 9 (18%) excellent scores, 27 (54%) good scores, 5 (10%) fair scores and 9 (18%) poor scores. Modified Stoppa approach was performed in 4 patients (8% of study size) and all of reductions achieved were satisfactory. Antegrade posterior column screw was performed in 3 patients (6% of study size) all had satisfactory reduction There was significant association between clinical result and radiological reductions.

Conclusion: Operative treatment of Associated patterns of acetabular fractures is an effective method for the management of displaced acetabular fractures. Clinical and radiological results correlate closely specially with an anatomic reductions. Both modified Stoppa approach and Antegrade posterior column screw need further evaluations in future studies as they are promising tools with large potential benifits in surgical treatment of fractures acetabulum.

Key words: Associated patterns, fractures, acetabulum, Stoppa, column screw.

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Introduction:

Through the efforts of Judet and Letournel in the 1960s, Surgical intervention with open reduction and internal fixation (ORIF) became the treatment of choice for displaced acetabular fractures. Conservative treatment leads to an unacceptably high frequency of secondary arthritis(1). The operative treatment of complex acetabular fractures is often difficult and technically demanding. The goal of operative treatment is to preserve a functional, mobile, painless hip joint that continues to function for the rest of the patient's life through achieving anatomic restoration of the articular surface, a stable and congruent hip joint, preventing posttraumatic osteoarthritis, preserving a good bone stock for possible future salvage surgery and to allow...
early mobilization without endangering fracture stability(2). The positive results reported by Letournel and Judet can be reproduced by the concentrated efforts of a surgeon who treats these fractures frequently and over an extended period of time. Other authors have reported poor results for as many as twenty-four (43 per cent) of fifty-six hips when multiple surgeons with less experience and inconsistent protocols participated(3). Thus, the indications for operative treatment may not be the same in all clinical settings, as a patient who has had an operation that resulted in a poor reduction or a serious complication can be worse off than one who has had no operation at all. Management of patients at specialized centers where these injuries are treated frequently will probably yield the best clinical results(4)

Patients and methods:

During period between January 2011 and January 2014, sixty four patients of associated patterns fracture acetabulum ( according to Letournel and Judet classification) underwent surgery in Zagazig university hospitals. Five patients did not meet the criteria of the study were excluded and nine patients were lost in the follow up, only 50 patients were available for this study. Follow up was at least for 1 year . Evaluation of patient was done clinically and radiologically. This study was conducted to assess the Surgical treatment of associated patterns of fracture acetabulum with new trends in surgical treatment in Zagazig university hospitals . We adopted in this study in addition to standard methods of surgical treatment of open reduction and internal fixation : (modified Stoppa approach) as new trend in the surgical exposures in some patients and (antegrade posterior column screw) as new trend in the methods of fixation in other patients . The age of the patients ranged from (21-58) with a mean (32.9) years. There were (39) males representing (78%) of the patients and (11) females representing (22%) of the patients . The mechanism of injury was car accident in (28) patients representing (56%), falling from height in (10) patients representing (20%) and motorcycle accident in (12) patients representing (24%). The side of injury was left in (17) patient representing (34%), right in (33) patients representing (66%) and no bilateral cases. Isolated acetabular injury in this study was (38%), and associated injuries in this study were (62%). Some patients had more than one associated injuries; all extremities fractures were treated before acetabular fixation. There were 2 head injuries , 2 cases fracture mandible , 1 fracture ribs , 1 fracture spine , 6 cases internal haemorrhage , 6 cases upper extremity fractures , 15 cases lower extremity fractures , 8 cases with pelvic fractures , 6 cases with preoperative sciatic nerve injuries , 1 Morel-Lavalee lesion in the front of the thigh .

All patients were operated upon within time frame from time of injury up to three weeks, ranged from 3 days to 20 days, with a mean of 10 days. In this study all patients treated within three weeks of injury. Fractures acetabulum were classified according to Letournel and Judet classification(1). The treated fractures were 17 cases both-column fractures, 13 Transverse and posterior wall fractures, 10 Posterior column and posterior wall fractures and 10 T-shaped fractures. We were confronted with 2 cases Anterior column and posterior hemitransverse fractures that were minimally displaced and treated conservatively so they were not included in the study.

