

## Original Research Article

# Outcome analysis of surgical management of comminuted quadrilateral plate acetabulum fractures

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### ABSTRACT

**Background:** The acetabular quadrilateral fractures are difficult to treat and ORIF using a spring plate buttressing the quadrilateral surface underneath an iliopectenial plate in a 90-90 construct. The aim of the study was to assess the clinical and radiological outcome, success rate and proportion of the post-operative complications of surgical management of comminuted quadrilateral plate acetabulum fractures after ORIF.

**Methods:** It was a hospital based descriptive type of observational study conducted in the Department of Orthopaedics, SMS Medical College. The data collection was done from May 2016 up to June 2018. The sample size was 31 for the study purpose, at 95% confidence limits and 20% relative allowable error.

**Results:** We studied 31 patients of comminuted quadrilateral plate fractures, who were evaluated preoperatively and optimized. ORIF was performed. The mean blood loss was 450 ml and the mean operating time was 130 minutes. The patients were followed up at 1 year postoperatively where 24 patients had an excellent to good Harris Hip clinical score and 24 patients had an excellent to good Matta radiological score, and both were found to be statistically significant.

**Conclusions:** Comminuted quadrilateral plate fractures of the acetabulum are managed surgically by ORIF using a spring buttressing plate beneath the infrapectenial plate. The clinical and radiological follow up for one year duration scores showed good scores which were statistically significant, indicating the success of quadrilateral fixation using this technique.

**Keywords:** Quadrilateral plate, Spring plate, Acetabulum

### INTRODUCTION

The quadrilateral plate refers to the medial wall of the acetabulum and its fractures are most frequently associated with both column, anterior column and posterior hemi transverse, posterior column and combined transverse or T-shaped fractures.<sup>1-4</sup>

Current treatment options for acetabular fractures include both conservative and operative methods. Techniques used include open reduction and internal fixation with pins, screws, plates and screws, percutaneous screws,

cerclage wiring and cable fixation, delayed and acute total hiparthroplasty (THA).<sup>5,6</sup> Quadrilateral plate fractures can be reduced indirectly by reduction and stabilization of column fractures.<sup>7</sup> However, it can be difficult to achieve a congruent reduction of the hip in those with a comminuted or free-floating medial wall fracture.

Open reduction and internal fixation is the gold standard treatment for displaced acetabular fractures involving weight bearing dome and fractures of intra-articular fragments. The goal of treatment relies on restoration of

articular anatomy with stable internal fixation, allowing early mobilization for the patient.<sup>8</sup>

A quadrilateral plate fracture with medial displacement is usually seen in anterior column fractures, anterior column and posterior hemi transverse fractures, T-type fractures, or both-column fractures. Along with the respective column fixation, the quadrilateral plate in such cases needs medial buttressing to prevent medial subluxation of the femoral head.<sup>8-10</sup>

The fixation of a medial buttress plate in an infrapectenial fashion has been described for quadrilateral plate fractures with medial displacement.<sup>10</sup> However, extensive comminution of the quadrilateral plate cannot be effectively buttressed with this infrapectenial plate alone. In such instances, additional fixation of a spring plate, which is usually a small-fragment T-plate, semi tubular plate, and the 3.5 mm reconstruction plate beneath the infrapectenial plate is needed. One end of these spring plates is fixed to the ilium whereas the other limb buttresses the quadrilateral plate when placed underneath the medial-buttressing infrapectenial reconstruction plate.

Our goal was to investigate the appropriateness of ORIF with buttes plating of quadrilateral surface fractures with medial displacement. We used the Modified stoppa approach and the outcome analysis was made clinically and radiologically using the Harris hip score and Matta radiological scoring system.

## METHODS

It was a hospital based descriptive type of observational study, in the Department of Orthopedics, SMS Medical College and attached group of hospitals, the data collection done from May 2016 up to June 2018. The sample size was 31 for the study purpose, at 95% confidence limits and 20% relative allowable error. The study was approved by the institution ethical committee.

