

# Comparison of Therapeutic Effects of Modified Stoppa Approach and Rectus Lateral Approach on Treating Pelvic Acetabular Fractures

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## Research article

**Keywords:** Pelvic fracture, Modified Stoppa approach, Acetabular fracture, Abdominal rectus lateral approach

**Posted Date:** January 13th, 2020

**DOI:** <https://doi.org/10.21203/rs.2.20707/v1>

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# Abstract

**Objective** To investigate the effect of modified Stoppa approach and lateral rectus abdominis in the treatment of pelvic acetabular fractures.

**Methods** The clinical data of 30 patients with acetabular fractures with ipsilateral pelvic fractures were collected from March 2010 to August 2017. Fifteen patients were treated with modified Stoppa incision approach (group A) Abdominal rectus lateral incision approach (group B). According to the surgical approach were divided into group A and group B, 15 cases, A group improved Stoppa approach, B rectus abdominis lateral approach.

**Results** Compared with Stoppa approach, the operation time, intraoperative blood loss and postoperative drainage volume ( $P < 0.05$ ) were obtained by lateral rectus incision. There was no significant difference between the two surgical groups in terms of postoperative complications and fracture reduction. But the rectus abdominis lateral incision approach can fully reveal the acetabular anterior column and the quadratic body, can face under the reduction and fixation of the acetabular fracture sacroiliac joint and iliac crest fractures, and surgery revealed simple, less damage, less surgical complications.

**Conclusions** The rectus abdominis lateral incision approach is the treatment of pelvic and acetabular fractures, especially with sacroiliac joint iliac crest fractures in the ideal surgical approach.

## Introduction

With the rapid development of China's transportation and construction industry, the incidence of high-energy fracture is significantly higher. Pelvic acetabular fracture is an important type of fractures (1), and its incidence is also obviously increased (2–4). In this study, based on the analysis of the clinical data of patients with pelvic and acetabular fracture admitted into our hospital, we investigated the therapeutic effect of Stoppa approach and rectus lateral approach on treating pelvic and acetabular fractures. The results are reported as follows.

## Method

### General data

Studies on 30 patients with pelvic acetabular fracture treated in our Orthopedics from March, 2015 to August, 2017 were conducted, including 15 cases of traffic accident injury, 12 cases of high fall injury and 3 cases of heavy pound injury. According to the surgical approach, patients were divided into group A and group B with 15 cases in each group. There were 9 males and 6 females in group A aged from 20 to 65. By Tile classification, there were 3 cases of type B1, 5 cases of type B2, 4 cases of type B3, and 3 cases of type C1 in group A. There were 8 males and 7 females in group B aged from 21 to 70. By Tile classification, there were 3 cases of type B1, 4 cases of type B2, 4 cases of type B3, and 4 cases of type

C1 in group B. There were no significant differences in general data between the 2 groups which were comparable ( $P > 0.05$ ).

## **Surgical methods**

All patients taking the 2 approaches were positioned supine under general anesthesia or continuous epidural anesthesia. The operating table was adjusted to ensure that the fixed position of pelvic fractures was well exposed with intraoperative fluoroscopy. Catheter was retained in patients for intraoperative observation of urine. Patients at flexion position were elevated at the affected buttock, and then the affected lower limb was wrapped with routine sterile drape to facilitate intraoperative traction.

