

Original Research Article

Comparative study of modified Stoppa approach and ilioinguinal approach for pelviacetabular fractures

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ABSTRACT

Background: The present study was done to study advantages and disadvantages of modified Stoppa approach (MSA) and ilioinguinal approach (IIA) for surgery of pelviacetabular fractures involving anterior column, anterior wall, quadrilateral plate with protrusion and complex fractures, pelvic ring fractures with pubic diastasis or sacroiliac joint disruptions which needs to be stabilized anteriorly.

Methods: Study was conducted in Department of Orthopaedics, Government Medical College and Hospital, Aurangabad on patients with pelviacetabular fractures during June 2018 to March 2020. In our study of 25 patients, they were divided into group A containing 13 patients operated using MSA and group B containing 12 patients operated using IIA. Follow up period was 12-18 months (mean=15) and 12-16 months (mean=14) for group A and B, respectively. Patients assessed using modified Merle d'Aubigné score and Matta's score.

Results: Mean modified Merle d'Aubigné score was 16 and 14 for group A and B, respectively (p value=0.89). Mean blood loss and operative time were less in MSA. Superficial infection was found in one patient each of group A and B whereas one patient developed deep infection in group B. One patient each of both group had hip pain suggestive of early arthrosis. In group B, two patients developed meralgia paresthetica. One patient developed external iliac artery thrombosis and inguinal hernia in group B. One patient from group A developed incisional hernia.

Conclusions: MSA was better and simpler than IIA with due adequate training and practice to achieve direct access for pelviacetabular fracture reduction and also it requires less operative time, less blood loss and better postoperative outcome.

Keywords: IIA, Matta's score, MSA, Modified Merle d'Aubigné score

INTRODUCTION

Incidence of pelviacetabular fractures is high due to better road network and increasing use of sport bikes and sport utility vehicles. Pelviacetabular fracture management became an ever learning topic because of its increasing trend.¹ Acetabular fracture pattern determines which approach is needed for surgery.^{2,3} Anterior column, anterior wall, transverse fractures, quadrilateral plate fractures with protrusion and complex acetabular fractures

like T fractures and bicolunar fractures and associated pubic rami fractures, pubic diastasis or sacroiliac joint disruptions can be managed using modified Stoppa approach (MSA) or ilioinguinal approach (IIA).³ So, there is a keen interest in studying which approach is better considering various factors such as ease of access of the fractured anatomical area, surgeons experience and skills, intraoperative blood loss, handling of neurovascular structures, operative time, postoperative infection and postoperative rehabilitation.

The MSA is an intrapelvic approach which was previously used for inguinal hernia surgery by Rives and Stoppa in the early 1990's.^{4,5} Further it was introduced by Cole and Bolhofner and Hirvensalo as the method for complete access to the anterior column from the sacroiliac joint to the pubic symphysis along with good exposure of quadrilateral plate.^{6,7} It was basically invented to overcome shortcomings of IIA. The IIA was invented in 1961 by Emile Letournel as an anterior approach to the pelvis and acetabulum and it gives complete access to the anterior column from the sacroiliac joint to the pubic symphysis.¹⁰ Damage to neurovascular bundles, heterotopic ossification, traumatic arthritis, screw penetration, infection, external iliac and femoral vessels thrombosis and postoperative hernias are known complications that occurs while managing pelviacetabular fractures. Golden rules in reducing complications and better postoperative rehabilitation during management of pelviacetabular fractures are proper preoperative evaluations, better soft tissue dissection and better reduction.^{8,9} In our study, we used both MSA and IIA to get sufficient data about which approach is better for managing pelviacetabular fractures keeping low complications rate and better postoperative rehabilitation. We tested a hypothesis of MSA being significantly better than IIA with respect to intraoperative access and complications and postoperative rehabilitation.

METHODS

Total 25 patients of pelviacetabular fractures coming to emergency unit of Department of Orthopaedics, Government Medical College and Hospital, Aurangabad during June 2018 to March 2020 and who met following criteria were included in study.

Inclusion criteria

Patients between 15 to 60 years of age; anterior column, anterior wall, transverse fractures, quadrilateral plate fractures with protrusion and complex acetabular fractures like T fractures and bicolumnar fractures; pubic rami fractures, pubic diastasis and sacroiliac joint disruptions; fractures less than 3 weeks old were included.

Exclusion criteria

Patients <15 years and >60 years of age; isolated posterior wall, posterior column acetabular fractures or posterior fracture dislocation of hip; patients with chest injury, associated abdominal injury and those requiring ICU admission; fractures older than 3 weeks; compound fractures were excluded.