On receiving the patients in the ER, general assessment and resuscitation, followed by stabilization of vital parameters, complete skeletal survey and associated neurovascular injuries were assessed. Radiological assessment was done with anteroposterior, Judet views of the acetabulum. Computerized tomography with 3D reconstruction was done in selected patients. Skeletal traction was applied in all the patients.

Our inclusion criteria were patients with both anterior and posterior column fractures with comminuted quadrilateral plate fractures of acetabulum, age between 18-70 years of both sexes, fracture duration less than 14 days after hemodynamic stabilization and patients who are fit for anesthesia and surgery with written informed consent and willing for follow up.

Our exclusion criteria were pregnant patients, periprosthetic fractures, associated major visceral injury

and uncontrolled diabetes, hypertension, psychiatric illness, acute myocardial infarction less than 1 year.

All the fractures were classified as per the Judet and Letournel system. The choice of surgical approach and the implants to be used during the surgery were assessed after a thorough clinical, radiological and pre-operative assessment. Patients were taken up for surgery as earliest after anesthetic clearance.

## Surgical technique

We used non extensile approaches either alone or in combination, they were: the modified stoppa approach (24 patients), anterior ilioinguinal approach (4 patients), iliofemoral approach (1 patient) and the iliofemoral approach with a medial window (4 patients). The modified Stoppa approach was used in 24 patients (72.7%).

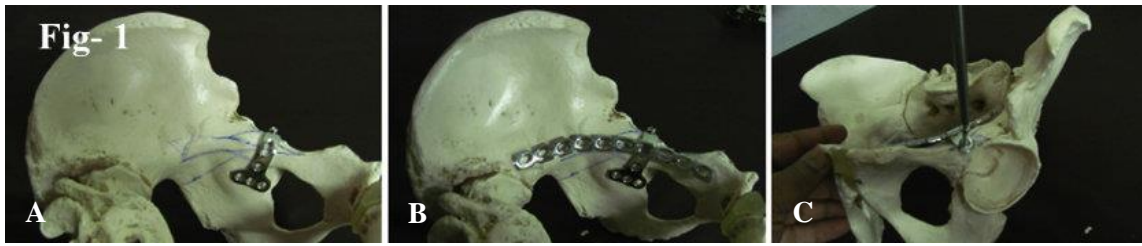
## Modified Stoppa approach

The patient was positioned supine on the operating table and the reducibility of the fracture was checked with C-arm. The surgeon performed the operation standing on the contralateral side of the injured acetabulum. An arc-shaped skin incision of 12–15 cm was made 2 cm proximal to the superior pubic ramus. The incision was deepened to the abdominal fascia. The exposed rectus abdominis muscle was divided along the linea alba to approach the internal aspect of the pelvis.

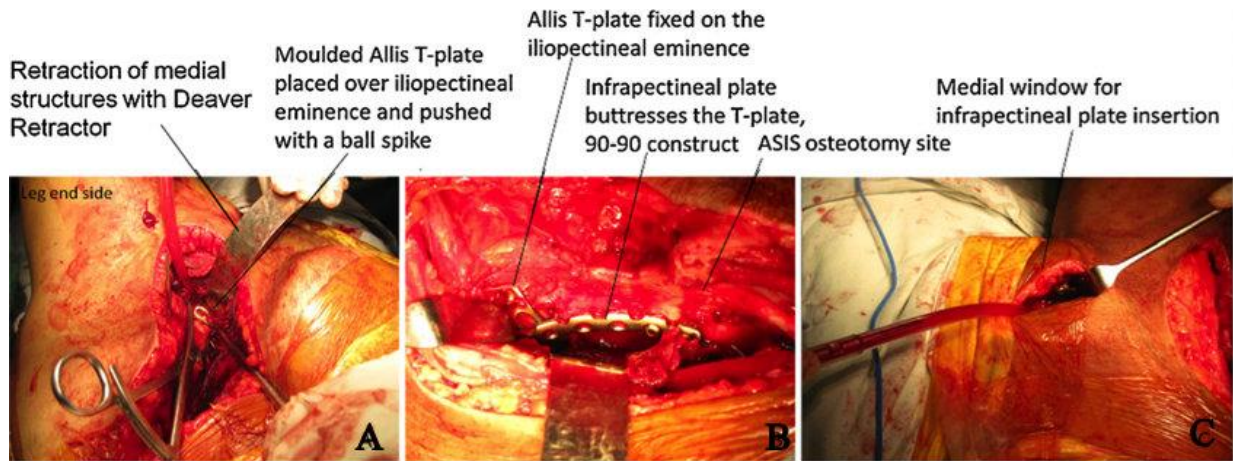
On approaching the inside of the pelvis, corona mortis was identified and ligated first and sub periosteal dissection was performed along the pelvic brim to expose the fracture fragments.