After being fully assessed, managed and stabilized ( following Advanced Trauma Life Support guidelines) , we received our patients. The patients were reassessed and examined for associated skeletal injuries , neurological injuries or soft tissue injuries. There was no open fracture acetabulum in this study Radiological assessment included plain X-rays (antero_posterior view of the pelvis showing both hips, obturator and iliac oblique views.Inlet and outlet views were done for cases with fracture pelvis. Axial CT for all cases and computer 3D reconstruction, coronal and sagittal reconstruction done for majority of cases. After doing X-rays and before CT is done , we had 10 cases presented with fracture dislocation acetabulum ( 4 cases in transverse associated with posterior wall fractures, 4 cases in posterior column associated with posterior wall fractures and 2 cases in T fractures).All were reduced immediately under general anaesthesia.
Indications of surgery included: displacement of fractures, Roof-arc angle less than 45 degrees on anteroposterior (AP) and oblique radiographs, Irreducible fracture-dislocation, hip loss of congruence of the femoral head with the acetabulum on any of the three plain radiographic views, posterior wall fracture with associated demonstrated hip instability (size of posterior wall fragment <50%). An incarcerated osteochondral fragment with a nonconcentric reduction of the femoral head and Some polytrauma patient with an acetabular fracture that needs to be mobilized early. All patients received DVT prophylaxis by 40 L.U. of Clexane to be stopped 12 hours before surgery and then continued for 2 weeks after surgery. Prophylactic broad spectrum antibiotic was given at night of surgery and preoperatively and urethral catheter was introduced before surgery in all patients.

Surgical techniques:

Planning of the approach to be used and methods of reduction and fixation were done based on specific fracture patterns and displacement. In our study, we used 4 types of surgical approaches which include (Kocher-Langenbeck approach, the Ilio-inguinal approach, the anterior intra-pelvic (modified Stoppa) approach (AIP) and combined approach (Kocher-Langenbeck with ilio-inguinal approach). 37 (74%) patients were operated through Kocher-Langenbeck approach, in this group 3 patients needed trochantric osteotomy modification of the approach. 7 (14%) patients were operated through the ilio-inguinal approach. 4 (8%) patients were operated through modified Stoppa approach, combined approach (Kocher-Langenbeck with ilio-inguinal approach) was used in 2 (4%) patients only. Kocher-Langenbeck approach was used for 11 Transverse and posterior wall fractures, 10 Posterior column and posterior wall fractures, 9 T-shaped fractures and 7 both column fractures. Trochantric osteotomy was needed in 1 T-shaped fracture and 2 both column fractures. The modified Stoppa approach was used in 4 both column fractures. The surgical incision begins 2 cm superior to the symphysis pubis in a transverse fashion with the length extending approximately from the ipsilateral external inguinal ring to the contralateral external ring. The rectus abdominus muscle is split vertically from inferior to superior with care taken to stay extraperitoneal in the proximal portion, Protecting the bladder, the rectus is retracted superiorly, with sharp dissection used to elevate the rectus to expose the symphysis body and superior pubic ramus. The rectus and neurovascular structures next are retracted laterally and anteriorly to protect them. The remainder of the surgical procedure is performed beneath the iliac vessels, femoral nerve, and psoas muscle. A plethora of vascular anastomoses are often encountered, the majority being communications of the inferior epigastric and obturator vessels Anastomoses of the external iliac extending to the bladder and multiple nutrient vessels also are common. These are ligated as necessary with suture ligation or vascular clips. As with the ilioinguinal approach, this portion of the exposure places vascular structures at risk, particularly if a "corona mortis" is present. The initial vascular obstruction is an anastomotic branch between the inferior epigastric and the obturator vessel. This is always present but variable in size. Another common obstacle is the nutrient vessel branch from the iliolumbar artery, which is often severed by the fracture or torn during elevation of the iliacus. Prior to elevation of the posterior iliacus, this vessel should be clipped to avoid excessive hemorrhage. Large lymph nodes also may need to be retracted or excised as necessary to improve visualization. Despite these structures, appropriate placement of retractors provides adequate exposure (5). For fractures with a high anterior column component (exiting the iliac crest) or those requiring placement of posterior column lag screws, a second incision exposing a lateral window along the iliac crest is used to facilitate reduction and placement of fixation. A second incision is made starting 1 to 2 cm beyond the anterior superior iliac spine along the crest posteriorly. The insertion of the external oblique muscle is released permitting dissection over the crest into the internal iliac fossa where the iliacus muscle is elevated subperiosteally to the pelvic brim and anterior aspect of the sacroiliac joint (5).
The ilioinguinal approach which was delayed by 11 days due to anterior thigh Morel lavalle lesion. The combined approach was also used for 1 both column fracture with ilioinguinal approach done first then Kocher-Langenbeck approach was done 1 week later with cannulated screws to fix fracture sacrum. The most commonly used implant was the 4.5 mm reconstruction plates (standard and low profile) and 4.5 mm cortical screws with or without interfragmentary screw. It was stronger with better purchase of screws decreasing incidence of implant failure. The 3.5 mm reconstruction plates with 3.5 screws used alone in 2 cases (1 transverse and posterior wall fracture and 1 both column fracture) and in combination with 4.5 mm plate in to fix the iliac wing 2 cases (1 T shaped fracture and 1 both column fracture). 1/3 tubular plate was used as spring plate buttressing comminuted posterior wall fracture, in 1 T shaped fracture and posterior wall fracture, posterior antegrade column screw (<90mm long 4.5 cortical screw) applied from proximal to distal in the body of the posterior column starting in the iliac fossa anterior to sacroiliac joint aiming for ischial spine reaching the ischium or the ischial spine(6), through or outside the plate used for anterior fixation through one of anterior approaches. The posterior antegrade column screw was used in 3 both column fractures (in 2 cases with modified Stoppa approach and in 1 case with ilioinguinal approach).

