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FIXATION OF ACETABULAR (ANTERIOR RIM, QUADRILATERAL PLATE) FRACTURES WITH MODIFIED STOPPAA APPROACH “OPTIMUM APPROACH”

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Abstract

Introduction: Pelvis is important bony structure of body that provide main weight bearing surface for the hip joint in form of acetabulum, with the advancement of the high speed transportations, pelvic trauma has been raised in numbers so as acetabular fractures. Stable acetabular fractures fixation with accurate anatomic reduction always has been a big challenge for orthopaedic surgeons. Acetabular fractures fixation has risen step ahead after evolution of modified stoppa approach, as this approach allow minimum soft tissue handling, easy accessibility and provide adequate exposure to intrapelvic structures. Recently modified stoppa approach has evolved as primary approach for acetabular fractures fixation.

AIM: To perform acetabulum fracture fixation through an optimum surgical exposure “modified stoppa approach”

Materials And Method: this study conducted on 20 patients who presented with acetabular fractures after an RTA or fall from height or due to other various cause. Fracture fixation done through modified stoppa approach for those who met in our inclusion criteria ,to provide pelvic and hip joint stability. Patients demographics, location, duration from injury to surgical interventions, duration of hospital stay, if any complication occurred during surgery were recorded.

Result: Out of total 20 patients 17 were male and 3 patients were female, average age 39year[Range from 18 to 60 yr], 12 patients having isolated unilateral acetabulum fracture present, 2 having bilateral acetabular fracture and 4 having associated pelvic bone fracture along with unilateral acetabulum fracture, 2 patients having long bone of lower limb fracture along with acetabular injury. All the fixation done through modified stoppa approach. Intraoperatively in all the patients easy accessibility and wide exposure obtain for intrapelvic structures. All the neurovascular structures easily identified and protected over the surgical site. Intraoperatively no clinical and radiological complication were observed in all patients. Post operatively

all the patients were able to bear weight, within the 12±4 week,.

Conclusion: We got a conclusion that the modified stoppa approach is anterior intrapelvic approach which provides an excellent view to the acetabular[anterior column, quadrilateral plate, posterior hemitransverse] and other intrapelvic structures, with minimal soft tissue handling, easy accessibility to preserve neurovascular structures. This approach provides direct access to the pubis, the posterior surface of the ramus, the quadrilateral surface, the pubic eminence, and the infrapectineal surface, as well as the sciatic buttress, sciatic notch, and the anterior sacroiliac joint. It can be used in most of the acetabular fractures fixation, the only downside is being the steep learning curve and familiarity of the structures while addressing these fractures.

Keywords: Acetabulum, Acetabular fracture, Modified stoppa approach, quadrilateral plate.

Introduction:

Acetabular fracture is an intra-articular fracture of the most important weight-bearing joint, the hip joint, and in order to obtain optimal results, accurate anatomic reduction, firm fixation, and early rehabilitation are essential¹⁻³. However, the treatment of acetabular fractures is quite difficult not only due to the associated major organ injuries but also due to the complicated fracture type and difficulties in the operative approach for reduction. Marked progress has been made after a systematic approach and treatment algorithm were proposed by Judet et al⁴ and Letournel and Judet⁵ in the 1960s.

After the efficient work done by Letournel the surgical method of treatment has become gold standard for difficult acetabulum fractures^{6,7,8,9,10}. Surgical planning for acetabular fractures fixation entails fracture classification and ideal surgical approach. The ideal surgical approach is based on pattern of acetabular fractures, direction of displacement, skin condition over wound and incision area, and time duration since injury^{9,11}.

Fracture patterns involving medial displacement, particularly of the quadrilateral plate of the acetabulum, are technically challenging, due to the fracture's location in the true pelvis, the limited bone stock, and the fracture's proximity to the articular surface of the hip joint^{9,12,13,14}.

Different approaches for pelvic fracture fixation has been advocated in the literature and include the Kocher–Langenbeck, iliofemoral, ilioinguinal, combined anterior and posterior approaches, extended iliofemoral, transtrochanteric, and triradiate approaches^{7,15,16,17,18,19,20,21,22,23,24}. These approaches gives limited exposure of

particular pelvic and acetabular region.

Thus the use of an intrapelvic approach assures adequate exposure of the pelvic ring, thereby giving the appropriate exposure for the reduction of the anterior wall and column fractures, anterior fractures associated with a posterior hemitransverse component, as well as both-column fractures. In addition, for certain fracture patterns, an intrapelvic approach allows for utilization of plating configurations that is not possible with an extrapelvic approach²⁵.