The obturator nerve and vessels that pass through the obturator foramen were usually identified easily and were protected during the further procedure. Extreme precautions were taken to protect the external iliac artery and vein which lie just over the iliopsoas muscle which was retracted upwards. Once the fracture site was exposed, reduction was attempted and internal fixation was performed. Extensive comminution of the quadrilateral plate cannot be effectively buttressed with this infrapectenial plate alone. In such instances, additional fixation of a spring plate beneath the infrapectenial plate is needed.

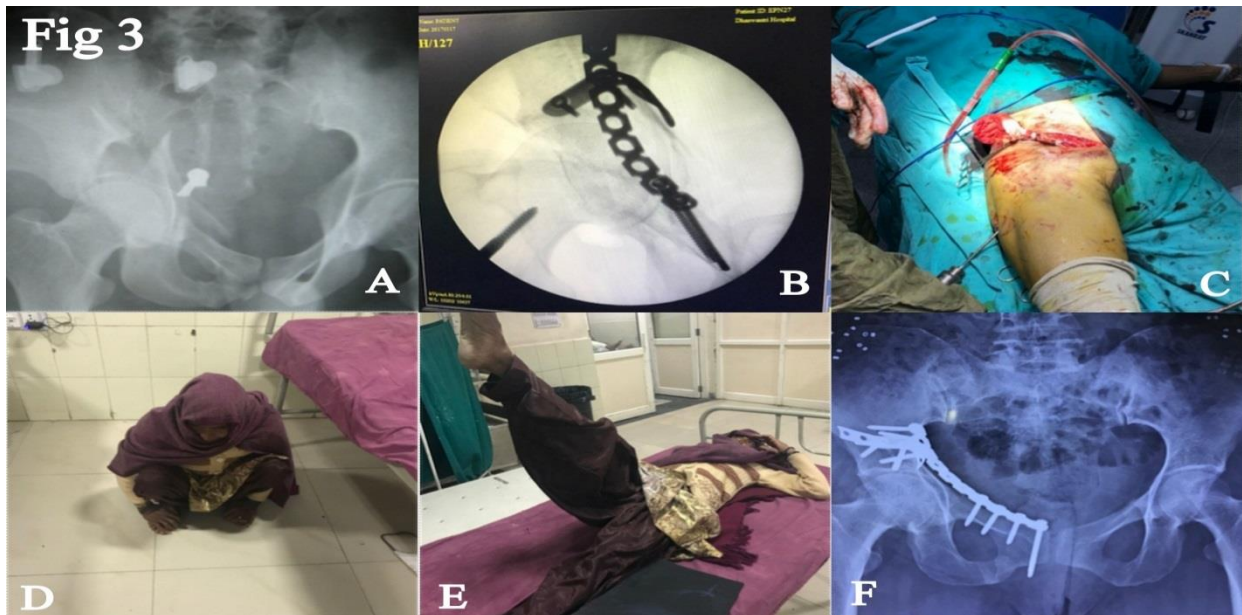
Tile and Mast et al. described the use of various plates i.e., small-fragment T-plate, semitubular plate, and the 3.5 mm reconstruction plate (used as spring plate) to buttress the quadrilateral surface. One end of these spring plates is fixed to the ilium whereas the other limb buttresses the quadrilateral plate when placed underneath the medial-buttressing infrapectenial reconstruction plate which alone provides a better buttressing force over the spring plate but without holding the iliopectenial comminution.