Figure(1): Intraoperative footage showing the access after modified Stoppa incision

Figure(2): Intraoperative footage in the same case showing fixation of the fracture at pubis (view from surgeons position)

Figure(3): Intraoperative footage in the same case showing fixation of the fracture at the ilium

Figure (4) landmarks of antegrade posterior column lag screws

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Postoperative management included closed suction surgical drains were used routinely for 24-72 hours. Prophylactic parenteral broad spectrum antibiotics were used for 1 week, then oral antibiotics for 2 weeks. Indomethacin (25 mg three times daily begun within twenty-four hours of surgery and continued for six weeks postoperatively) was used for prophylaxis against heterotopic ossification. Few cases did not tolerate indomethacin due to GIT upset. Subcutaneous single injection of low-molecular-weight heparin preparations (Clexane 40IU) were used for prophylaxis against DVT which started 12 hours postoperatively lasting for at least 2 weeks. Postoperative x-rays (AP view of the pelvis, obturator view and iliac view) were done in addition to postoperative CT in some cases. These postoperative radiographs were used to assess reduction, degrees of displacement, quality of fixation and the presence of joint penetration. Postoperatively, the patients were mobilized and moved in bed as soon as pain tolerated. They subsequently began physical therapy for muscle-strengthening and gradually active range-of-motion exercises. Those patients who could use axillary crutches were allowed to move without weight bearing which was delayed in all cases for 3 months. After 3 months gradual weight bearing was allowed. However, progression to full weight-bearing was individualized. Physical therapy was continued until maximum possible muscle strength and a range of motion were regained.

After discharge from the hospital, routine follow-up evaluation (including clinical and radiographs of the pelvis) was scheduled at two weeks, six weeks, three months, six months, ninth months and one year and annually thereafter. Most patients did not return for all of these scheduled visits, but all were seen at the final interval and the data from that examination were used for this study. Data including all complications, were recorded at each visit, the last of which provided the information used for this study. The longest follow-up period was 26 months and the shortest was 12 months with a mean of 12.6 months. The plain radiographs made after surgery were reviewed to assess fracture reduction (degrees of displacement), according to Matta et al. (1986)'s criteria which was graded as anatomic (0 to 1 mm of displacement), satisfactory (2 to 3 mm of displacement), or unsatisfactory (>3 mm of displacement). The followup radiographs were examined for loss of reduction, fracture union, implant failure, heterotopic ossification (HO), avascular necrosis of the femoral head, arthritic changes e.g. osteophytes, sclerosis and narrowing of the joint space compared with the contralateral hip. The clinical grade was based on a modification of the system of Merle d'Aubigné and Postel (Matta, 1996). This is a validated clinical grading system in which pain, walking and range of movement are assigned a maximum individual score of six points. The three individual scores are summed to derive the final clinical score, according to which the clinical result is classified as excellent (18 points), good (15, 16, or 17), fair (13 or 14), or poor (<13). The modification involves a more strict grading of the score for the range of motion of the hip, which is determined by comparison of the total score for the injured side with that for the uninjured side.

**Statistical analysis:**

Statistical analysis of the data was performed by an independent biostatistician who was not directly involved with the study. Data collected throughout history, clinical and radiological evaluation, preoperative data, intraoperative data complications and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis. According to the type of data, the following tests were used to test differences for significance; Differences between frequencies (qualitative variables) and percentages in groups were compared by Chi-square test. Differences between means (quantitative variables) in two parametric group by t test and multiple parametric quantitative by ANOVA test. Correlation test by pearson correlation. P value was set at <0.05 for significant results & <0.001 for high significant result.
Results:

In this study 50 patients with 50 acetabular fractures (both-column fractures, Transverse and posterior wall fractures, Posterior column and posterior wall fractures and T-shaped fractures) were available for clinical and radiological follow up (12-26 months). All of this study patients were allowed to be out of traction immediate post operative and sitting second day post operative and full weight bearing allowed 3 months post operative. Time interval till operation in all patients was less than 21 days, operative time was 120 minutes to 300 minutes, blood loss ranged from 500 to 2800 ml. The achieved reduction was assessed by measurements of the remaining articular displacement on A.P and oblique radiographic views of the pelvis according to the Matta's criteria (1986) (8). Anatomical reduction found in 15 cases, satisfactory in 26 cases and unsatisfactory in 9 cases.

