



Original Research

Comparison of Surgical Results of Modified Stoppa and Ilioinguinal Approach in Patients with Acetabular Fractures Involving Quadrilateral Surface Fractures

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Abstract

Objectives: The aim of this study was to evaluate the results of surgical treatment in patients with acetabular fractures with a fractured quadrilateral surface treated using two different approaches.

Methods: The study included 106 patients who were operated on with ilioinguinal (group A) or modified Stoppa (group B) technique for acetabular fracture with a fractured quadrilateral surface between 2011 and 2020 in our clinic. The quality of reduction was evaluated according to Matta criteria and postoperative pelvic (anteroposterior, external oblique, iliac oblique) radiographs. Evaluation of hip function was recorded using the Merle d'aubigne and Postel Score and Harris Hip Score.

Results: Among the patients included in the study, there were 45 patients in group A and 61 patients in group B. When the group data were compared, it was seen that the modified Stoppa approach was superior in terms of intraoperative reduction quality, radiological data, Harris hip score, Merle d'aubigne and PostelScore. (Respectively $p=0.40$, $p=0.49$, $p=0.040$, $p=0.028$).

Conclusion: Modified Stoppa approach has successful clinical and radiological outcomes and better reduction quality and hip scores than ilioinguinal approaches in acetabular fractures involving quadrilateral plates.

Keywords: Acetabulum, fixation, quadrilateral pelvis, trauma

Please cite this article as "Tekin SB, Karsli B, Ogumsogutlu E, Bozgeyik B, Karabulut C. Comparison of Surgical Results of Modified Stoppa and Ilioinguinal Approach in Patients with Acetabular Fractures Involving Quadrilateral Surface Fractures. Med Bull Sisli Etfal Hosp 2024;58(1):10–16".

The presence of acetabular fracture has several difficulties in terms of the treatment process. The main aim of the acetabulum surgery is to provide a stable joint reduction, to initiate early joint movement, to reduce pain and thus to prevent early joint arthrosis. The studies of Judet and Letournel have identified surgical treatment as the optimum treatment approach for displaced acetabular fractures.^[1] Acetabular fractures require anatomical reduction

due to the involvement of the joint, for which it is first necessary to properly understand the fracture type, to have good data of surgical techniques and to choose the appropriate implants. The importance of anatomical reduction and its effect on clinical outcomes were reported in the study by Matta,^[2] while Judet and Letournel provided a classification of acetabular fractures and described the treatment.^[3] The quadrilateral plate (QLP) is a relatively flat bony area

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Submitted Date: August 08, 2023 **Accepted Date:** September 07, 2023 **Available Online Date:** April 05, 2024

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that lies medial to the acetabulum. Fractures in this region, which are located in the true pelvis beneath the pelvic brim, can be accessed through a limited safe surgical zone, although the plate is close to the hip joint, which complicates the surgical treatment. The QLP injuries can be in the anterior column and anterior wall and can be transverse, T type, anterior column, posterior hemitransverse or double column fractures.^[4, 5] For fractures requiring an anterior approach, ilioinguinal and modified Stoppa approaches can be used.^[6-8] Although the ilioinguinal technique is the traditional method for this fracture pattern, QLP and corona mortis can be seen directly with the modified Stoppa approach.^[9] This study compares the surgical outcomes of patients treated with two different approaches after acetabular fracture in which the quadrangular surface is affected.

Methods

After Ethics Committee approval (No: 2020/262), 106 patients who met the study criteria were included in the study and evaluated in accordance with the Helsinki declaration. The study groups were determined as group A for patients using the ilioinguinal approach and group B for patients who preferred the modified Stoppa technique. The inclusion criteria were: presence of an acetabular fracture requiring an anterior surgical approach, an accompanying QLP fracture, availability of appropriate imaging, age > 18 years, and adequate follow-up duration and data. Patients with simple posterior wall and column fractures, those with-

out appropriate imaging, and those who did not attend follow-up examinations were excluded from the study. All patients underwent 3D computed tomography (CT) in the emergency department and conventionally administered skeletal traction until surgery. The patient's demographic data, fracture mechanism, type of fracture, accompanying injuries and presence of accompanying neurovascular injury were noted. The demographic data are presented in Table 1. The medical records and radiological images of the patients who were followed up at regular intervals for at least 1 year were analyzed retrospectively. All patients were administered low-molecular-weight heparin for 4 weeks after injury and antibiotics for 3 days after surgery. All patients were mobilized on postoperative day 2 without weight-bearing, with gradual weight-bearing initiated at weeks 8-10. Radiological and clinical outcomes were assessed after being documented at the last visit.

