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Modified Stoppa approach for treatment of acetabular fractures

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Abstract

Objectives: The purpose of this work was to assess the clinical and imaging outcomes of the modified Stoppa technique for surgical management of acetabular fractures.

Methods: Between September 2019 and November 2021, twenty-one individuals (mean age 39.09 years; range 18–64) who received surgical therapy for acetabular fractures with modified Stoppa participated in the research. The average follow-up period was 12.95 months, with a range of 6 to 24. The data were examined for perioperative difficulties, loss of blood, effectiveness of reductions, fractures patterns, and time to surgery and operation time. There were three levels of reduction quality: poor, imperfect, and anatomic. The functional assessment was done using the Merle d' Aubigne score.

Results: Among the 21 acetabulum fractures, 10 were associated with both columns, 5 were anterior column, 3 were T-type fractures, 2 were transverse and one case was anterior column/posterior hemitransverse. Incisions along the pfannenstiell were utilized in 9 patients and vertical midline incisions in the other twelve. In 18 (85%) of the individuals, supplementary lateral windows were employed, with an average duration until surgery of 7.8 days. The typical loss of blood during surgery was 780 mL, and the procedure took 239 minutes. In 14 (66.6%), 6 (25.8%), and 1 (5%) of the fractures of the acetabulum, respectively, the radiological results were anatomic, satisfactory, and poor. According to Merle D'Aubigne scores, fifteen patients out of 21 (71.4%) regained their pre-injury activity level. Seven participants were excellent while eight participants were good. Four participants were fair while two were poor. The functional result was significantly affected by occupation and time lag. All fractures were seen to be united radiographically by six months after surgery. No cases of redisplacement were detected. no instances of delayed union or nonunion was existed. No Heterotopic ossification was observed. According to Matta scoring, There were seven excellent cases (33.33%), nine good cases (42.8%) two fair cases (9.5%) and three poor cases (14.2%). On studying the complications, we had two cases of vascular complications, one case of sciatic nerve injury and five cases of paresthesia of the lateral cutaneous nerve. Five cases developed postoperative infection. Only one of them who had poor results.

Conclusion: Despite of being technically demanding, the results of this research demonstrate that the modified Rives-Stoppa technique, when used for treating acetabular fractures, usually results in satisfactory to excellent reduction. Additionally, it provides outstanding accessibility and visibility to the posterior column, quadrilateral surface, and corona mortis. This method avoids the need for inguinal canal and femoral neurovascular bundle dissection and repair surgery.

Keywords: Anatomic, satisfactory, poor, internal fixation

Introduction

Fractures of the Acetabular are intra-articular fractures of the hip joint, which is the most significant joint that bearing weight. As a consequence of intense trauma (such as vehicle crashes or fall from great heights), they mostly affect young people ^[1]. In the elderly and osteopenic individuals, simply slipping falls on the greater trochanter might end in an acetabular fractures. The anterior wall and/or column are the sites of the fractures that occur most frequently. While high-energy traumas often result in subsequent skeletal or other system damage, these comparatively low-energy injuries typically result in separate fractures ^[2]. Proper anatomic reduction, robust fixation, and prompt rehabilitation are necessary for best outcomes ^[3].

Major organ harm caused by fractures of the acetabular region make surgical intervention fairly tough. However, complicated fracture types and challenges with the operational approach for reduction also add to the difficulty of the procedure^[4].

Judet and Letournel laid the foundation for today's knowledge of and approach to treating fractures of the acetabular region in 1962. They created a system for categorizing and innovative surgical techniques that are still used today^[5]. To enhance surgical results, modifications of these techniques, such as ilioinguinal and Kocher-Langenbeck, had been created. The surgeon ought to become knowledgeable about the technical recommendations and the benefits and drawbacks of each strategy. The most popular anterior route is the ilioinguinal one. The femoral nerve, the inguinal canal, and the external iliac vessels are all at risk of damage when using the ilioinguinal approach's middle window^[6, 7].