Patients of this study were subjected to clinical examination to assess the hip function achieved at the last follow up visit, which is based on Modified Merle d'Aubigné and Postel score.

The final clinical assessments of (50) patients is excellent results in 9 cases, good in 27 cases, fair in 5 cases and poor in 9 cases. Statistically, \(X^2 = 32.2\) \(P = 0.00\) There was significant association between clinical result and radiological reductions. The fifty patients were classified according to Letournel and Judet classification into groups and assessment of the clinical results of each group was done as shown in figure (5) to determine the prognostic value of the fracture type. In this study, best clinical results occurred in (Transverse and posterior wall fracture) with 12 satisfactory clinical results (5 excellent + 7 good) out of 13 patients. The worst clinical results occurred in both column fractures with 7 unsatisfactory clinical results (4 fair + 3 poor) out of 17 patients. Yet, Statistically, \(X^2 = 14.8\) \(P = 0.09\) Showing that there was no significant association between type of fracture and clinical result.

Significant association between type of fracture and radiological result was shown statistically \((X^2 = 13.5, P = 0.03)\) as about half of anatomical results were in Transverse and posterior wall fracture group while unsatisfactory results (9) were (4) in Both column fracture group and (5) in T fracture.

![Figure(5): Fracture types and clinical results](image)

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Thirteen patients had preoperative complications of the fracture (26%). 10 cases had hip fracture dislocation (7 posterior dislocation and 3 central) representing 20% All were reduced immediately under general anaesthesia. 6 cases had preoperative sciatic palsy 1 case (2%) had subcutaneous dissecting haematoma (Morel Lavalle injury)(10) in front of the thigh. Intraoperative complications occurred In one both column fracture while working on the fracture through anterior ilio-inguinal approach , injury of both external iliac vein and artery occurred which led to severe bleeding requiring compression , urgent vascular surgeon intervention and repair and 1500 ml blood transfusion, and we were able to reduce and fix the fracture. The patient was stable postoperatively and had no consequences from that incident throughout the followup. Early postoperative reviewing of cases showed that Some patients had more than one postoperative complication.

We had 18 patients with early postoperative complications (36%) 13 cases had infection (26%) (11 superficial infections responded to repeated drainage, dressing and antibiotics according to culture and sensitivity and 2 deep infections both required debridment intraoperatively and antibiotics according to culture and sensitivity, one of them responded well and infection subsided, the other failed to responded and implants were removed requiring later arthrodesis hip). There was 4 cases of postoperative sciatic nerve palsy (8%) , 2 recovered completely and the other 2 cases show no recovery. 2 cases had lateral cutaneous nerve palsy (4%), 1 case improved partially the other one did not . There was 1 case with wound complication (angle necrosis) (2%) ( at the connection between Kocher-langenbeck incision and iliac incision to reduce iliatic wing fracture). It required debridment of necrotic tissue and repeated dressing and it healed by scar tissue. We had 1 case with pulmonary embolism 6 weeks postoperative, necessitating his admission to intensive care unit, and urgent medication and thrombolytic drugs. This case responded well to treatment and continued his follow up with pulmonary embolism prophylaxis medication. Twelve patients (24%) had late postoperative complication, while 38 patients (76%) did not have such complications Some patients had more than one complication but each complication was considered separately. Those 2 cases with avascular necrosis acetabulum and 3 cases with avascular necrosis femoral head (2 of them developed Osteoarthritis ) , all required total hip replacement. 1 patient had late infection with intermittent draining sinus required removal of implants after union is achieved but patient refused further surgical intervention. The 2 Heterotrophic ossification cases were grade 1 and 2 and needed no intervention. shows the association between clinical results and late postoperative complications. Statistically, $X^2 = 21.3$ $P = 0.00$ showing significant association between clinical result and late complication as poor results associated more with complication.

Modified Stoppa approach was performed in 4 patients( 8% of study size) All of them were both column fractures (23,5% of both column fractures). They were 3 males and 1 female .Their age ranged from 21 years old to 45 years old. The mechanism of injury in 2 cases was car accident the other 2 was motorcycle accident. 3 of them had associated injuries (internal haemorrhage, fracture both bone leg , fracture sacrum). The lag time till operation ranged from 5 days to 9 days. Operative time ranged from 3 to 4,5 hours . blood loss ranged from 600 ml to 900ml . No blood transfusion was needed . Fixation was don through low profile 4,5 mm reconstruction plate in all 4 cases in addition to 4,5 mm antegrade posterior column screw in 2 cases .There were no preoperative or intraoperative complications . Early postoperative complications were superficial infection in 2 cases (responded well to repeated drainage , dressing and antibiotics according to culture and sensitivity) and one postoperative sciatic palsy which did not improve . There was no late postoperative complications(AVN acetabulum or head femur , heterotropic ossification or arthritis). These cases were the first to be done in Zagazig university hospitals and in order to formulate the previous data into valuable information , This should be done in comparison with another well established anterior approach (ilio-inguinal approach which is well known with much longer learning curve and both share the same indications (type of fractures)
as the ilioinguinal approach was also included in this study. In 7 cases we used the ilioinguinal approach. There was no statistical significance concerning (type of the fracture, reduction achieved, clinical scoring and complications). The only significance appeared in the clinical score means as Modified Stoppa approach has higher scores P= 0.03.