**Figure 1 (A, B and C):** The bone model depicting the surgical technique in the fixation of comminuted anterior column and quadrilateral plate fracture. The T plate acting as a spring plate buttresses the quadrilateral surface with its horizontal limb; the vertical limb holds the fracture fragments along the iliopectineal line and in the supra-acetabular area.



**Figure 2:** (A) Intraoperative clinical photograph showing reduction of anterior column with pelvic clamp and ball spike through the iliofemoral approach, (B) infrapectineal reconstruction plate pushes the underneath spring plate to buttress the quadrilateral surface, (C) medial window for fixation of the medial end of the infrapectineal reconstruction plate.



**Figure 3:** (A) Pre-operative X-ray, (B) intra-operative placement of spring plate buttressing the quadrilateral plate, (C) modified stoppa approach, (D and E) follow up at 1 year showing squatting and good range of motion at hip, (F) post-operative X-ray at 1 year.

Figure 1 shows the bone model depicting our surgical technique in the fixation of comminuted anterior column and quadrilateral plate fracture. The T plate acting as a spring plate buttresses the quadrilateral surface with its horizontal limb, the vertical limb holds the fracture fragments along the iliopectineal line and in the supra-acetabular area.

The vertical limb is fixed to the supra-acetabular region with one or two holding screws. Placement of an infrapectineal reconstruction plate along the pelvic brim exerts force over the spring plate and hence buttresses the quadrilateral surface. As both the plates are right angle to each other, it is called as 90°–90° construct (Figure 2).

Antibiotics were given pre-operatively and continued post-operatively for 5 days. Drain removal done on 2nd post-operative day. Indomethacin 25 mg TDS was prescribed orally for 6 weeks from next day after surgery. Passive mobilization was started on post-operative day 2 and active movements started gradually in accordance with pain. Wound inspected on 2<sup>nd</sup>, 5<sup>th</sup> and 8<sup>th</sup> post-operative day and suture removal done on 12<sup>th</sup> post-operative day. Weight bearing was allowed as the fracture consolidates mostly on the 3rd or 4th month. Patients were asked to follow up at 1 month, 6 months and 1 year. Radiological and functional evaluation was done at the visit by the Harris Hip score and radiologically by the Matta scoring system (Figure 3).

## RESULTS

There were 21 males and 12 females in our study. The average age was 36 years. More than half (51.5%) of the patients showed presence of AC+PC+Q on X-ray. One third of the patients had AC/AW+Q as X-ray finding and 5 (15.2%) subjects showed T+Q on X-ray.

The average blood loss was 450 ml (ranges from 350 ml to 600 ml), and the mean operative time was 130 minutes (ranges from 110 minutes to 170 mins). Two patients had intra operative bleeding because of the injury to the corona mortis and the obturator artery and both these bleedings were controlled by compression packing. Post operatively, superficial wound infection was seen in 4 patients, which were managed with intravenous antibiotics and did not require debridement of the wound.

**Table 1: Harris Hip score at different follow up time.**

Harris hip score	No. of patients at different follow up time (%)		
	1 month	6 months	1 year
Poor (<70)	7 (21.2)	3 (9.1)	3 (9.1)
Fair (71-80)	6 (18.2)	6 (18.2)	4 (12.1)
Good (81-90)	20 (60.6)	19 (57.5)	10 (30.3)
Excellent (>90)	0	5 (15.2)	16 (48.5)
Friedmann test	p<0.001 (S)		

**Table 2: Matta score at different follow up time.**

Matta score	No. of patients at different follow up time (%)		
	1 month	6 months	1 year
Poor	6 (18.2)	2 (6.1)	2 (6.1)
Fair	5 (15.2)	7 (21.2)	5 (15.1)
Good	19 (57.5)	16 (48.5)	6 (18.2)
Excellent	3 (9.1)	8 (24.2)	20 (60.6)
Friedmann test	p<0.001 (S)		

At one year follow up of clinical outcome, most patients (48.5%) had an excellent score and 10 (30.3%) had good score, 4 (12.1%) with fair and only 3 (9.1%) had poor score. This improvement in Harris hip score with time was found to be statistically significant (p<0.001) (Table 1).