Preoperatively, we performed X-ray pelvis with both hips (PBH) antero-posterior (AP) view, Judet views, pelvic inlet and outlet views and computed tomography scan (CT scan) with 3-dimensional (3D) reconstruction which helps surgeon to plan surgical approach. Classification of fractures done according to Letournel-Judet and Young-Burgess classifications.^{11,12} Patients were divided into two

groups, such as group A- 13 patients, operated using MSA and group B- 12 patients, operated using IIA. These patients were evaluated prospectively in our study. Informed written consents were taken from all patients who had undergone surgery. Third generation cephalosporin was given intravenously to every patient 30 minutes before procedure. Spinal-epidural anaesthesia was given to each patient included in study. Femoral block given to patients for better positioning during spinal-epidural anaesthesia procedure and better postoperative pain management.

Procedure for MSA

Supine position was given to patient. Surgeon stands on contralateral side of fracture. 1-2 cm above the pubic symphysis, Pfannenstiel incision taken. Skin and soft tissue dissected and retracted till anterior rectus fascia reached. Anterior rectus fascia was split. Then inferior epigastric artery ligated. Two heads of rectus abdominis muscle dissected in midline along linea alba. Then urinary bladder protected elevating it superiorly under retractor. Pelvic brim palpated and subperiosteal dissection carried out along the pelvic brim to expose the fracture fragments. Pointed Hohman retractor inserted over pubic tubercle to reflect the insertion of rectus abdominis from pubic bone. During further dissection external iliac vessels and iliopsoas muscle are protected with deep retractors. Corona mortis vessels ligated to get better handling along pelvic brim. Iliopsoas muscle separated over the anterior column and the dome of acetabulum. Dissection also carried out in direction of sacroiliac joint to expose entire pelvic brim. Then direct fracture reduction attempted and internal fixation was performed using suitable implant. Proper wound closure along with rectus sheath repair required to avoid postoperative hernias (Figure 1).

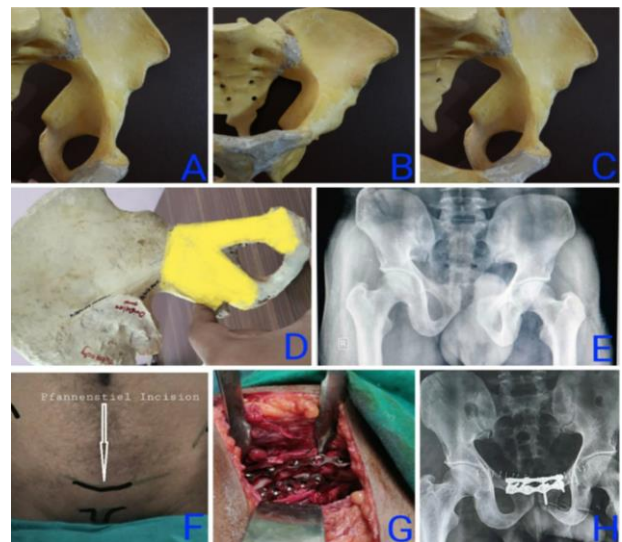


Figure 1: Pelviacetabular fracture managed with MSA; (A-D) Accessed regions of MSA, (E) preoperative X-ray, (F) landmarks for Pfannenstiel incision, (G) intraoperative photograph showing plate fixation, (H) postoperative X-ray.

Procedure for IIA

Supine position was given to patient which can be converted to floppy lateral position as and when required. Surgeon stands on ipsilateral side of fracture. Curved incision along ilioinguinal line made beginning at the anterior 2/3rd of the iliac crest then extended to anterior superior iliac spine and then till 2 cm above the pubic symphysis crossing midline inferiorly. External oblique insertion on iliac crest released with thick fascial/periosteal cuff to facilitate its repair later. In continuity with this, expose the internal iliac fossa subperiosteally by mobilizing the iliacus muscle. Pack the fossa with a sponge. Next, the external oblique aponeurosis is incised from the anterior superior iliac spine to the lateral border of the rectus sheath, passing cranial to the external inguinal ring. The spermatic cord (or round ligament in females) is mobilized in the medial aspect of the wound in males. Medially the transversus abdominis is then released from the inguinal ligament, usually taking 1-2 mm of the ligament with the tendon. This release begins at the anterior superior iliac spine and progresses medially to the conjoint tendon of the internal oblique, and the pubic tubercle. Care must be taken during this portion of the procedure to protect the ilioinguinal nerve which normally lies just proximal to the inguinal ligament after penetrating the abdominal wall. The lateral cutaneous nerve of the thigh is usually encountered just deep to the conjoint tendon (of the internal oblique and the transversus abdominis) approximately 1-2 cm medial to the anterior superior iliac spine. This nerve can usually be preserved if it is mobilized as it exits the abdominal wall and enters the fascia of the thigh. After dissecting carefully, 3 working windows were observed: lateral window- one can access the internal iliac fossa and sacroiliac joint through this window, middle window- iliopectineal fascia can be excised to get access to pelvic brim and medial window- it is medial to the femoral vessels which can give access to superior pubic ramus and prevesical space.