Antegrade posterior column screw was performed in 3 patients (6% of study size). All of them were both column fractures (17.6% of both column fractures). They were 2 males and 1 female. Their age ranged from 21 years old to 28 years old. The mechanism of injury in 1 cases was car accident, 1 case was motorcycle accident and 1 case fall from height. 2 of them had associated injuries (fracture both bone leg and fracture medial malleolus). The lag time till operation ranged from 5 days to 6 days. Operative time ranged from 3 to 4.5 hours. Blood loss ranged from 600 ml to 900 ml. No blood transfusion was needed. Fixation was done through low profile 4.5 mm reconstruction plate in all 3 cases in addition to 4.5 mm antegrade posterior column screw in all 3 cases. They were operated through modified Stoppa approach in 2 cases and through the ilio-inguinal approach in 1 case. There were no preoperative or intraoperative complications. Early postoperative complications were superficial infection in 1 cases (responded well to repeated drainage, dressing and antibiotics according to culture and sensitivity) and one postoperative sciatic palsy which did not improve.

There was no late postoperative complications (AVN acetabulum or head femur, heterotropic ossification or arthritis). Evaluation of antegrade posterior column screw was done through comparing cases fixed by it (3 cases, 17.6% of both column fractures) and those cases where fixation did not include this screw (14 cases 82.4% of both column fractures). There was no statistical significance concerning type of the fracture, reduction achieved, clinical scoring or complications. The only significance appeared in the clinical score means as column screw group has higher scores P= 0.03.

Cases: Case 43: Female patient, 26 years old, housewife. Car accident Right both column fracture acetabulum (associated with ipsilateral fracture both bone leg fixed by interlocking nail tibia 1st) Open reduction and internal fixation of the both column fracture acetabulum was done 6 days postinjury. Using the modified Stoppa approach, operative time was 3 hours, blood loss was 600 ml and no blood transfusion was needed. Fixation of the iliac part of the fracture was done through 1 (4.5mm) reconstruction plate and 1 malleolar screw and anterior column fracture fixed by another (4.5mm) reconstruction plate while posterior column was fixed by one long antegrade posterior column screw. Reduction was satisfactory and clinical scoring was 17 good.

Figure (7): both column fracture xray and 3 D CT
Case 50: Male patient, 35 years old, driver. car accident, Left Posterior column and posterior wall fracture dislocation (reduced on urgent basis) with marginal impaction (not associated with any other skeletal or extra skeletal injuries). Operative management was carried out after five days, operative time was 2 hours through Posterior Kocher-Langenbeck approach, bone graft from greater trochanter to support marginal impaction after its reduction. Reduction of the fracture was done and fixation was done by low profile 4.5 mm reconstruction plate after fixing posterior wall by 1 interfragmentary screw. Blood loss was about 600 ml and no blood transfusion was needed. Reduction achieved was anatomical, and clinical scoring was (17) good.
Discussion:

Surgical intervention with open reduction and internal fixation (ORIF) is the treatment of choice for displaced acetabular fractures. Conservative treatment leads to an unacceptably high frequency of secondary arthritis. (11) The operative treatment of complex acetabular fractures is often difficult and technically demanding. The goal of operative treatment is to preserve a functional, mobile, painless hip joint that continues to function for the rest of the patient's life through achieving anatomic restoration of the articular surface, a stable and congruent hip joint, preventing posttraumatic osteoarthritis, preserving a good bone stock for possible future salvage surgery and to allow early mobilization without endangering fracture stability. (3) Our study was carried out from 2011 till 2014, 50 patients were available. The higher incidence among males than females attributed to the cause of injury being the result of excessive vigorous trauma such as car accidents (in this study the main mechanism of injury (56%) which is more often related to occupation and activities of young males. This matched other comparative studies. (9) (12) In our study, The youngest patients were 21 years old, and the oldest was 58 years old, with a mean (32.9) years. Geriatric age group (< 60 years old) was excluded from this study as there is growing direction in the literatures to deal with this group as individual entity with specific recommendations and preferences regarding treatment options e.g. early total hip arthroplasty and locked plates.