Surgical Procedure

In line with conventional procedures, skeletal traction was performed to all patients in the emergency department. In the ilioinguinal approach, the incision is in the anatomical location between the pubis and the iliac wing over the ilioinguinal ligament. Considering the anatomical structures between the iliac crest and the spermatic cord, it is evaluated in 3 regions lateral, middle and medial windows. Dissection of the iliopectineal fascia is necessary to visualize the fracture line.^[10] X-ray images of the patient operated with ilioinguinal approach are shown in Figure 1.

Table 1. Demographic data

	Group A (n=45)	Group B (n=61)	Total number	p
Mechanism of injury, n (%)				
Age	41.3 (18-86)	38.62 (18-79)		0.561
Male gender	34 (75.6)	50 (82)		0.421
Traffic accident	25 (55.6)	33 (54.1)		0.960
Fall from height	19 (42.2)	27 (44.3)		
Crush	1 (2.2)	1 (1.6)		
Fracture classification, n (%)				
AW	12 (26.7)	12 (19.7)	24 (22.6)	0.745
AC	5 (11.1)	6 (9.8)	11 (10.4)	
Transverse	9 (20.0)	15 (24.6)	24 (22.6)	
T-type	4 (8.9)	11 (18.0)	15 (14.2)	
AC+PH	9 (20)	11 (18)	20 (18.9)	
BC	6 (13.3)	6 (9.8)	12 (11.3)	
Multiple Injuries, n (%)				
Pelvic fracture	7 (15.5)	10 (16.3)	17 (16.03)	0.782
Extremity fracture	8 (17.7)	13 (21.3)	21 (19.81)	
Spine fracture	1 (2.2)	0	1 (0.09)	
Pleural effusion	12 (26.6)	17 (27.8)	29 (27.35)	
Intracranial hemorrhage	2 (4.4)	2 (3.2)	4 (0.37)	



Figure 1. Preoperative and postoperative radiographs of a 33-year-old male patient who underwent an operation with the ilioinguinal approach.

In the Stoppa approach, a rectus abdominis dissection is performed after a horizontal incision 1 cm above the symphysis pubis. Anastomosis of the inferior hypogastric and obturator vascular bundle (corona mortis) is important at this stage. Afterwards, the dissection is advanced towards the sacroiliac joint and quadrangular surface.^[11] The surgeon stands on the opposite side of the fracture line, which permits access to the QLP and posterior region. Reduction clamps can be used for reduction purposes, while femoral traction can reduce the deforming forces on the QLP. If necessary, the opening of the lateral window with an additional incision on the iliac wing can be used to fix the iliac wing. X-ray images of the patient operated with stoppa approach are shown in Figure 2.