Through these windows, fracture site reached. After achieving reduction, appropriate implant can be used to fix fracture. After this, layered wound closure required to avoid postoperative hernias (Figure 2).

The given postoperative protocols used for both groups A and B. Immediate postoperative and during each follow up, X-ray PBH AP view, Judet views, pelvic inlet and outlet views were taken to assess fracture union. Patients were followed up regularly in out-patient department at 2 weeks, 6 weeks, 12 weeks, 6 months, 12 months and 18 months. Patients were given complete bed rest for 6 weeks. Suture removal done at 2 weeks postoperatively, partial weight bearing started at 6 weeks, and at 12 weeks full-weight bearing can be started if good union noticed on X-ray. Follow up period was 12-18 months (mean=15) and 12-16 months (mean=14) for group A and B, respectively. Active and passive range of motion exercises were given from early postoperative period to facilitate postoperative rehabilitation. Radiological and functional assessment of

patients done at the end of follow up period using Matta's score and modified Merle d'Aubigné score (Table 1 and 2).^{13,14}

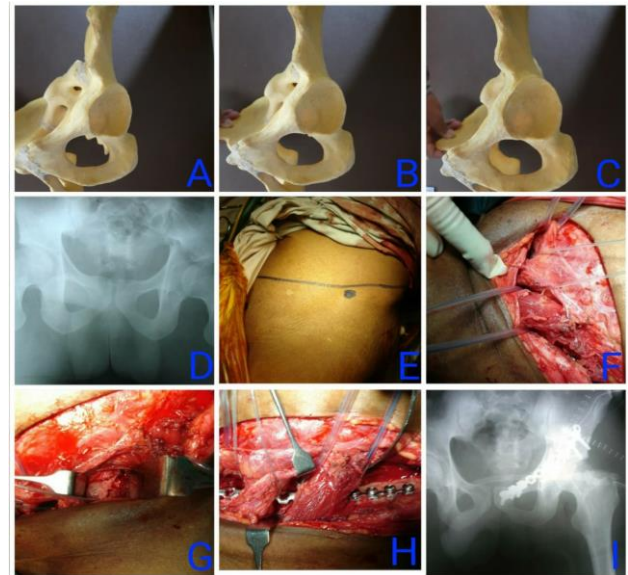


Figure 2: Acetabular fracture managed with IIA; (A-C) Accessed regions of IIA, (D) preoperative X-ray, (E) landmark for incision, (F) 3 windows seen during IIA; (G) intraoperative photograph of fracture site, (H) intraoperative photograph showing plate fixation, (i) postoperative X-ray.

Table 1: Matta's scoring system.

Radiological quality (for immediate post-operative assessment)	Anatomical reduction	≤1 mm of displacement
	Satisfactory reduction	≤3 mm of displacement
	Unsatisfactory reduction	>3 mm of displacement
Radiological results (used at last follow up)	Excellent	Normal appearance of hip
	Good	Mild changes, small osteophytes, minimum sclerosis, moderate narrowing (1 mm) of joint space
	Fair	Intermediate changes, moderate sclerosis, moderate narrowing (1 mm) of joint space, moderate osteophytes
	Poor	Advanced changes, large osteophytes, collapse of femoral head, >50% narrowing of joint space

Mean operative time, mean intraoperative blood loss, ease for reduction of fracture, reduction quality, postoperative complications and rehabilitation were studied in our study. Intraoperative blood loss was calculated from blood

collected in suction machine and approximate amount of blood in gauze pieces. In group A, 7 patients had anterior column fractures, 3 patients had transverse fracture, 2 patients had anterior column with posterior hemi-transverse fracture, and one patient had pelvic ring fracture with pubic diastasis. In group B, 6 patients had anterior column fractures, 2 patients had transverse fractures and remaining 4 patients had anterior column with posterior hemi-transverse fractures.

Radiological assessment was done using Matta's scoring system.¹³

Functional assessment was carried out using modified Merle d'Aubigné score.¹⁴

Table 2: Modified Merle d'Aubigné score (possible score: 3-18).

