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*Research Article*

# Modified Stoppa Approach for Acetabular Fixation

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## Abstract

Introduction: When acetabular fractures are intra-articular, correct anatomic reduction is important to achieve an excellent functional outcome. A few of the surgical techniques like ilioinguinal and modified Stoppa techniques are the only available intra-pelvic procedures. Despite the fact that ilioinguinal method is more commonly used, modified Stoppa technique is becoming more popular due to the possibility of visualizing and reducing quadrilateral plate fragments in addition to fixation of posterior column through anterior approach. The goal of our study is to assess the efficacy of various reduction tools/ techniques for reduction and fixation of fractures by use of modified Stoppa technique.

Materials and Methods: We have operated on 16 patients with acetabular fractures through modified Stoppa approach within the age group of 19 years to 70 years (mean 42 years) with male female ratio of 13:3. In patients requiring combined method, the anterior approach was performed first. In most of the patient's, modified Stoppa was combined with a lateral window. we have used various reduction strategies consisting of trans trochanteric Schanze pin, intra-focal elevators, ball spike, bone hook, iliac crest Schanze pin, Farebeat forceps, under contoured plate and many others.

Results: Matta's radiographic reduction criteria showed anatomic reduction in 10 cases. Clinical evaluation using Merle d' Aubigne scoring showed excellent outcomes in 9 cases and good results in 6 cases. Follow up was done for a most duration of six months.

Conclusion: Modified Stoppa technique provides better visualisation of quadrilateral floor and sciatic buttress while compared to the ilioinguinal method. Using suitable reduction strategies gives good reduction of anterior column, at the same time offers possibility to restore the posterior column from the anterior aspect using anterior to posterior column screws, obviating the need for a separate posterior approach.

**Keywords:** Modified Stoppa; Acetabulum Fracture; Anterior Column; Fixation; Quadrilateral Plate

## Introduction

Since acetabular fractures are intraarticular and involve major weight bearing joint, accurate anatomic reduction is crucial to gain a very good functional outcome. The surgical procedures include Kocher Langenbeck, Iliofemoral, Ilioinguinal, combined anterior and posterior approaches, extended iliofemoral, trans trochanteric and triradiate techniques [1-9]. Of those procedures, only the ilioinguinal is intrapelvic. Considering its original description by Letournel in 1961, the ilioinguinal technique has gained popularity for fixation of anterior wall and column fractures, anterior fractures related to a posterior hemitransverse component, or even both column fractures. The modified Stoppa method is an intrapelvic approach initially used for inguinal hernia surgery by Rives, et al. and Stoppa, et al., [10,11]. Hirvensalo, et al. and later Cole and Bolhofner used the same approach with a few changes to visualize the quadrilateral plate and the sciatic buttress for fixation of acetabular fractures and duly credited Stoppa by means of describing the method as modified Stoppa technique [12,13]. Ilioinguinal and Modified Stoppa approaches are the currently available intrapelvic approaches, of which ilioinguinal is more commonly used and its results had been reported more

extensively [14]. Sagi, et al., additionally defined the use of Smith Peterson approach (and/or an anterior superior iliac spine osteotomy) to better visualise the anterior portion of the joint and anterior wall [15]. Qureshi, et al., in addition described steps to "infrapectineal plating" as a technical trick [16]. The goal of our study was to evaluate the efficacy of various reduction tools/ techniques for reduction and fixation of fractures operated using modified Stoppa method.

The incidence of acetabular fractures in the general population is relatively low, estimated to be around 3 to 4 per 100,000 person-years. However, the incidence may vary depending on factors such as geographic location, age and the prevalence of high-energy trauma events like motor vehicle accidents.

**Materials and Methods**

This is a retrospective study performed in a tertiary care hospital from January 2020 to February 2021 involving 16 patients who had undergone modified Stoppa technique for acetabular fractures. There were 13 men and 3 women in the age group of 19 years to 70 years (mean 42 years). Letournel and Judet classification system was used to classify the fractures. We had 16 patients operated through modified Stoppa technique. Informed written consent was obtained from all the patients. There had been 11 cases of anterior column with posterior hemitransverse, 3 patients having anterior column and two instances of transverse fractures. We have used blended anterior and posterior approach in ranges in eleven patients. In most of the cases requiring combined approach, the anterior technique was done first.