Inguinal hernias are fixed using the Stoppa method. For the internal stabilization of pelvic and acetabular fractures, Cole and Bolhofner proposed a modified Stoppa method in 1994 that used an anterior intrapelvic (AIP) extraperitoneal technique via the rectus abdominis muscle. When combined with a lateral window, it may be utilized to access the whole anterior column and provides great quadrilateral surface visibility contrary to the indirect technique, this may be directly instrumented. In particular, direct (medial) buttressing of breaks with accompanying central femoral head protrusion is made possible by the improved access to the acetabulum^[8]. However, there is little information available on the immediate and long-term effects of acetabular fracturing. The study's objective was to assess the effectiveness of the Modified Stoppa method for the surgical management of acetabular fractures.

Patients and Methods

The orthopedic surgery department at Tanta University Hospital in Egypt and the orthopedic trauma unit at Spedali Civili di Brescia in Italy both served as two level I trauma facilities for the research. Patients underwent full history taking and thorough examination with documentation of the neurovascular status of the affected lower limb. Plain X-rays including antero-posterior, obturator oblique, iliac oblique views and CT-scans with 3-Dimensional reconstruction were obtained for the patients together with regular preoperative lab testing such as a complete blood count, tests for liver functioning, and tests for kidney function and coagulation profile. In this study, age ranges between (18-64) years. Fifteen males (71.4%) and six females (28.5%) were injured. Accidents involving pedestrians and falls from great heights were the most frequent injury mechanisms. In accordance with Letournel and Judet's categorization, the associated both columns fractures, which was discovered in 10 patients (47.6%), were the most frequent fractures type, followed by anterior column fracture in five patients (23.8%).

The participant was lying flat on an operating table that was radiolucent, allowing for clear fluoroscopic visibility for the AP and Judet radiographic images. The external femoral/iliac and iliopsoas neurovascular bundle were relaxed by allowing the ipsilateral limb to hang freely in the field while the knee and hip joints were flexed. The whole abdominal wall from the iliac crests to the palpable pubic bodies has been incorporated in the surgical field. The image intensifier was on the side in opposition to the fracture, and the surgeon was there. In 12 cases, a vertical incision that went from 2 cm over the symphysis pubis all the way up to

the umbilicus was employed. One to two centimeters above the symphysis of the pubic region, a transvers incision (Pfannenstiel incision) was performed, and its length from the external ring on the shattered side to the opposite side was around four centimeters. (Figure 1) In a craniocaudal orientation, superficial dissection was conducted down via subcutaneous tissue to the rectus fascia level. (Figure 2) Blunt lateral retraction of the rectus muscle's two bellies by a finger indicated the beginning of deep dissection. Through the aid of a Deaver retractor or flexible retractor, the dissection was continued towards the acetabulum in order to raise and safeguard the iliopsoas muscles and the external iliac arteries. If the external iliac vein, that may be near to the elevators, is injured, a lengthy Hohmann retractor across the acetabular anterior lip may be an alternative. With the pelvic brim periosteal dissection extended distally, greater visibility was gained. Using a Cobb elevator or periosteal elevator, the iliopectineal fascia was separated from the acetabulum's dome and anterior column. The whole pelvic brim was exposed by continuing the dissection towards the anterior portion of the sacroiliac joint.

In the fractures of the anterior column which exit the iliac crest and fractures that couldn't be sufficiently minimized and/or stabilised utilizing the main stoppa window, the lateral window was incorporated.

To reveal the insertion of the oblique abdominal muscles, a curved incision was made along the iliac crest, starting posterior to the gluteus medius pillar. From the fracture's side, this was done. The muscular gap was punctured with electrocautery when the boundary between the external oblique muscles and the gluteus muscles was identified. The iliac crest was subperiosteally raised from the external oblique muscle. The same subperiosteal layer was used to raise the iliac muscles, expose the iliac fossa to the pelvic brim and the anterior portion of the sacroiliac joint. Bone wax has been utilized to reduce nutrient vessel hemorrhage that might happen while raising the iliacus muscle. The method helped to expose the whole hemipelvis and overlapped in the middle of the Stoppa window's view. To aid with vision, a blunt Hohmann retractor was carefully positioned along the quadrilateral surface.