Domain	Grading	Score
Pain	No pain	6
	Slight or intermittent	5
	Pain after ambulation, but it disappears	4
	Moderately severe, permits ambulation	3
	Severe with ambulation	2
	Severe, prevents ambulation	1
Ambulation	Normal	6
	No cane, slight limp	5
	Long distances with cane or crutch	4
	Limited, even with support	3
	Very limited	2
	Bed ridden	1
Range of motion (%)	95-100	6
	80-94	5
	70-79	4
	60-69	3
	50-59	2
	<50	1
Results	Excellent	18
	Good	15-17
	Fair	13-14
	Poor	<13

Other variables which are taken into considerations at the end of follow-up period were superficial or deep infection, screw penetration, sciatic nerve injury, lateral femoral cutaneous nerve injury causing meralgia paresthetica, heterotopic ossification, slippage of vascular ligatures, external iliac and femoral vessels thrombosis, postoperative hernias and traumatic arthritis.

Statistical analysis

It was done in SPSS version 25 statistical software, Microsoft Excel 2007, Microsoft Word 2007, Null hypothesis. Categorical variables were analyzed by Pearson's chi-square test or oneway ANOVA test

wherever appropriate. P value<0.05 was considered significant with 95% confidence interval.

RESULTS

Mean age of patients was 45 years. Mean blood loss was 855 ml and 1000 ml in group A and B patients, respectively. Mean operative time was 180±45 minutes and 240±45 minutes in group A and B patients, respectively. Mean blood loss and mean operative time found less in MSA than IIA. Results of modified Merle d'Aubigné are as shown in Table 3.

Table 3: Modified Merle d'Aubigné score of patients.

Groups	Excellent	Good	Fair	Poor
Group A (n=13)	3	7	2	1
Group B (n=12)	1	6	3	2
F value	0.0216			
P value	0.89			

Oneway ANOVA test was applied to analyze data of modified Merle d'Aubigné score which showed no significant difference (p value=0.89) (Table 3).

Reduction quality was measured by Matta radiological grading as shown in Table 4. Pearson's Chi-square test was applied to data achieved through Matta's scoring system and we found no statistically significant difference between these two groups (p value>0.05).

The complication rate was 23.07% in group A and 58.33% in group B. 1 case of superficial infection in each group was found. 1 patient who had diabetes developed deep infection in group B which was managed by suture removal, pus drainage, thorough wash and debridement, wound kept open for daily dressing. Once infection subsided, wounds were closed by secondary suturing. Pus culture and sensitivity done. And according to sensitivity of drugs, specific antibiotics were given intravenously for 1 week in superficial infection and for 3 weeks in deep infection cases. There were two incidences of meralgia paresthetica in group B, caused by injury to lateral femoral cutaneous nerve and gradually recovered after taking combination of multivitamins, gabapentin and nortriptyline (anti-depressants). One incidence of external iliac vessels thrombosis noted in group B, treated with anti-coagulants after consultation with physician. One patients from each group developed hip pain suggestive of early arthrosis. One patient from group B developed inguinal hernia due to inappropriate closure of external oblique aponeurosis and one patient from group A developed abdominal hernia due to residual defect in closure of rectus abdominis which was managed with help of general surgeon.

Table 4: Matta radiological gradings of patients.

Groups	Radiological quality		Radiological results				
	Unsatisfactory	Satisfactory	Anatomical	Excellent	Good	Fair	Poor
Group A (n=13)	1	7	5	6	4	2	1
Group B (n=12)	2	6	4	4	3	3	2
χ^2 value	0.4821		1.0379				
P value	0.7857		0.7920				

DISCUSSION

Number of pelviacetabular fractures has increased in emergency department in tertiary healthcare hospitals. Complexity of fractures and vital structures around pelvis demands trained and expert orthopaedic surgeons for their management.¹⁶ Selection between MSA and IIA for pelviacetabular fractures after proper diagnosis of anterior column, anterior wall, quadrilateral plate with protrusion, complex fractures, pelvic ring fractures with pubic diastasis and sacroiliac joint disruptions depends on various parameters which were studied in our study to form a help guide for budding pelviacetabular surgeons in future. Other basic things about MSA and IIA can be taken into consideration while selecting between them are: MSA gives better access to middle window and pubic bone as shown in Figure 1 while IIA gives better access to iliac blade and sacroiliac joint as shown in Figure 2; MSA is more cosmetic than IIA; MSA is more appropriate for quadrilateral plate fixation than IIA; generally pushing is easier than pulling during reduction of pelviacetabular fractures. So, MSA is better than IIA in fracture reduction because we use push technique; there is no need to dislocate hip joint in MSA; pubic symphysis injuries can be managed using MSA while IIA can be used to manage sacroiliac joint injuries.