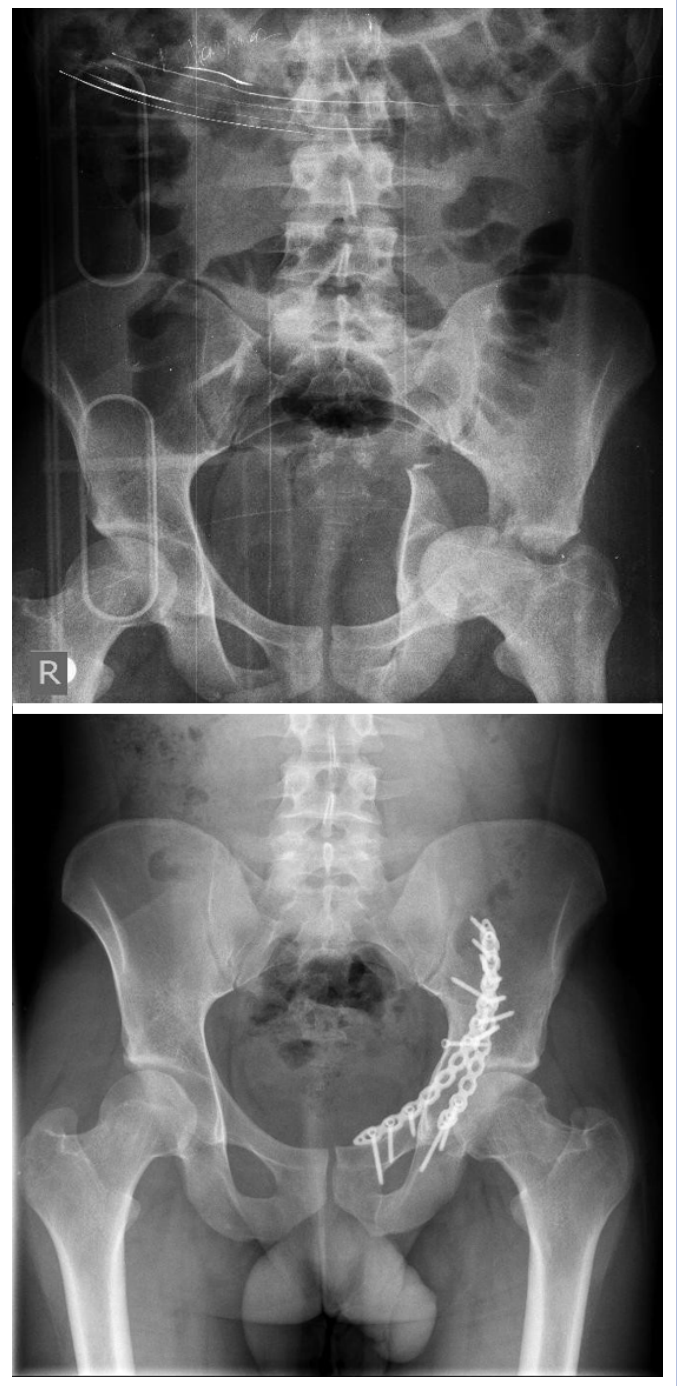


Figure 2. Preoperative and postoperative radiographs of a 22-year-old male patient who underwent an operation with the modified Stoppa approach.

Radiological Assessment and Follow-Up

Fracture reduction evaluation was commented via post-operative pelvic (anteroposterior, external oblique, iliac oblique) X-rays, based on Matta's criteria. Displacement of 0–1 mm was accepted as anatomical, 2–3 mm as imperfect, and >3 mm as poor reduction. All patients were followed

up at postoperative month 1, month 3, month 6 and year 1, and longer if necessary. At the last follow-up examination, hip function was recorded using the Merle d'aubigne and Postel Score, and the Harris Hip Score.^[12] The patients were evaluated by Merle d'aubigne and Postel scoring with pain, range of motion and gait, and they were classified as excellent, good, fair and weak according to their scores.^[13]

A radiological assessment was made during the follow-up according to Matta's criteria.^[14] A normal-appearing hip joint was accepted as excellent; minimal sclerosis and a <1 mm narrowing of the joint space as good; moderate sclerosis and a <50% narrowing of joint space as fair; and severe sclerosis and a >50% narrowing of joint space as poor.

Statistical Method

Qualitative variables were evaluated using the Shapiro-Wilk test. Evaluation of non-parametric data was done with Mann-Whitney U test and Chi-square test was used in the analysis of categorical variables. A p-value of <0.05 was considered significant. All analyses were performed using IBM SPSS Statistics for Windows (Version 22.0. Armonk, NY: IBM Corp.).

Results

Surgical Details

Group A included 45 patients (34 male; 11 female) with a mean age of 41.38 years (range: 18–86, SD: 19.40); and Group B included 61 patients (50 male; 11 female) with a mean age of 38.62 years (range: 18–79, SD: 17.06). Among the patients treated with the ilioinguinal approach, 12 had an anterior wall, five had an anterior column, nine had transverse, four had T-type, nine had an anterior column and posterior hemitransverse, and six had double column fractures. Among the patients treated with the Stoppa approach, 12 had an anterior wall, six had anterior column, 15 had transverse, 11 had T-type, 11 had an anterior column and posterior hemitransverse, and six had double column fractures. The operative time was 146.39 (105–215) in Group A and 156.56 (110–235) in Group B. The amount of bleeding was 607.33 (380–1080) in Group A and 542.13 (350–970) in Group B. While the amount of bleeding was lower and the operative time was shorter in Group B than in Group A, the differences were statistically insignificant ($p=0.60$ for intraoperative hemorrhage, $p=0.157$ for operative time). Additionally, a KL approach was used in 16 of the patients in Group A and in 31 of the patients in Group B ($p=0.118$).