The importance of that time frame has been well documented in the literature by various authors (2), (8), (10); operative treatment may achieve greater than 80% good to excellent results if fixation occurs within three weeks from injury. As the time from injury to reduction and stabilization increases beyond 21 days, definite changes occur in the surrounding soft tissue envelope, scar tissue formation increase between bony fragments and the resorption of acute fracture lines becomes prevalent. The fracture surface remodel and loss their anatomic fit and fracture gaps fill with maturing fibrous tissue and callus formation. The muscles attached to individual fragments shorten because of loss of counter balancing force attainable only when the fragments are reduced in their anatomic position. These factors result in a more difficult situation for exposure, reduction, and stabilization which decrease the long term results. In this study all patients were operated within three weeks. Reduction achieved in this study included 15 patients (30%) had anatomical reductions, 26 patients had satisfactory reductions (52%) and 9 patients had unsatisfactory reductions (18%). There were no cases with surgical secondary congruence. Reduction achieved in comparative studies is shown in table(1) according to Matta et al. (1986) (8).

<table>
<thead>
<tr>
<th>Author</th>
<th>Anatomic ≤1mm</th>
<th>Satisfactory 2-3mm</th>
<th>Unsatisfactory &gt;3mm</th>
<th>Surgical 2ndry congruence</th>
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<td>71%</td>
<td>20%</td>
<td>7%</td>
<td>2%</td>
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<tr>
<td>Giordano V, et al.2007(14)</td>
<td>74%</td>
<td>16%</td>
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<tr>
<td>Andersen et al (2010) (13)</td>
<td>82%</td>
<td>18%</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Sagi et al 2010(5)</td>
<td>49%</td>
<td>41%</td>
<td>10%</td>
<td>-----</td>
</tr>
<tr>
<td>This study</td>
<td>30%</td>
<td>52%</td>
<td>18%</td>
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</tbody>
</table>

Table (1): Reduction achieved in comparative studies.
Giannoudis et al (2005) recorded the postoperative reduction as being satisfactory, with less than 2 mm of displacement, in 85.6% of fractures. However, in (14.4%) the post-operative displacement was more than 2 mm indicating an unsatisfactory reduction.

Letournel E and Judet R. (1993) (1): defined anatomic perfect reduction as the complete restoration of roentgenographic landmarks on the three standard Judet roentgenograms (anteropostenor, iliac oblique, and obturator oblique views). Imperfect reductions, as seen on these roentgenograms, included loss of landmark reconstruction, technical failures, head root incongruency. loss of paralism of upper joint space, central femoral head protrusion and secondary congruence of the fracture fragments around the femoral head. Their clinical results of operations within three weeks were perfect in 69% cases and imperfect in 31%.

Mears et al (2003)(15) showed in his study of 424 fractures treated by operation, that simple fractures were reduced anatomically in 87% of patients, whereas associated fractures could be reduced anatomically in only 59%.

Matta(1996)(9) had similar results, achieving anatomical reduction in 96% of simple fractures and only 64% of associated fractures. Both Matta and Mears had the same conclusion.

In this study, unsatisfactory reduction percentage is higher than other studies . This is because each of these studies compared to our study was done by pioneer s in ace tabular surgery and most unsatisfactory reductions were at the beginning of our work and are due to our evolving learning curve, also our study was exclusive only for associated patterns lacking the easier and better reduction outcome of simple patterns. Patients of this study were subjected to clinical examination to assess the hip function achieved at the last follow up visit , which is based on Modified Merle d'Aubigné and Postel score. The final clinical assessments of (50) patients is shows excellent clinical results in 9 patients(18%) , good clinical results in 27 patients (54%) , fair results in 5 patients (10%) and poor in 9 patients (18%). We couldn’t associate type of fracture and clinical result through statistics (non significant association) this may be due to the few number of cases in some fractures and variability of approaches in management .Table (2) Compared clinical results in this study with other studies.

<table>
<thead>
<tr>
<th>Author</th>
<th>Excellent (18)</th>
<th>Good (17-16-15)</th>
<th>Fair (13-14)</th>
<th>Poor &lt;13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matta, 1996 (8)</td>
<td>40%</td>
<td>36%</td>
<td>8%</td>
<td>16%</td>
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<td>Giannoudis et al ,2005(12)</td>
<td>50.3%</td>
<td>29.1%</td>
<td>8.6%</td>
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<tr>
<td>Giordano V, et al.2007(14)</td>
<td>17.2%</td>
<td>62%</td>
<td>12%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Andersen et al (2010) (13)</td>
<td>39%</td>
<td>41%</td>
<td>11%</td>
<td>9%</td>
</tr>
<tr>
<td>Sagi et al 2010(5)</td>
<td>36%</td>
<td>55%</td>
<td>----</td>
<td>10%</td>
</tr>
<tr>
<td>This study</td>
<td>18%</td>
<td>54%</td>
<td>10%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Table (2): Compared clinical results in this study with other studies
The percentage of unsatisfactory (fair and poor) clinical results is somewhat higher than comparative studies due to previously mentioned causes in the quality of reduction, also this study was exclusive only for associated patterns lacking the better outcome of simple patterns. In our study, All Transverse and posterior wall fracture had satisfactory reduction (54% anatomical and 46% satisfactory) and best clinical results with 12 satisfactory clinical results (5 excellent + 7 good) out of 13 patients (92%), and this may be due to that column displacement was not sever and easily reducible in many cases in addition to usage of non extensile single posterior approach with much lower morbidity. All Posterior column and posterior wall fracture had satisfactory reduction (50% anatomical and 50% satisfactory) and 80% satisfactory clinical results (20% excellent and 60% good).