Both lateral and longitudinal traction via the greater trochanter has been given to the lower limb. The reduction process for high anterior column traumas that extended to the iliac crest began at the lateral window. Then, according to Letournel's proximal to distal rule, the anterior column was diminished to the pelvic brim. In order for preparing the fracture areas, the hip joint cavity was first made more distal before granulation tissues, early callus, comminuted pieces, and hematomas were eliminated. It was decided to reduce the whole articular fragments gradually and simultaneously. In Figure 3. Typically, the iliac crest (if existing), anterior column, and posterior column were fixed in that order. A pelvic reconstruction plate and lag screws were used to anchor the reduction in the conventional way along the pelvic brim and pubic eminence. The plate's length allowed for a sufficient stabilization of both anterior and posterior damage. (Figure 4) The plate was positioned along the pelvic brim, which runs from the pubis to the innominate bone at the SI joint. (Figure 5) The appropriateness of the obturator oblique, AP, and iliac oblique views as well as the position of screws were examined once all fixation was complete. The average procedure lasted $239,52 \pm 52.19$ minutes. Each participant has been evaluated radiologically utilizing X-rays and clinically utilizing the Merle D'Aubigne score. (Figure

6) The mean follow-up was 12.95 months, with the shortest follow-up being 6 months and the longest being 24 months.

Results

Based on the score of Merle D'Aubigne, the functional results were satisfactory in (71.4 %). The functional result was significantly affected by occupation and time lag. Utilizing the Matta grading method, reduction was evaluated on all 3 radiographic images. Fourteen cases (66.66%) were classified as anatomical reduction. Six cases (28.57%) were classified as satisfactory reduction while poor reduction was represented by only one case (4.7%). A substantial correlation was existed among the postoperative radiological reduction and the final clinical outcomes. (p-value =0.043). All fractures were seen to be united radiographically by six months after surgery. No cases of redisplacement were detected. no instances of delayed union or nonunion was existed. No Heterotopic ossification was observed. According to Matta scoring, there were seven excellent cases (33.33%), nine good instances (42.8%) two fair instances (9.5%) and three poor instances (14.2%). A substantial association was existed among the postoperative radiological reduction and the final radiological results. (p-value =0.0424). On studying the complications, we had two cases of vascular complications: A) External iliac vein injury was developed in one case due to improper manipulation of the large clamp (King Tong). Trial of repair by vascular surgeon but it failed. Ligation of the vein was done. B) Obturator artery injury: During reduction of the posterior column and buttressing of the quadrilateral plate, obturator artery was injured in one case. Vascular repair was done. One instance of sciatic nerve injury and five instances of paresthesia of the lateral cutaneous nerve. Five cases developed postoperative infection. Two cases had superficial wound infection. They developed postoperative persistent discharge after the first week. The two cases refused any surgical debridement. They were managed by a continuation of oral antibiotics and frequent dressing. There was not any residual infection, and the final clinical outcomes were good. Two patients developed wound infection and dehiscence. Surgical debridement was done for both cases. The first one (18 y., girl) had fungal infection and had a dramatic response to antifungal treatment. The final clinical outcome was excellent with proper wound healing. The other patient (49 y., female) had postoperative wound infection and dehiscence of the lateral wound. She improved with surgical debridement. After one year, she had a sinus related to the ASIS. Surgical debridement was done with removal of the ethibond sutures which were used for reconstruction of the inguinal ligament. No residual infection was detected in the following up visits. The fifth case (55 y., male, diabetic T type fracture) developed early deep wound infection. The patient got postoperative COVID infection and deep vein thrombosis. He was medically unfit for anesthesia and any surgical debridement. He was managed at home by daily dressing and antibiotics for six weeks. The patient developed arthritis and near complete fusion of the joint. The final clinical outcome was poor. Conversion to total hip replacement without definite exclusion of infection was not possible. The patient accepted the poor results.