### **Modified Stoppa Approach**

A 10–12 cm incision was made from the site 2 cm under umbilicus to pubic symphysis in patients with general anesthesia, and the skin was cut to expose rectus sheath extraperitoneally. During this procedure, attention should be put to the ligation of blood vessels under abdominal wall. Blunt dissection was done extraperitoneally to fully expose the pelvis. Extraperitoneal blunt dissection was gently conducted along the pubic symphysis toward affected pelvic margin. Do not forcefully dissect to avoid bleeding of damaged vessels and damages to the bladder. Gauzes were used to protect the inner peritoneum and then intestinal spatula to displace the peritoneum. Acetabular and abdominal retractors were used exteriorly to fully expose medial acetabulum of pubis, quadrilateral plate and to reach the margin of sacroiliac joint. After the check of separation, ligation was done. Attention must be paid intraoperatively to protect the spermatic cord and round ligament of uterus from damages. The fractured periosteum was cut and then separated to fully expose the fractures. Angled pelvic clamps and related reduction devices were used to replace the fracture bones and provide anatomical reduction as far as possible. Besides, proper steel plate and screws were used for fixation. Intraoperative fluoroscopy was conducted to ensure that the fixed position with steel plate was safe and reliable, and the screws would not enter the acetabulum (5). The incision was rinsed with many saline, and repeatedly examined for active bleeding. Once found, the incision would be ligated to avoid bleeding. Furthermore, the bladder was checked for breakage or not. The rectus sheath, subcutaneous tissue and skins were sutured tightly. A drainage tube was placed in the posterior space of pubis intraoperatively for easy postoperative observation of bleeding inside the pelvic incision.

### **Rectus lateral incision approach**

The incision was marked preoperatively. The line connected the midpoint of the anterior superior iliac spine and 1/3 intersection of the pubic symphysis was taken as the incision. According to the location of fractures, the lower edge of the incision could be adjusted for complete exposure of fractures. Skin and subcutaneous tissue was incised for blunt dissection of the external abdominal oblique, the fascia and transversus abdominis of external oblique and internal oblique were incised for blunt extraperitoneal dissection with fingers along medial acetabulum toward sacroiliac joint while protecting spermatic cord and round ligament from damages (6). It was found intraoperatively that the sacroiliac joint was right below the incision, so the exposure of sacroiliac joint and posterior margin of pelvis was rather direct.

This incision could completely expose the half of the affected pelvis and the front margin of the sacrum. Then the intestinal spatula was used to protect inner peritoneum and retract external lateral iliac artery and iliopsoas. Related reduction devices were used to replace and fix the whole posterior pelvic ring, acetabulum and pubis. The posterior column of pelvis can be fixed with tension screws by hand under direct vision (7). Intraoperative fluoroscopy was conducted to ensure that the fixation was safe and reliable. The incision was rinsed and then a drainage tube was placed. The internal oblique, transversus abdominis, external abdominal oblique and skins were sutured.

Postoperative treatment: Antibiotics were administered for routine prevention, and were generally stopped after 48 hours. Then the incision drainage of patients was observed, and the drainage tube could be removed (generally removed after less than 48 hours) when drainage fluid was less than 50 ml. Postoperative conventional anticoagulant therapy. Patients performed muscle contraction under routine rehabilitation guidance one day after the operation, performed lower limb flexion and extension movement on the bed 3 days after the operation, did lower limb movement without weightbearing about one to two weeks after the operation, and did part of the weightbearing activities 6 weeks after the operation. Postoperative X-ray showed that callus growth and blurred fracture line enable patients to walk with weight bearing (8).

Comparison of incision size, intraoperative exposure range and amount of bleeding. Patients in the two groups were positioned supine under general anesthesia of epidural anesthesia, and underwent operations with lower limb bent and affected buttock elevated with routine sterile drape. The operational time, amount of bleeding and incision exposure range were compared between the two groups. Group A: Modified Stoppa approach made incision in the straight middle of the lower abdomen, entered the pelvic cavity from the middle of the rectus sheath, and replaced and fixed the pubic rami, pelvic quadrilateral plate and posterior pelvic ring. It would be harder to replace the fracture of wing of ilium behind the pelvis. At this time only through another incision of the iliac wing combined with operations can perform reduction and fixation (9). Group B: Rectus lateral incision approach made oblique incision inwardly from rectus abdominis. Due to smaller damages to rectus abdominis, the incision was smaller than that of Stoppa approach. The incision was straight to the inner edge of pelvis and the sacroiliac joint was right under the incision, so there was no need to add another incision for iliac crest fractures and operations could be performed with the one incision. There were no significant differences in incisions of pubic rami and quadrilateral plate fractures.