T fracture had the worst reductions with only 50% satisfactory reductions (10% anatomical and 40% satisfactory) and 60% satisfactory (good) clinical results. T fractures had 3 parts with 2 parts which are mobile and difficult to control simultaneously leading to inadequate appreciation of the displacement intraoperative which may be minimized or obscured by hardware and accepting of seemingly satisfactory reduction but in fact it is not acceptable due to complex 3-dimension anatomy of acetabulum that can be overlooked on C-arm radiographs. Both column fractures had 76% satisfactory reductions (11% anatomical and 65% satisfactory)

The worst clinical results occurred in both column fractures with 7 unsatisfactory clinical results (4 fair + 3 poor) out of 17 patients (41.2%), this may be attributed to high energy trauma, sever displacement anterior and posterior dictating the approach to be used and associated pelvic injuries. In both column fractures we follow sequential indirect reduction starting at the ilium so accepting minor displacements at iliac parts of the fractures may end by major displacements at main fracture site. This is why seeking new trends in this study was a target (modified Stoppa approach and antegrade posterior column screw) to achieve satisfactory reduction and clinical results while avoiding the morbidity and mortality of extesile approaches or double approaches by allowing total reduction and fixation through single approach (antegrade posterior column screw) and moving toward less invasive approach (modified Stoppa approach).

We assessed relationship between different types of fractures and reduction achieved in each one. Statistically, $X^2 = 13.5$, $P = 0.03$ showing significant association between type of fracture and radiological result as about half of anatomical results were in Transverse and posterior wall fracture group while unsatisfactory results (9) were (4) in both column fracture group and (5) in T fracture. Mears et al (2003) and Matta (1996) had the same conclusion that we had about both column and T-type fractures showing the least accuracy of reduction and less favourable outcome.

In this study, 13 patients had preoperative complication of the fracture (26%). Some patients had more than one complication. 10 cases had hip fracture dislocation (7 posterior dislocation and 3 central) representing 20% All were reduced immediately under general anaesthesia. 6 cases had preoperative sciatic palsy (4 of them were combined with hip dislocation) representing 12%; 4 recovered completely but 2 did not improve at all 1 case (2%) had subcutaneous dissecting haematoma (Morel Lavalle injury) in front of the thigh which was managed in the operating theatre by percutaneous drainage, irrigation, suction drain was placed and tight bandage.

In one patient with both column fracture (2% of the study) while working on the fracture through anterior ilio-inguinal approach injury of both external iliac vein and artery occurred which led to severe bleeding requiring compression, urgent vascular surgeon intervention and repair and 1500ml blood transfusion, and we were able to reduce and fix the fracture. The patient was stable postoperatively and had no consequences from that incident throughout the follow up. Giordano V, et al. 2007 had a 2.4% incidence of intraoperative vascular lesions (one external iliac artery and one external iliac vein).
Comparing early complications in this study and comparative studies showed much higher incidence of infection more than any other study. It is very clear specially in early cases with longer surgical intervention time and those cases that had associated injuries to be managed with fracture acetabulum. We also had experienced this problem while using non disposable drapes and gowns early in the study besides the fair sterilization system that was used early in the study in Zagazig university hospitals. After using disposable drapes and gowns and improving the sterilization system by adding new automated machineries to the system and infection control section incorporated , this problem is tapering but much more efforts are yet to be done to eradicate the problem including shifting to modern systems of sterilization , providing professional and devoted nursing teams, better equipments and tables, keeping intraoperative discipline and regulations, professional planning of the intended surgery and performing acetabular surgeries only by experienced surgeons with consistent protocols to avoid prolonged surgery time.

In this study, 4 cases were approached through Modified Stoppa approach, they were the first to be done in Zagazig university hospitals. These 4 cases make tiny number to perform a conclusive study so they were included as part of this study as a less invasive new trend in Zagazig university avoiding morbidities of the ilioguinal approach that we encountered, clearing the way for further studies which include Stoppa approach evaluation in larger numbers and comparing it to the ilioguinal approach. Antegrade posterior column screw usage in part of our study open the way for further and larger studies in this regard, and as part of column screw concept it can revolutionize our practice as our learning curve grows.