The ilioinguinal, first described by Letournel in 1961, ilioinguinal approach is the only intrapelvic approach of the above mentioned approaches²¹, which gives exposure of the anterior column and part of the wall, and a limited vision of the quadrilateral plate. This approach is advised in all anterior column and wall fractures, associated anterior column and posterior hemi-transverse fractures, selected both-column fractures, transverse and T-fractures. It is also recommended for the restoration of displaced superior rami fractures^{7,8}. The main limitations of ilioinguinal approach is it include lack of direct visualization of the acetabular surface and lack of control in extensively displaced posterior column fractures. The main complications are a high rate of postoperative infections and iatrogenic injury to the iliofemoral blood vessels and the femoral nerve^{11,12,26,27}.

By the evolution of minimally invasive techniques aimed at minimizing surgical dissection, trials have been made to treat pelvic ring/acetabular fractures with an even less extensile approach.

In 1973, first time stoppa described his approach as a subperitoneal

median approach for the treatment of groin hernias.

In 1994, Cole and Bolhofner^{26,28} described the Stoppa approach^{29,30} directing the surgeon to stand at the opposite side of the involved hip joint during reduction and fixation of the acetabular fractures, this approach allow the direct visualization of the medial wall, dome, quadrilateral plate, and extending as far as the sacroiliac joint. Certain limitations that stand during this approach is that it does not enable maneuvering the fractures for anatomical reduction of iliac wing, which is important step in fixation of anterior wall to accomplish this an additional lateral iliac wing window is necessary along with modified stoppa approach.

Jakob et al.³¹ and more recently, Anderson et al.³² described a modified approach using the Stoppa and iliac surgical window for the treatment of acetabular and pelvic ring fractures. This approach became popular over the past decade for anterior column fractures and is suitable for the majority of cases, while providing excellent visualization of and access to the quadrilateral plate and parts of the posterior column^{33,34,35}.

Modified Stoppa approach or The anterior intrapelvic approach for the treatment of pelvic and acetabular fractures has been gaining popularity. This approach is emerges as the rivals of ilioinguinal approach and the workhorse approach for most orthopedic trauma surgeons who want to gain access and adequate exposure to the anterior pelvis and acetabulum. Its advantages include ease of surgical dissection, excellent access to the quadrilateral plate, good visualization of a portion of the posterior column and, when combined with a lateral window, visualization of the entire

anterior column. The modified Stoppa approach can be performed in isolation (without the need for the lateral window) when the iliac wing is not fractured³⁶.

Indication: For The Modified Stoppa Approach

Anterior column fractures:[low, high and intermediate]. Anterior column and posterior hemi-transverse fractures. Transverse fractures with main anterior displacement. T-fracture of the acetabulum as a single or part of a two staged approach Associated both-column fractures.

Tilt fractures of the pelvis. This is the most unusual type of pelvic lateral compression injury. The major problem was reported to be protrusion of the pubic ramus into the perineum.

Contraindication:

Acetabular fractures of posterior wall displacement or comminution of the posterior column.

T-fractures of the acetabulum with main posterior element involvement.

Previous major lower abdominal surgery.

Fractures older than 3 weeks.

Materials And Method:

This study was a prospective study, conducted at tertiary care teaching center at southern part of Rajasthan. During the period of may 2017 to June 2019. The study was done after obtaining approval from institutional research ethics committee. Total 20 patients with acetabular fractures admitted in orthopaedic department who gave consent to participate were enrolled in the study.

Radiographic evaluation included plain antero posterior X ray of the pelvis, oblique Judet views (obturator oblique& iliac oblique) and CT scan

of the pelvis with 3D reconstruction. Fractures were classified based on *Letournel and Judet Classification*.

Inclusion Criteria:

1. Anterior wall.
2. Anterior column.
3. Anterior column and posterior hemitransverse fractures.
4. Both-column fractures in which the anterior displacement was larger than the posterior displacement, bilateral acetabulum fracture).
5. Male and female with age group between 18 to 60 year.

Exclusion Criteria:

1. Open wound over incision site or any skin loss over incision site or any infection in the intrapelvic region.
2. Acetabular fractures with posterior wall displacement or comminution of the posterior column,
3. T-fractures of the acetabulum with main posterior element involvement,
4. Sciatic buttress comminution
5. Fractures greater than 3 weeks of age.
6. Any extension of the fracture to the iliac wing necessitated an additional lateral window.
7. In cases with posterior displacement, an additional approach was utilized to address a posterior wall fractures.
8. Patients with age more than 60 year or less than 18 year male or female.

Preoperative Assessment And Management:

Simple anteroposterior radiographs (fig-1) of the obturator foramen and iliac wing, inlet-outlet views of the pelvis, and computed tomography

(CT) images were obtain.

Skeletal traction was applied prior to surgery to all acetabular fracture patients to reduce pain and to maintain reduction. Surgery was performed within a week of admission. Preoperatively, systemic conditions and accompanying injuries in the patients were evaluated sufficiently. Surgical indication was displaced fractures through the weight-bearing surface. More specifically the operation was performed in cases with free fragment (s) within the joint space, the roof arc angle less than 45°, and displacement more than 2 mm.