There were 22 (48.9%) smokers and 23 (51.1%) non-smokers in Group A, while 26 (42.6%) patients were smokers and 35 (57.4%) were non-smokers in Group B. The difference in smoking was statistically insignificant ($p=0.522$).

The fracture side was left in 20 (44.4%) patients in group A,

and left the fracture side in 27 patients (44.3%) in group B. The difference in fracture was statistically insignificant ($p=0.985$).

In Group A, 12 patients had pleural effusion, seven patients had accompanying pelvic fractures, eight patients had accompanying extremity fractures, two patients had intracranial hemorrhage and one patient had a lumbar vertebral fracture. In Group B, there was a pleural effusion in 17 patients, intracranial hemorrhage in two patients, accompanying extremity fractures in 13 patients and accompanying pelvic fractures in 10 patients.

Radiographic Analysis

When the postoperative reduction quality was evaluated according to Matta criteria, anatomical reduction in 13–30 patients, imperfect reduction in 15–20 patients, and reduction poor in 17–11 patients in Groups A and B, respectively. Group A was superior in terms of reduction quality ($p=0.40$).

Radiographs of the patients at the final examination were evaluated based on Matta's criteria.^[13] Group A and B were also classified as 12 - 28 excellent, 17–16 good, 6–12 fair 10–5 poor, respectively. Group A was statistically superior in terms of radiological data ($p=0.049$).

While arthrosis developed in 19 (42.2%) patients in Group A, there were no arthrosis findings in 26 (57.8%) patients. In Group B, arthrosis was detected in 13 (21.3%) patients, while there were no arthrosis findings in 48 (78.7%) ($p=0.02$).

Follow-up Results and Complications

All patients were examined and controlled at regular intervals, with a mean follow-up of 22.98 months (12–76) in Group A and 18.10 (12–48) months in Group B ($p=0.199$).

Clinical outcomes were evaluated based on the Harris Hip Score and Merle d'aubigne and Postel Score at the last visit. According to the Merle d'aubigne and Postel scoring system, Group A had 12 excellent, 17 good, eight fair and eight poor outcomes; while in Group B, there were 30 excellent, 23 good, four fair and four poor outcomes. The difference was statistically significant ($p=0.028$). According to Harris Hip scoring, the mean score was 73.96 (SD: 15.29 (42–96)) in Group A and 79.36 (SD: 14.91 (48–96)) in Group B, and this difference was statistically significant ($p=0.040$).

Table 2. Complications

	Group A	Group B
Sciatic nerve injury	1	0
Peroneal nerve injury	2	4
Vascular injury	0	2
Deep vein thrombosis	1	0
Heterotopic ossification	2	1

The complications encountered are presented in Table 2. In Group A, postoperative sciatic nerve injury was observed in one patient, peroneal nerve injury in two patients, heterotopic ossification in two patients and deep vein thrombosis in one patient. In Group B, there was postoperative peroneal nerve injury in four patients. When looking at the others, heterotopic ossification in one patient and vascular damage in two patients.

Discussion

Acetabular fractures accompanied by a QLP fracture can be operated using ilioinguinal, modified iliofemoral and modified Stoppa approaches, as well as a wide variety of implants. The present study has compared the ilioinguinal and modified Stoppa approaches for surgical results in patients with acetabular fractures with QLP fractures. Although the ilioinguinal approach is considered the optimum technique for the treatment of anterior acetabular fractures, many orthopedic surgeons opt for the modified Stoppa technique.^[15-17] While the ilioinguinal approach provides indirect access to QLP fractures, the modified Stoppa method allows the direct visualization of the infrapectinal region and the QLP fracture.^[18]

Prolonged operative times have been reported with the ilioinguinal incision due to the increased surgical morbidity, hemorrhage, repeated mobilization of the neurovascular bundle and working through different windows.^[19] Shazar et al.^[16] reported a mean time of 293.4 min for the ilioinguinal incision and 240.5 min for the modified Stoppa approach, while another study reported a mean time of 134.4 min for the ilioinguinal approach and 107.14 min for the modified Stoppa incision.^[20] According to the study by Elmadag et al.,^[21] there is no significant difference in the amount of bleeding. In the present study, the amount of bleeding was lower and the surgery time was shorter in the Modified Stoppa group, although the difference was statistically insignificant ($p=0.60$ for intraoperative hemorrhage, $p=0.157$ for operative time).