**Conclusion:** Operative treatment of Associated patterns of acetabular fractures is an effective method for the management of displaced acetabular fractures. Clinical and radiological results correlate closely specially with an anatomic reductions. Both modified Stoppa approach and Antegrade posterior column screw need further evaluations in future studies as they are promising tools with large potential benifits in surgical treatment of fractures acetabulum.

**References**


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المعالجة الجراحية للانماط المرتبطة لكسر الحق الحرقفي مع الاتجاهات الحديثة
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خلال الفترة ما بين يناير 2011 و يناير 2014 أجريت هذه الدراسة لتقديم المعالجة الجراحية للانماط المرتبطة لكسر الحق الحرقفي مع الاتجاهات الحديثة في العلاج الجراحي في مستشفيات جامعة الزقاقيق، حيث كان عدد المرضى (78٪ ذكور و 22٪ إناث و أعمارهم تتراوح بين 21- 85 سنة) عناصر بحث لهذه الدراسة. وقد كانت فترة المتابعة لنصيب عن العام واحد حيث تم تقييم المريض الاكلينيكي والباشره. وقد اعتمدنا في هذه الدراسة بالإضافة إلى الأساليب القياسية من المعالجة الجراحية للمرض المفتوح والتمثيل الداخلي (اقتراب سويا العبد) كاتجا جراح في طريق الاقتراب الجراحي في بعض المرضى (مسمار العمود الخلفي الاصطناعي)، كاتجا جراح في طريق التشريحة في مرضى آخرين. وكانت انماط الكسور المعالجة جراحيا في هذه الدراسة كالآتي: 17 كسر للعمودين الأمامي والخلفي ، 13 كسر مستعرض مع كسر الجدار الخلفي ، و 10 كسور للعمود الخلفي والجدار الخلفي و 1 كسور على شكل حرف (T).

الهدف من البحث : تقييم النتائج الاكلينيكي لطرق العلاج الجراحية للانماط المرتبطة لكسر الحق الحرقفي والاتجاهات الحديثة في العلاج.

• مقاييس إثبات الحالة في عينة البحث : الحالات التي تعاني من كسر الحق الحرقفي من الانماط المرتبطة التي تتضمن (الكسور على شكل حرف T، كسر العمود مع الجدار الخلفي، كسر العرضي مع الجدار الخلفي، كسر بالعمود أو الجدار الأمامي مع كسر عرضي، كسر عرضي، كسر العمودين الأمامي والخلفي) والتي تحتاج إلى تدخل جراحي في الشريحة العضوية من 20 إلى 60 عام.

• مقاييس لاستخدام الحالات في عينة البحث : وجود بور صيدلية أو الحالات التي تعاني من فقدان للأنسجة الرخوة عند موضعي الاقتراب.

• النتائج والمضاعفات: تم تقييم رد الكسر بواسطة الاشعة لجميع الحالات وفقاً لمعايير ماتا (1986) وكانت نتيجة التقييم: 15 حالة (30٪) رد تشريحياً، 26 حالة (52٪) رد مرضياً و 9 حالات (18٪) رد احتمالياً. وتم عمل التقييم الاكلينيكي لخمسين مريض على أساس مقياس ميرل دي أوبونيه ويوستيل بنتيجة 4 حالات (8٪) ممتازة، 27 حالة (54٪) جيدة، 5 حالات (10٪) ضعيفة و 9 حالات (18٪) شديدة. وتشمل المضاعفات إصابات الأوعية الحرقافية الخارجية في حالة واحدة، 13 حالة انتفاخ صدغي سطحي، 4 حالات شلل العصب الوركي بعد العملية، وموت لا دومي (بالحق أو رأس عظام الفخذ) في 5 حالات وتعرض لظاهرة في حالات. كان هناك ارتباط كبير بين النتيجة الاكلينيكي ونتيجة تقييم رد الكسر بواسطة الامامه، كما ارتبط من النتائج الاكلينيكي والمضاعفات المتاخرة حيث ان النتيجة السينية ترتبط بالمضاعفات.

• الملاحظات والاستنتاج: المعالجة الجراحية للانماط المرتبطة لكسر الحق الحرقفي وسيلة فعالة وضرورية من وسائل العلاج حيث ان هناك ارتباط كبير بين النتيجة الاكلينيكي ونتيجة تقييم رد الكسر جراحياً. ويعتبر الاقتراب سويا المعالج و مسار عمود الخلفي الاصطناعي من الاتجاهات الحديثة التي تحتاج إلى مزيد من التطبيق والتقييم حيث أنهما من الوسائل الواضحة في العلاج.

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