Comparison of satisfaction of fracture reduction Postoperative X-ray and CT examination suggested that the maximum distance of dissection was below 3 mm, acetabular fracture displacement below 2 mm was determined as marked effective; the maximum distance of dissection was 3–8 mm, acetabular fracture at 2–3 mm was determined as effective; the maximum distance of dissection was 8–15 mm, acetabular fracture displacement at 2–3 mm was determined as acceptable; the maximum distance of dissection was above 15 mm, acetabular fracture displacement at more than 3 mm was determined as ineffective (10). Fracture reduction satisfaction= (number of markedly effective cases + number of

effective cases) / total number of cases × 100%. 1.4.3 Hip function was evaluated at 6 months after hip operation according to the Merled Aubign-Postel Score (11).

## Results

### Comparison of the amount of bleeding and operation time

The length of incision, operation time, operation blood loss and hospitalization time were lower than those of the group with Stoppa approach, and the differences were statistically significant ( $P < 0.05$ ).

### Fracture reduction and hip function recovery

All patients were followed up for 3 to 12 months with an average follow-up of 4 months. In terms of fracture replacement quality, there were 8 markedly effective cases, 6 effective cases, and 1 acceptable case of reduction quality, and the replacement satisfaction was 14/15 in the rectus lateral approach group; there were 5 markedly effective, 6 effective cases, and 4 acceptable cases, and the replacement satisfaction was 11/15 in the Stoppa approach group. In terms of hip joint function score, there were 9 excellent case and 5 good cases, and the excellent and good rate were 14/15 in the rectus lateral approach group; there were 6 excellent cases, 4 good cases and 5 acceptable cases, and the excellent and good rate was 10/15. The former was superior to the latter in the excellent and good rate of hip joint function score ( $P < 0.05$ ), but there was no significant difference in replacement satisfaction between the two groups ( $P > 0.05$ ).

### Comparison of postoperative complications

There was one case of postoperative superficial incision infection in the rectus lateral approach group, while there were 1 case of superficial incision infection, 1 case of deep vein thrombosis, 1 case of bladder injury and 1 case of lateral femoral paralysis in the Stoppa approach group. The incidence of complications in the former was lower than that in the latter one, but the differences were not statistically significant ( $P > 0.05$ ).

## Discussion

Pelvic and acetabular fracture are high-energy. For unstable pelvic acetabular fractures, surgical treatment is recommended with the absence of obvious contraindications. Stoppa approach is currently a common surgical approach and is often used for fractures in the anterior wall, anterior column of pelvis and in pubis (12). This approach was originally used by surgeons for complex hernioplasty. After the approach was modified, longitudinal incisions have more extensive exposure, which can show the range from the pubic symphysis to the sacroiliac joint. The modified Stoppa approach has obvious advantages when compared with the traditional ilioinguinal approach. In terms of fracture displacement and fixation, since the pubic rami, acetabular quadrilateral plate and the front border of sacroiliac joint can be exposed after Stoppa approach retracts the lateral vessels and nerves, fractures can be replaced and fixed intraoperatively under direct vision. The steel plate is placed under the bottom of pelvic border, which is