Various studies available which states the amount of bleeding that occurs in these two approaches.¹⁷⁻¹⁹ Severe bleeding in group A patients prevented by ligation of corona mortis which is encountered during subperiosteal dissection. Fan studied mean blood loss in the MSA which was 320 ml (with range of 100-1200 ml).¹⁷ Elmadag recorded a mean blood loss of 1170 ml (with range of 750-2150 ml) and 1110 ml (with range of 450-2000 ml) for the IIA and MSA, respectively.¹⁸ In our study, Mean blood loss was 855 ml and 1000 ml in group A and B patients, respectively. The reason behind less blood loss in MSA was due to shorter intraoperative time and less wound drainage, avoids neurovascular bundle which usually encountered in second window of IIA. Our study also showed that mean blood loss in MSA is less than IIA. Mean operative time was also less in group A patients as it gives direct fracture reduction.

In our study, modified Merle d'Aubigné score was not statistically significant (p value=0.89). Mean modified Merle d'Aubigné score was 16 and 14 for group A and B, respectively. Elmadag et al reported that no significant difference between MSA and IIA with respect to

functional outcome.¹⁸ Rommens et al study showed that 76% patient had excellent to good mean modified Merle d'Aubigné score.¹⁹ Meena et al reported that fractures achieving anatomical reduction were significantly higher in Stoppa group than in ilioinguinal group (p=0.02).²⁰ RCT conducted by Kunlong et al also showed no significant difference between these two groups with respect to all complications.²¹ According to Matta radiological criteria, reduction quality and final radiological results were not statistically significant for MSA and IIA, in this study. But 76.8% patients had excellent to good radiological results in group A whereas in group B it was only 58.8% patients. Shazar et al study showed a 79.4% anatomical reduction rate.²²

Various complications studied in our study showed mean complication rate of 23.07% in group A and 58.33% in group B. In our study, 2 patients from group B developed meralgia paresthetica due to lateral femoral cutaneous nerve injury which is the most common complication with IIA, may be due to trauma to nerve while careless dissection around conjoint tendon and excessive handling of fracture for anatomical reduction. This was recovered over 6-8 months after giving combination of multivitamins, gabapentin and nortriptyline (anti-depressants). Group A patients did not show such injuries because there is direct fracture reduction and less intrapelvic soft tissue trauma. Superficial infection cases were reported equally in both groups as one and there was one deep infection case in group B. It was documented that 16% of surgical wound infection (both superficial and deep) occurs in IIA. Cause for this can be longer mean operative time, more muscular dissection and long incision size. Due to inaccurate reduction we found one patient each of both group had hip pain suggestive of early arthrosis. Although we could not find its progress towards traumatic arthritis as duration of study was less. Different studies reported varied results of traumatic arthritis, 17% by Letournel et al to 57% by Pennal et al.^{23,24} Letournel et al concluded that 50% of the patients developed traumatic arthritis with anatomical reduction in 10-25 years of follow up and 80% of the patients who had imperfect reduction develop traumatic arthritis in <10 years.²⁴ In our study one patient from group B had external iliac vessel thrombosis and one patient had iatrogenic inguinal hernia. Also in group A, one patient had developed incisional abdominal hernia. Rommens et al study also showed that there was one case of external iliac artery thrombosis.²⁵ Prob et al also reported external iliac vessel thrombosis in his

study.²⁶ Korovessis et al reported one case of postoperative hernia after IIA.²⁷

Sole purpose of our study is to help pelviacetabular surgeons in selecting better approach between MSA and IIA for management of pelviacetabular fractures in future. We found that parameters like mean blood loss, mean operative time, and various complications were less in MSA. Our study also showed that functional outcome is also better with MSA. So it was recommend MSA over IIA for pelviacetabular fractures which are managed anteriorly. The main drawback of this study is, less number of study subjects which is due to selection of limited fracture patterns

CONCLUSION

In this study, we have taken efforts to outline the selection criterias for use of either MSA or IIA and mentioned its anatomical accessibility, intraoperative difficulties and postoperative complications and results so that budding pelviacetabular surgeons get a rough outline to use this publication to determine which approach is to be followed for the pelviacetabular fractures that he/she encounters. We wish to consider a larger study with a larger number of patients over a long duration of time in the near future.

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Ethical approval: Not required

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