At one year follow up of radiological outcome, most patients (60.6%) had improved to Excellent score and 6 (18.2%) had good score, 5 (15.1%) with fair and only 2 (6.1%) had poor score. This improvement in Matta score with time was found to be statistically significant (p<0.001) (Table 2).

Two patients had paresthesia along the lateral aspect of the thigh because of lateral femoral cutaneous nerve injury. Both of them recovered completely within 6 months.

## DISCUSSION

Comminuted quadrilateral plate fractures with medial displacement are a technically difficult fracture to treat. Minimal bone stock, proximity to the hip joint with limited surgical access and difficulty in obtaining stable fixation contribute to surgical challenges of open reduction and internal fixation of these fractures.<sup>11</sup> Fixation of a medial buttress plate in an infrapectineal fashion is inadequate to buttress all the fragments in comminuted quadrilateral plate fractures. Hence, a spring plate in a 90-90 construct is fixed underneath the infrapectineal buttress plate.

In our study the mean blood loss was 450ml and the mean operating time was 130mins, Modified stoppa approach being used In 24 (72.7%) of patients, in our study which was comparable with the similar parameters studied by Sen et al.<sup>11</sup>

The Stoppa approach is a limited intra pelvic approach that has been associated with a decreased complications rate and faster hip abductor mechanism rehabilitation. The ability to regain full hip strength postoperative was reported in 95% of the patients with manual muscle testing preventing scarring and heterotopic ossification around the hip may also facilitated late reconstruction like total hip arthroplasty. This approach was used in a study and has a complication rate comparable to ilioinguinal approach used by Sagi et al.<sup>12</sup>

In comparison to our study, where functional clinical outcome was assessed by Harris Hip scores, showed excellent results in 48.5%, good in 30.3%, fair in 12.1% of patients at 1 year follow up, study by Matta clinical functional outcome, post-surgery was excellent in 37%, good in 47% and fair to poor in 16% of patients.<sup>13</sup> Sen et al had an excellent outcome in 78% of the patients.<sup>14</sup> In comparison to our study, where anatomical reduction quality was assessed by Matta radiological scores, showed Excellent to good results in 78.8% of patients at 1 year follow up, study by Matta showed reduction that was satisfactory anatomically in 74% of patients, Hivrunulo et al had a reduction quality of good to excellent in 84% patients, Sen et al had good anatomical reduction in 83.3% of the patients, Letournel<sup>10</sup> had an anatomical reduction in 61.2% in both column fractures.<sup>13-15</sup>

In a study done by Laflamme et al in 2011, where 21 patients were operated by plates for quadrilateral plate fracture of acetabulum, 11 cases achieved anatomical reduction (<1mm) and 70.6% had satisfactory Harris hip scores which was comparable to our study.<sup>4</sup>

In our study reported only one case (3.03%) of iatrogenic sciatic/femoral nerve palsy. The patient was followed up for a period of 1 year and there was improvement in the neurological deficit with physiotherapy and rehabilitation which was comparable to the study by Letournel which reported a 6% iatrogenic of sciatic/femoral nerve palsy in their study.<sup>10</sup>

Even though our study was composed of a small group of 33 patients with good pre-operative planning, use of extensile approaches and early rehabilitation, we have been able to produce good to satisfactory functional clinical outcomes in 90.9% of the patients and good anatomical reduction assessed radiologically in 93.9% of the patients in a one year follow up. However further follow up is required to comment on the long term outcome.

## CONCLUSION

From our study we conclude that, treatment of quadrilateral plate fractures of the acetabulum is a challenging task for any orthopaedic surgeon with a definitive learning curve. Good pre-operative evaluation, operative planning, surgical technique described above in our study, that is the use of a spring plate in a 90-90 construct below an infrapectenial plate, accurate buttressing of the quadrilateral plate can be obtained. With good post-operative protocol and early rehabilitation it is possible to obtain improved outcome.

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