Discussion

Rives and Stoppa reported an intrapelvic technique using an incision at the midline for the mesh repair of challenging and recurring hernia throughout the late 1960s until the early 1980s [9]. Cole and Hirvensalo independently documented

about small series of individuals who had fractures of the acetabular region repaired and stabilized with different variants of this method in various papers in the beginning of the 1990s. The key alteration to the original Rives-Stoppa method was the continuation of the dissecting laterally and posteriorly across the pelvic brim in the direction of the internal iliac fossa [10-11] additional studies by Quereshi and Hirvensalo in 2004 and 2007, respectively, adopting this approach for infra-pectineal plating as well as management of fractures of the acetabular region with inclusion of the quadrilateral surface, have demonstrated positive preclinical and early clinical outcomes. In addition to providing an additional space for instrumentation, a lateral window, as reported by Sagi *et al.* in 2010, is better suited for treating high anterior iliac blade traumas [12]. When contrasted with individuals in previous trials, the typical period between an injury and operation is longer. The time it takes to go to the tertiary center of expertise is what is causing this delay. Additional operating time is caused by postponed presentation. The relationship between time lag and operation time was statistically substantial. As we gained accustomed, we also noticed that some of our early instances took longer than the ones that arrived later. These were similar to previous investigations, indicating that this method has a high learning curve. Vascular complications were mainly responsible for extended time in two cases [13]. According to the functional outcome, our study clinical results showed that at 6-months follow up, seven (33.33%) patients were rated excellent, eight (38%) patients were rated good while six patient functional result rated fair and poor. Hirvensalo *et al.* in 2007 had 164 patients with 75% excellent -good clinical outcome while Sagi *et al.*'s clinical outcome rating study from 2010 revealed that 88% of the subjects (50 participants) were graded good or excellent at one year follow-up, [14, 15]. Bastian *et al.* in 2013 with 43 patients had 69% excellent -good clinical outcome while Kilinic *et al.* in 2018 had 57 patients with 87 % excellent-good clinical outcome [16]. Nayak *et al.* in 2020 had 23 patients with 82% satisfactory outcome. One of the unique features of this study that all reduction and fixation techniques were done through the stoppa window combined with the lateral window without the need for Kocher-Langenbeck approach. A additional posterior KL was used in 3 instances (8.3%) for a further posterior column or wall fractures, according to Isaacson *et al.*'s 2014 study of 36 participants [17]. Cole and Bolhofner conducted a research in 1994 on 55 individuals with acetabular fractures in which they only employed the Modified Stoppa anterior intra-pelvic technique in 32 (58%) of the cases and the posterior approach (KL) in 18 (33%) of the cases [10]. The approaches employed in the treatment of fractures of the acetabular region with quadrilateral plate inclusion and fix stabilization have received very little attention in the recent literature. The major topic of conversation is supra-pectineal vs infra-pectineal plating. Other interesting technical aspects of fixation include the utilization of either horizontal or vertical infra-pectineal plates, or the inclusion of periarticular lag screws across the supra-pectineal plate [18]. They found that the pairing of posterior lag screws across a supra-pectineal plate and an infra-pectineal plate fostering the pelvic brim along both sides of the Linea terminalis provided greater stability with fewer displaced fractures than a supra-pectineal plate accompanied by a vertical infra-pectineal plate. In this study, it was difficult to the use the posterior lag screws due to difficult intraoperative radiological imaging of the posterior column and unavailability of long cortical screws. However, no cases

of fixation failure or redisplacement were reported [19]. Regarding comparison with the ilioinguinal approach, Hammad *et al.* in 2015 concluded that regarding clinical ratings and efficiency of reduction, all strategies were comparable. The Stoppa method may be more beneficial in designs needing direct buttressing of the quadrilateral surface as well as related column fractures. On the contrary, the ilioinguinal approach's middle window allows for a greater exposure of anterior wall fractures and transversely orientated fractures. According to them, an acetabular fractures surgeon should be knowledgeable with both of these methods [20].