As in all joint fractures, reduction quality and stable fixation determine the clinical outcomes and posttraumatic arthritis most in acetabular fractures.^[22] Matta reported excellent and good outcomes in 150 (81.1%) of 185 patients in which anatomical reduction was achieved.^[2] In the study, anatomical reduction was obtained in 52 (57%) of 92 patients with double-column fractures. Briffa, on the other hand, achieved anatomical reduction in 53 (77.9%) of 68 patients who underwent an operation with the ilioinguinal approach.^[23] Sagi et al.^[24] reported 50 cases (92%) with excellent and good reduction achieved using the Stoppa approach. Ponsen^[25] reported an anatomical

reduction rate of 58% in patients operated on with the modified Stoppa approach. Meena,^[20] on the other hand, achieved anatomical/appropriate reduction in 68.3% of patients operated with the ilioinguinal incision and 78.1% of those treated with the modified Stoppa incision. In the present study, the rate of anatomical/imperfect reduction quality was 62.2% in Group A and 72% in Group B. The results are comparable. The reason for the more successful reduction in patients treated with the Stoppa approach may be attributed to the direct visualization of the QLP, while Shazar et al.^[16] mentioned specifically the better impaction and better reduction quality achieved as a result of direct visualization.

Concerning clinical outcomes, Laflamme^[5] reported a mean Harris Hip Score of 83.3 in patients treated with the ilioinguinal approach. Hirvensalo, on the other hand, reported that 80% of patients treated with the modified Stoppa method had a score of ≥ 75 .^[26] The Harris Hip Score did not indicate a significant difference between the two approaches in Elmadağ's study.^[21] In our study, the group treated with the modified Stoppa approach was superior in terms of Harris hip score and Merle d'auvigne and Postel scoring. There are studies in the literature supporting this.^[17]

In the present study, an additional Kocher-Langenbeck incision was performed on 16 (35.5%) patients in ilioinguinal technic group and on 31 (50.8%) patients in modified Stoppa group. The study by Shazar, in turn, reported a Kocher-Langenbeck incision being performed in 9% of the patients treated with the ilioinguinal approach and 2% of those treated with the Stoppa approach.^[16] It was thus seen that we use the Kocher-Langenbeck incision more frequently in our surgeries than reported in the literature.

According to the evaluation at the last visit based on Matta's radiological criteria, the radiological data were statistically significantly better in ilioinguinal approach group than in modified Stoppa approach group ($p=0.49$). The study by Giannoudis et al.^[27] reported 40.0% excellent, 36.7% good, 13.3% fair and 10.0% poor outcomes. These results are comparable.

There have been several articles identifying nerve injury as a common complication, occurring at a rate of 2–26% after acetabular surgery.^[24] In the present study, there was one patient with sciatic injury and two patients with a peroneal nerve injury in Group A, while a peroneal nerve injury developed in four patients in Group B. A single patient in each group reported no improvement in nerve function at follow-up.

There are some limitations, the first of which is its retrospective design. Despite the several implant options available, only screw fixation methods were compared in

the study. The study focused on surgical technique and radiological and clinical outcomes, and the learning curve of the surgical team was not taken into account. Despite these limitations, we believe our study reveals that the modified Stoppa approach is associated with better radiological and clinical outcomes in acetabular fractures with a QLP fracture.

Conclusion

The treatment of acetabular fractures with a QLP fracture may be challenging. Surgical approaches to the management of such fractures should be well-known by the orthopedic surgeon. Our study encourages the adoption of the modified Stoppa approach given its relationship with successful radiological and clinical outcomes and better reduction in such fractures.

Disclosures

Ethics Committee Approval: After Ethics Committee approval (No: 2020/262), 106 patients who met the study criteria were included in the study and evaluated in accordance with the Helsinki declaration.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – B.K., C.K.; Design – B.B., E.O.; Supervision – S.B.T., C.K.; Materials – B.K.; Data collection &/ or processing – E.O.; Analysis and/or interpretation – S.B.T., B.K.; Literature search – E.O., C.K.; Writing – S.B.T., B.B.; Critical review – E.O., B.B.

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