The Modified Stoppa approach is a surgical technique employed for treating acetabular fractures, particularly those involving the anterior and medial columns. It is ideal for complex fractures, including T-shaped patterns that have both anterior and posterior column involvement. This approach provides optimal exposure for addressing challenging fractures resulting from high-energy trauma. Isolated posterior wall fractures of the acetabulum are managed through alternative surgical methods, like the Kocher-Langenbeck approach, which specifically targets the posterior aspect of the hip socket. The choice of approach depends on the unique characteristics of the fracture, ensuring that the surgical strategy aligns with the injury's specifics for effective treatment.

*Procedure*

A horizontal or vertical (Fig.1) incision depend on surgeon preference given approximately 8-10 cm long, was made 2 cm proximal to the superior pubic ramus. The incision extended through the abdominal fascia and the exposed rectus abdominis muscle was dissected along the linea alba to access the internal aspect of the pelvis. Bleedings are properly secured by cautery. After proper exposure, through wash with normal saline to be done clear the field. Use gauze dissection.

Upon reaching the interior of the pelvis, corona mortis was identified and ligated, followed by subperiosteal dissection along the pelvic brim to expose the fracture fragments. The obturator nerve and vessels passing through the obturator foramen were typically readily identifiable and safeguarded throughout the procedure. Particular care was taken to protect the external iliac artery and vein, which traverse the iliopsoas muscle and were retracted upwards during the procedure. In some challenging cases, damage to the external iliac vein occurred, typically in patients with extensive adhesions resulting from previous surgeries like recurrent hernia operations or multiple cesarean sections.

For the reduction of fracture, Steinman pin applied over GT (Fig. 1) and continuous traction to be applied with T handle. Throughout the surgery knee should be flex to 9o' (Fig. 2) and continuous traction to be applied with T handle. Use small hammer for reduction of fracture fragments. Retractors applied (Fig. 2). First bone lever lateral to pubic tubercle that is middle of superior pubic ramus. Second posterior to acetabulum on the iliac part of pelvis to apply the plate. Third at lesser sciatic notch which is opposite to 1$^{st}$ retractor. While two Dyons retractor used. First to push the bladder down and second to ileus muscle laterally to apply the plate (Fig. 1).