relatively flat for easy plate remodeling and screw fixation (13). As replacement and fixation meet biomechanical needs, operations are easy to perform. The Modified Stoppa approach usually makes a median incision 2 cm under the umbilicus or a transverse incision 2 cm above the pubic symphysis, and then cuts the linea alba peritoneally. In cases of bilateral pelvic fractures and acetabular fractures, reduction and fixation of bilateral pelvic acetabular fractures can be performed on a Stoppa incision. But since the incision is made through the middle of the rectus abdominis and rectus abdominis cannot be retracted easily towards two sides, the exposure to partial fractures of sacroiliac joint and space are limited, thereby limiting the fracture replacement and fixation of the steel plate. Especially the limitations are more obvious in obese patients or when muscles are not relaxed under epidural anesthesia. For unilateral acetabular fractures, we took the ipsilateral rectus abdominis straight incision approach, which effectively avoided the obstruction of rectus abdominis. The incision was closer to the acetabulum, which was more conducive to the exposure and operation of fractures. This incision could expose the quadrilateral plate and sacroiliac joint fractures well even under ineffective anesthesia, and would not affect the operation. Therefore, some scholars believe that the advantages of the approach lie in that the anatomical reduction and fixation can be performed through the incision under direct vision among patients with unilateral posterior column and sacroiliac joint fractures. Especially for posterior column fractures, we can directly fix the posterior column with a single long screw with hand touching the ischia node to avoid trauma caused by posterior reduction and complications. Currently, the Third Affiliated Hospital of Southern Medical University mainly uses this incision at home. Pubic rami, quadrilateral plate and sacroiliac joint fractures can be exposed with lateral rectus abdominis incision. The reports on the reduction and fixation were satisfactory, suggesting that this approach is safe and feasible (14). According to our surgical experience, the advantages of lateral rectus abdominis incision are as follows:

1. The surgical incision is small. The incision size and direction can be adjusted intraoperatively based on the location of fractures. Besides, the trauma and bleeding are less.
2. The quadrilateral plate and sacroiliac joint are right under the incision with rectus lateral incision, which provides a favorable surgical vision for fracture fixation and enable surgeons to more directly treat fatal coronary artery under direct vision.
3. Damages to neurovascular bundles can be effectively avoided without dissection of external iliac arteriovenous and femoral nerve.
4. The size and direction of incisions can be flexibly adjusted based on fracture sites, and be more favorable for patients with developed rectus abdominis and obese patients. Three windows can expose the whole pelvic ring from the pubic symphysis to the sacroiliac joint. The incision close to fractures facilitate fracture reduction and fixation. Our findings showed that for unilateral pelvic acetabular fractures, the incision length, exposure to sacroiliac joint, operational time, intraoperative blood loss and the excellent and good rate of postoperative hip joint function scores are better in the rectus lateral approach than in the Stoppa approach ( $P < 0.05$ ), which confirms that rectus lateral approach provides better application values for treating complex pelvic acetabular fractures (15). For complex C3 pelvic fracture, rectus lateral approach can fully expose the anterior ring and column and sacroiliac joint for effective reduction and fixation. In short, when treating pelvic fractures, we should carefully analyze a proper incision approach preoperatively based on the patient's imaging data to facilitate intraoperative fracture reduction and fixation. When treating bilateral pelvic acetabular fractures, Stoppa incision is a good surgical incision choice with one incision for bilateral fractures. But for

unilateral pelvic fractures, especially with sacroiliac joint fractures and posterior iliac crest fractures, rectus lateral approach is a feasible surgical approach to the separation and displacement of fractures (16). As a new way of treating pelvic acetabular fractures, the rectus lateral approach can expose anatomical structures including the quadrilateral plate, sacroiliac joint, which is conducive to fracture reduction and fixation. On the other hand, this approach can also shorten the incision length, lessen operative blood loss and improve hip joint function, so it is a better choice for treating complex pelvic acetabular fractures. Pelvic fractures complicated with lumbosacral plexus injury are difficult to be clinically treated. The rectus lateral incision can expose sacroiliac joint, loosen the compression of the lumbosacral plexus root and perform fracture reduction and steel plate fixation under direct vision. Therefore, the rectus lateral incision is a favorable choice for the reduction and fixation of sacroiliac joint and posterior iliac crest fractures (17).

## Declarations

### Disclosure of conflict of interest

None.

### Author's contribution

Xujin Wang and Jiazhao Yang for writing of the manuscript. Shiyuan Fang for the discussion of and Lei Xu for discussion and comments on an earlier version of the manuscript. All authors read and approved the final manuscript.

### Ethics, consent and permissions

Ethical approval was given by the first affiliated Hospital of USTC, Division of Life Science and technology of China.

### Funding

None.

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