Liu *et al.* came to the decision that the pararectus technique might provide a more accurate anatomical picture of the pelvis and acetabulum, including the quadrilateral plate and corona mortis, which would be helpful for reduction and fixation of the fractures. Additionally, it could successfully lower the length of the incision, the amount of blood lost during surgery, and the duration of the procedure. For the clinical management of complicated pelvic and acetabular fractures, it could be a preferable option [21]. More studies are required to compare the results as there are a lot of controversies about the indications and safety of the pararectus approach.

Strengths of the Study

Our outcomes are comparable to prior reported series of skilled surgeons. This demonstrates unequivocally how simple and repeatable the process is. Recently, Guo *et al.* reported utilizing Majeed grading that all radiological and functional results were 100% satisfactory (good and excellent) [22]. Recent years have seen a paradigm change in favor of the Stoppa strategy, as seen by the rise in annually publishes. despite the fact that the functional result is similar, a meta-analysis by many authors contrasting the IL to MSA has clearly showed greater reduction, reduced loss of blood, and fewer problems in the MSA group [23].

The modified stoppa approach's benefits were shown to include:

1. Dissection that may be less intrusive since the inguinal canal is not exposed.
2. Direct observation of the whole pelvic brim, including the area just in front of the sacroiliac joint and extending from the pubic body.
3. Accessibility to the corona mortis and direct observation of it.
4. Reduction and plating are possible because to direct vision and access to the quadrilateral plate.
5. From the larger sciatic notch to the ischial spine, there is obvious visibility as well as accessibility to the posterior column, enabling reduction and plating.
6. Opening the middle window of the ilioinguinal is not required that correlated with high risk of harm to neurovascular bundle.

Limitations of the study

The current study had a limitation that it included a small sample size. As a result, we were unable to separate the fracture patterns and carry out an analysis of subgroups to determine their relationship with the functional results at the end. The research was susceptible to a number of biases, including recollection bias and selection bias. Additionally, the follow-up period was just six months long. Additionally necessary is long-term monitoring for consequences, including post-traumatic arthritis. Another barrier to assessing the benefits and drawbacks of this method is the inclusion of

21 patients in the present research with no control group. One such contrast is between individuals who had vertical midline incisions and those who had Pfannenstiel incisions. But it was believed that if the randomization had not been performed and the learning curve had been taken into account, this comparison wouldn't be healthy.



Fig 1: Vertical incision 2cm above the symphysis pubis up to below the umbilicus and Transvers incision (Pfannenstiel incision), the length is about 4 cm from the external ring on the broken side to the contralateral side, and it is 1 to 2 cm above the symphysis pubis.



Fig 2: In a craniocaudal orientation, superficial dissection was conducted downward via subcutaneous tissue to the rectus fascia level.



Fig 3: Fixation of the iliac crest through LC II screws or plate



Fig 4: The use of the King Tong clamp

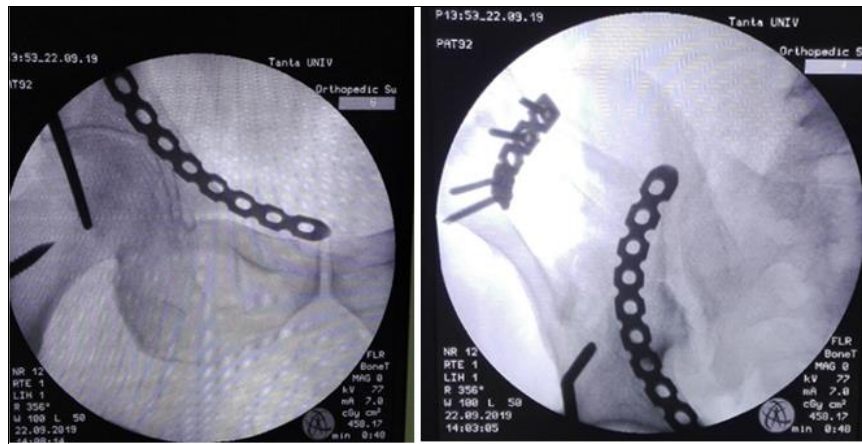


Fig 5: Adjustment of the length of the pelvic brim plate



Fig 6: Pre, postoperative X rays and clinical follow-up

Conflict of Interest

Not available

Financial Support

Not available

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