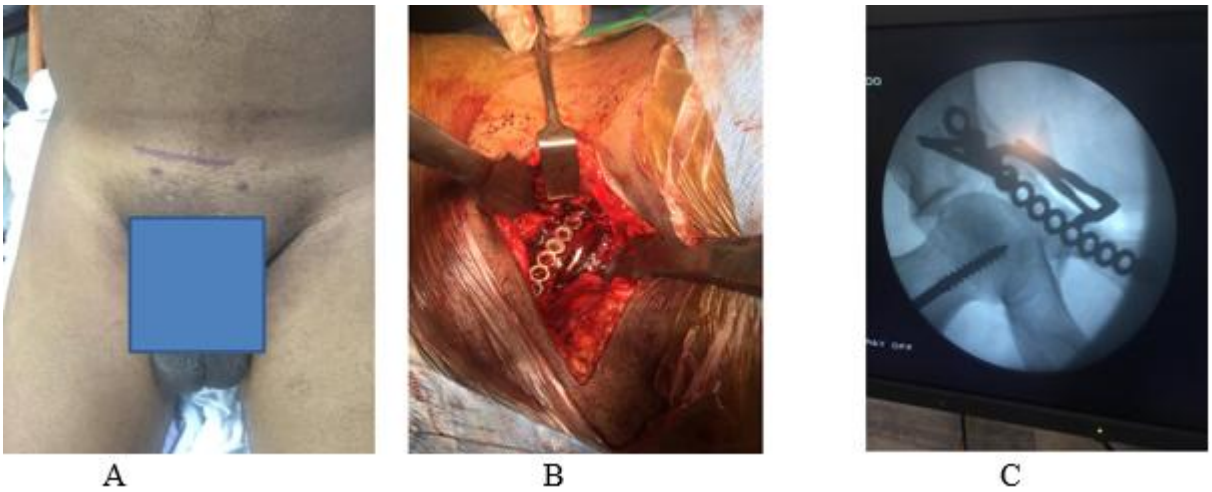


**Figure 1:** A: Horizontal incision 2 cm above pubic symphysis;.B: Supra pecteneal plate applied; C: Steinmen pin applied to head for reduction of fracture.

**Figure 2:** A: Vertical incision with lateral window; B: Knee flex to 90' throughout the procedure; C: Showing position of Retractors. First bone lever lateral to pubic tubercle that is middle of superior pubic ramus. Second posterior to of acetabulum on the iliac part of pelvis to apply the plate. Third at lesser sciatic notch which is opposite to 1st retractor. While two Dyons retractor used. First to push the bladder down and second to ileus muscle laterally to apply the plate.

**Reduction Techniques**

1. Pre-operative upper tibial pin traction provided pain relief, at the same time realigning the fracture fragments
2. A 5.5 mm Schanz pin introduced via the trochanter into the head of femur was used to apply lateral traction with the assist of a T handle
3. A Hohman retractor/ Cobb's elevator/ k wire/hook was inserted intrafocally into the fracture and manipulated in a fashion so as to reduce the step created through the overlapping fragments (Fig. 1)
4. A ball spike (straight/ curved) was used to push the fragments which had been lifted off from the fracture site. In cases of quadrilateral plate fracture displacement, ball spike was used to push the quadrilateral plate into position (Fig. 2)
5. Manual longitudinal traction applied to the lower limb was also used to reduce the fracture fragments
6. Manual pelvic compression was sometimes used to reduce the iliac wing fragments
7. A Farabeuf forceps was used as a push-pull method to reduce and approximate the iliac wing fracture fragments, by applying one screw on either side of the fracture
8. In cases where there has been plastic deformation of the pectineal eminence/ quadrilateral plate, an under- contoured reconstruction plate was applied at the bone (Fig. 2). In few cases supra pectineal plate is used
9. An oblique Matta's clamp was used in a few cases to reduce, compress and keep the fragments in position to facilitate plate fixation
10. Catheterization of bladder, pre-operative enema, flexion of the hip and knee to 30o (by placing a bolster beneath the ipsilateral knee) all manoeuvres helped for better visualization and relaxation of intra-pelvic structures, hence helping in fracture reduction and stabilization and additionally avoiding injuries to the neurovascular structures

**Post OP Protocol**

Oral feed was started as soon as bowel sounds were heard and patient passed flatus. DVT prophylaxis was initiated using pharmacologic agents 6 hours after surgery. Post op X-ray taken as pain relief. Follow up X-rays had been taken at 4 weeks, 6 weeks and 12 weeks post operatively. Radiological evaluation was done using Matta's criteria and clinical evaluation was done using Merle d' Aubigne scoring. Non-weight bearing mobilization was started on second post-operative day and continued till 12 weeks.

The rehabilitation protocol for acetabular fractures, particularly those managed with the Modified Stoppa approach, typically involves a phased approach. Early stages emphasize pain management, minimizing weight-bearing and maintaining joint mobility. Gradual progression involves range of motion exercises, weight-bearing as tolerated and strengthening. Full range of motion and muscle assessment criteria vary, but generally, full range of motion includes restoration of flexion, extension, abduction, adduction and rotation. Muscle assessment evaluates strength in hip and thigh muscles. Specific criteria depend on the patient's initial condition, fracture type and surgical approach. Successful rehabilitation aims to restore normal hip function, stability and strength while minimizing complications. Reducing complications in surgical approaches for acetabular fractures, including the Modified Stoppa approach, involves several key strategies:

1. Surgeon Expertise: Having a skilled and experienced orthopedic surgeon is crucial. Surgeons with expertise in acetabular fracture surgery are better equipped to handle complex cases, reduce complications and achieve optimal outcomes
2. Preoperative Planning: Comprehensive preoperative imaging, such as CT-scans, allows for precise fracture assessment and surgical planning. Understanding the specific fracture pattern helps determine the most appropriate surgical approach and fixation techniques
3. Anesthesia and Patient Positioning: Careful consideration of anesthesia and patient positioning can minimize complications Maintaining proper positioning during surgery is essential to prevent neurovascular injuries and joint instability
4. Minimally Invasive Techniques: Minimally invasive approaches and fixation methods can reduce soft tissue damage and postoperative pain, enhancing patient recovery
5. Vascular Protection: Protecting major blood vessels, such as the iliac vessels, is critical in the Modified Stoppa approach to avoid vascular complications
6. Neurologic Monitoring: Intraoperative neurologic monitoring can help detect nerve injuries and minimize their severity
7. Postoperative Care: Adequate postoperative care, including rehabilitation and monitoring for complications like infection or deep vein thrombosis, is essential for patient recovery
8. Multidisciplinary Collaboration: Collaboration with other specialists, such as vascular and neurosurgeons, can be necessary in complex cases to address potential complications effectively
9. Patient Education: Informed patients who understand the potential risks and complications are better prepared for surgery and postoperative recovery

**Results**

There had been 16 patients with male woman ratio of 13:3 in the age group of 19 years to 70 years (mean 42 years). The time from injury to surgery ranged from 6 to 14 days (mean 9 days). The reduction assessed by using intra-operative C arm images as well as post-operative x-rays. Matta's radiographic reduction criteria showed anatomical reduction in 10 cases, fair results in 4 cases and poor results in 2 cases. Clinical evaluation using Merle d' Aubigne scoring showed excellent effects in 9 cases, good results in 6 and fair results in 1 case. Follow up was done for a maximum of six months (4 to 6 months).

In surgical procedures for acetabular fractures, the incidence of malreduction and malrotation can vary depending on the surgeon's expertise, the complexity of the fracture and the chosen approach. Achieving precise reduction and rotation of the fractured fragments is critical to ensure proper hip joint function. Malreduction, which involves improper alignment of fracture fragments, can lead to hip joint instability and long-term issues. Malrotation, or incorrect rotation of the acetabulum, can affect leg length and gait. Studies suggest that the rate of malreduction or malrotation in acetabular fracture surgery is relatively low, especially when performed by experienced orthopedic surgeons. However, the exact incidence may vary case by case.

In the surgical management of acetabular fractures, preoperative imaging is crucial for accurate diagnosis and surgical planning. While standard X-rays are often the initial imaging tool, they may not provide enough detail for complex fractures. Computed

Tomography (CT) scans are frequently utilized to precisely evaluate the fracture pattern, assess displacement and plan the surgical approach. CT scans offer a 3D view of the acetabulum, aiding in fracture classification and allowing surgeons to choose the most appropriate approach and fixation techniques. Magnetic Resonance Imaging (MRI) is generally not the first choice but may be used in specific cases where soft tissue injury assessment is necessary. Comprehensive preoperative imaging is vital for successful surgery and optimal patient outcomes.

**Discussion**

The anterior intrapelvic approach (also known as AIP, Stoppa, modified Stoppa, extended Pfannenstiel, ilioanterior) expose the medial intrapelvic surface (including quadrilateral plate and sciatic buttress) of the innominate bone for reconstruction of acetabular and pelvic ring [17]. This approach utilizes preperitoneal/ retroperitoneal interval to expose the inner aspect of pelvis. This method provides access to pubic frame, superior ramus, pubic root, the ilium above and below the pectineal line, the quadrilateral plate, the medial aspect of the posterior column, the sciatic buttress and the anterior sacroiliac joint [15]. For access to the upper ilium and crest, a second incision following the upper limb of the approach described by Smith Peterson is used. An osteotomy of the anterior superior iliac spine improves the access to anterior wall pubic root region. Sagi, et al., reported that 60% of their patient's required exposure of the lateral window [15]. In our study, we have carried out a lateral window in most of our cases for placement of instruments for reduction and for fixation purpose.