Surgical Technique:

Like other surgical approaches, modified stoppa approach is used for the fixation of pelvic ring fractures, it is therefore critical to enhance access to while protecting the critical neurovascular structures to allow clamp placements and insertion of plate and screws. Modified stoppa approach is illustrated step wise :

Step 1:

Patient on supine position on operation table, after all the painting and draping done, ipsilateral limb was draped separately for traction and hip flexion during intraoperative procedure. A Foley catheter must be placed to decompress the bladder to decrease the risk of injury during retraction. A bump is placed under the knee in order to flex the thigh and relax the iliopsoas muscle and the femoral vessels, The surgeon performed the

operation on the contralateral side of the injured acetabulum. After giving an incision marking (fig2), an arc-shaped skin incision of 12–15 cm was made 2 cm proximal to the superior pubic ramus (fig3). The incision was deepened to the abdominal fascia.



Fig -2



Fig -3

Step 2:

The linea alba is split between two heads of the rectus abdominis muscle. This split will be extraperitoneal if it remains within about 10 cm of pubis symphysis.(fig 3) The ipsilateral rectus abdominis insertion onto the superior ramus is then detached to the pubic tubercle (fig 4) to place a hohmann retractor. This dissection greatly improve access to fracture site.

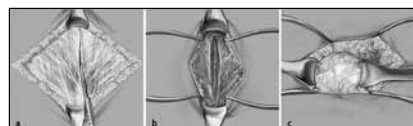


Fig 3 (a, b, c)(The rectus abdominis muscles are split vertically from inferior to superior with care taken to maintain the proximal portion to be extraperitoneal, the split length is required for the amount of retraction needed for the patient's musculature, it could be continued 3–4 cm distal to the umbilicus, the rectus abdominis muscle on the fractured site is then retracted both laterally and anteriorly, The rectus and the femoral neurovascular structures are subsequently retracted laterally and anteriorly so that they are protected)



Fig - 4

Step 3:

After careful exposure of iliopectineal fascia exposure of corona mortis artery, the external iliac vessels and the obturator nerve can be recognized. A wide malleable retractor and lap sponge is placed anterior to the bladder at all times to avoid injury (fig 5)



Corona mortis



Superior pubic ramus

Fig - 5 & Fig - 6

Step 4:

The focus is then directed to the identification and cauterization or ligation of the vascular anastomosis between the external iliac and obturator systems. This may include large veins or a corona mortis artery. These vessels are often found about 4 cm lateral to the midline running along the posterior aspect of the superior pubic ramus. We then move laterally using a Cobb elevator on the pelvic brim to place the iliopectineal fascia under tension. At this time, one must ensure to have placed a sterile bump under the knee to flex the hip and relax the neurovascular structures and iliopsoas muscle that crosses the hip joint anteriorly. With a Cobb elevator protecting the laterally located iliac

vein and artery, a long-handled scalpel is used to incise this fascia (Fig 7) from posterior to anterior following the pelvic brim (fig 8).



Obturator nerve



Pelvic brim

Superior pubic ramus

Fig- 7 & Fig - 8

Step 5:

This step is one of the most critical maneuvers to gain sufficient access to the fracture. Incomplete section of the iliopectineal fascia will make access to the fracture, the ability to reduce the fracture and the placement of hardware extremely challenging. This maneuver allows a second Hohmann retractor to be placed under the iliopectineal fascia (Figure 9) toward the anterior inferior iliac spine.



Posterior column

Fig - 9

Step 6:

This step is not without risk of injury to the neurovascular structures. The third Hohmann retractor goes as far posterior and lateral on the ilium ensuring that the iliac vein and artery are protected. At this point, we place the malleable retractor on the lateral surface of the bladder and apply gentle retraction, which will help visualize the obturator neurovascular structures (Figure 10), which are protected through out the case.

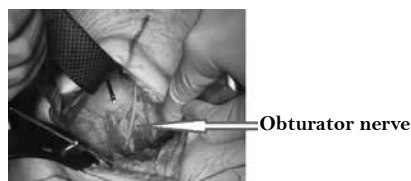


Fig- 10

Step 7:

In this step a retractor placed in the lesser sciatic notch (Figure 11) that will create a good view of the entire quadrilateral plate. The obturator internus muscle must be bluntly detached from its origin on the quadrilateral plate.



Fig- 11

After confirming anatomical reduction of fractured RT acetabulum, reconstruction plate is placed over fracture site (fig 12) and fixation done with screw, assessment of fixation is done by the fluoroscopy (fig 13).

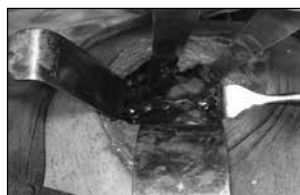


Fig - 12

After confirming fracture reduction and plate position, vascular status were assessed and hemostasis achieved, then closure was performed in layered with aseptic precaution with a negative suction drain in situ. Postoperatively fixation assessment done with radiograph (fig 14).



Fig- 13



Fig- 14

Post operative protocol:

All the patients after acetabular fracture fixation, were encouraged for active/passive hip joint range

of motion. Patients with severe comminution of the acetabulum were subjected to skeletal traction for 1-2 weeks to achieve better stability of fixation and patient were kept non weight bearing for 4-6 weeks, then allowed for partial weight bearing for next 4/6 weeks. Full weight bearing was advised after an average of 12±4 weeks, after radiographic assessment of fracture stability.

Master Chart:

No. of Cases	Sex	Age	Fracture Type	Side	Operative Approach
1	F	34	AC	RT	MSA
2	F	18	AC	LT	MSA
3	M	17	AC+PC	RT	MSA
4	M	39	QP	RT	MSA
5	M	56	PC	RT	MSA
6	M	25	AC	LT+RT	MSA
7	M	26	QP	LT	MSA
8	M	25	AC	RT	MSA
9	M	46	AC	RT	MSA
10	M	23	AC+PC	LT	MSA
11	M	29	PC	RT+LT	MSA
12	M	30	AC+PC	RT	MSA
13	M	60	AC	LT	MSA
14	M	20	QP	RT	MSA
15	F	22	AC+PC	RT	MSA
16	M	44	AC+PC	RT	MSA
17	M	56	PC	LT	MSA
18	M	32	AC	RT	MSA
19	M	40	AC	LT	MSA
20	M	50	QP	RT	MSA

AC: Anterior column, PC: Posterior column, QP: Quadrilateral plate, MSA: modified stoppa approach,

Discussion:

Being a weight bearing area stable surgical fixation of acetabulum is very important. Conservative treatment is a safe, effective and cost-efficient treatment modality in minimally displaced fractures. Surgery provides good to excellent medium term results only if the fracture is reduced anatomically. The

outcome results are influenced by the age of the patient, fracture pattern, associated injuries, delay to surgical fixation, the articular cartilage damage and surgical approach. Anatomical reduction is considered to be the main factor governing the functional outcome of the acetabular fractures. Acetabular fractures fixation is very difficult because of its complicated

anatomical structure and its location is deep in pelvis, and equally difficult to access to the site of the fractures. Proper radiographic evaluation and preoperative planning is necessary for the acetabular fracture fixation. Along with this it is also necessary to explore sufficient surgical field for accurate reduction and fixation of acetabulum, without affecting neurovascular structure around the fracture site.

Better results are obtain for acetabular fracture fixation due to greater evolution of radiographic technology. In particular the restoration of upper weight bearing dome of acetabulum is key to successful treatment. For the acetabular fracture fixation two classical intrapelvic approaches can be used in the form of ilioinguinal approach and modified stoppa approach. In classic ilioinguinal approach an anterior plate is used in majority of cases, extending along the anterior column, however modified stoppa approach gives extended access to quadrilateral plate and posterior column along with anterior column. While the fixation of comminuted acetabular fracture, we found the use of an additional under contoured buttress plate is useful. When applying this plate, special attention should be paid in order not to place the plate over obturator nerve which passes over quadrilateral plate, this should be retracted. Another useful plate is the posterior column plate which may be used in different configurations, depending on the fracture type. Such type of acetabular fracture can be efficiently fix with modified stoppa approach. It gives appropriate exposure to pelvic ring, quadrilateral plate both column and pubic rami with minimal soft tissue disruption and equally safe for neurovascular structure in surgical field.

Conclusion:

Acetabular fractures are complex injuries and should be viewed as an operative problem unless the criteria for nonoperative management are met. The modified Stoppa is a single window approach with excellent intrapelvic view of entire pelvic brim. It allows direct fracture exposure with possible direct reduction of the quadrilateral plate and medial aspect of posterior column, Infra-pectineal plate fixation is possible. The improved visualization provided by this approach facilitates fracture reduction and stabilization. The modified Stoppa approach is less invasive than standard approaches because it does not require surgical dissection of the inguinal canal and femoral neurovascular bundle.

The Anterior intrapelvic approach is a useful tool in the treatment of acetabular and pelvic fractures requiring access from the front. It can be used in isolation or in combination with other approaches to treat these complex injuries.

Familiarity with this approach will allow for a safe procedure and increase the odds of successful reduction and fixation, and ultimately a good outcome. Familiarity with this approach has fostered some new developments, such as laparoscopy assisted reduction of transverse acetabular fractures.

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