Numerous reduction strategies had been described in literature [13,17,18]. Various manoeuvres, however, often remain the most time consuming and difficult part of the procedure [13,19]. Of those, lateral retraction of the femoral head with a trochanteric traction pin is an important approach, which enables reduction by eliminating deforming forces on the medially displaced fracture. This manoeuvre additionally releases tension at the obturator neurovascular bundle during retraction [18]. A pelvic collinear reduction clamp, standard Matta pelvic reduction clamp can be used to reduce the column fractures. A ball spike pusher is a very beneficial instrument to reduce the anterior fracture. we have used ball spike in most of our cases. Using a bone hook in the sciatic notch to bring forward the posterior column has been reported in literature [17]. We have used a bone hook introduced through the lateral window to reduce anterior column fracture in of our cases. An under contoured plate has been used by Qureshi, et al., to reduce and fix fractures involving quadrilateral surface [16,18]. We have extensively utilized an under contoured reconstruction plate buttressing the quadrilateral surface with screws inserted into the posterior column and posterior surface of pubic ramus. In addition to the techniques described above within the literature, we have used different techniques like:

1. Schanz screw inside the iliac crest to manipulate the posterior column
2. Intrafocally placed Hohman/ Cobbs elevator/ k wire to lever out the impacted fragments
3. Farabeuf forceps to apply compression on two screws, one each on the either aspect of fracture
4. Manual longitudinal traction of the lower limb

The use of various reduction techniques helps in achieving anatomic reduction quickly, thus decreasing the duration of surgical treatment as well as blood loss. Moreover, proper placement of instruments helps in avoiding damage to the neurovascular structures and additionally prevents intraarticular placement of screw. According to Cole and Bolhofner, in fractures requiring both an anterior and posterior method, the anterior was always performed first to allow reduction of significant posterior column, transverse and medial wall fractures from the inside, essentially restoring an atomicity of the acetabulum prior to performing the posterior approach [13]. This leads to minimize of dissection when a subsequent posterior approach is done. The reduction quality translates itself to the good radiograph results as well as clinical results. According to Ha Yong Kim, et al., out of 22 patients treated by a Stoppa approach, anatomic reduction become executed in 17 cases, good and excellent radiographic results were obtained in 18 cases and good and excellent clinical outcomes had been obtained in 16 cases [17]. The radiographic outcomes were slightly better than the clinical results. Marsh, et al., stated that the most important factor that determines the clinical results was damage to the joint cartilage, which could induce degenerative changes within the joints even if anatomic reduction was achieved [14,20]. When you consider that damage to articular cartilage is a non-modifiable issue, we endorse that modifiable elements like anatomic discount must take delivery of priority to achieve maximum possible functional results. Various reduction strategies mentioned above will help in accomplishing this goal. Complications due to intraarticular screw placement can be prevented by means of following the "safe zone" mapping of Guy, et al. and the "safe and dangerous zone" mapping of Zang, et al., complications like neurovascular injury can be prevented by way of using appropriate instruments and

safe retraction of the pelvic structures [21,22]. In our study we have not encountered any major complications. Complications due to malreduction are common if the fixation is executed after 3 weeks of injury. Cole and Bolhofner therefore recommend that fixation be performed earlier than 3 weeks to acquire good outcomes with respect to reduction and function.

**Conclusion**

In acetabular fractures requiring an anterior approach, modified Stoppa method provides better visualization of quadrilateral surface and sciatic buttress when as compared to the ilioinguinal method. A lateral window markedly improves the quality of reduction and fixation. The usage of suitable reduction techniques helps in reaching proper reduction of anterior column, on the same time gives possibility to restore the posterior column from the anterior aspect using anterior to posterior column screws, eliminating the need for a separate posterior approach. This study indicates that the results of fixation through modified Stoppa approach can be improved by using various reduction techniques.

**Conflict of Interest**

The authors have no conflict of interest to declare.

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