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# Outcome for Patients with Acetabular Fractures Treated Using Only Modified Stoppa Approach or in Combination with Iliac Wing Approach: 10-Year Experience

## Výsledky léčení pacientů se zlomeninou acetabula s použitím samostatného modifikovaného Stoppa přístupu nebo v kombinaci s přístupem k lopatě kyčelní: 10 let zkušeností

**A. VIKMANIS[1,2], R. JAKUSONOKA[1], A. JUMTINS[1], Z. PAVARE[1]**

[1] Riga Stradins University, Department of Orthopaedics, Riga, Latvia
[2] Clinical Centre "Gailezers", Department of Traumatology and Orthopaedics, Riga Eastern Clinical University Hospital, Riga, Latvia

## ABSTRACT

PURPOSE OF THE STUDY
This retrospective study presents our experience in treatment of polytrauma patients with acetabular fractures treated with only modified Stoppa approach or in combination with iliac wing approach. The purpose of this study was to evaluate the outcome of polytrauma patients with acetabular fractures operated with only modified Stoppa approach or in combination with iliac wing approach.

MATERIAL AND METHODS
Polytrauma patients who suffered from acetabular fractures treated in our hospital during 2008–2018, operated by using only modified Stoppa or in combination with iliac wing approach, were included in the study. The patients were evaluated using Majeed score. Cases with hip replacement due to post-traumatic osteoarthritis (PTOA) were summarized. The study group was compared with control group, which was operated through ilioinguinal approach.

RESULTS
We examined 42 patients (12 women and 30 men; mean age 44 years). Anatomical or satisfactory fracture healing was achieved in 92% of the acetabular fractures. In the study group Majeed score was significantly better ($p<0.05$). Seven patients from the study group had hip replacement due to PTOA with following results – 5 patients (13%) with anatomical or satisfactory reduction and 2 patients (50%) with displacement more than 3 mm of all reductions of acetabular fractures.

DISCUSSION
In polytrauma patients, the risk of the development of severe PTOA is increased because of high-energy trauma impact and a satisfactory reduction of acetabulum does not always protect against severe PTOA with following necessity for total hip replacement.

CONCLUSIONS
Our experience with using the modified Stoppa approach and its combination with iliac wing approach shows that these techniques provide better fracture reduction, gain mostly good radiological and functional results, may decrease the risk of development of severe symptomatic hip PTOA and hip replacement in polytrauma patients with both column acetabular fractures. Our results suggest that unsatisfactory reduction of an acetabular fracture is a strong predictor of symptomatic severe PTOA, which is treated by using total hip arthroplasty.

**Key words:** acetabulum, modified Stoppa approach, iliac wing approach, post-traumatic osteoarthritis.

## INTRODUCTION

Treatment of polytrauma patients with acetabular fractures is challenging and using less invasive surgery in reduction and stabilization of the displaced acetabular fractures is essential in treatment of these patients. The modified Stoppa approach, being less invasive, allows to improve fracture reduction and functional outcome of polytrauma patients with acetabular fractures (4, 20). In reduction and internal fixation of both-column acetabular fractures, a combination of the modified Stoppa approach and the iliac wing approach may be used (1, 5). We described our 10-year of experience with these approaches used in polytrauma patients with acetabular fractures. The purpose of this study was to evaluate the outcome of polytrauma patients with acetabular fractures operated with only modified Stoppa approach or in combination with iliac wing approach. The most common mid-term and long-term complication is post-traumatic osteoarthritis (PTOA) which occurs in approximately 20% of the patients after displaced acetabular fractures (7). Using less traumatic surgical approaches

in the reduction and stabilization of the acetabular fractures is essential to decrease the incidence of PTOA and improve the outcome in these patients (9).

## MATERIAL AND METHODS

Retrospective study of 45 polytrauma patients who suffered from acetabular fractures treated in our hospital during 2008–2018 was performed. Polytrauma patients, operated by using only modified Stoppa or in combination with iliac wing approach in our hospital during the mentioned period, were included in the study. The New Injury Severity Score was used to evaluate the polytrauma severity (6).

The control group included 24 polytrauma patients, 17–65 years of age, operated through ilioinguinal approach (14).

### Surgical treatment

All patients were operated by the author. The modified Stoppa approach was used in 28 cases and its combination with iliac wing approach in 14 cases.

We have been using the modified Stoppa approach since 2008 as a good option in the treatment of polytrauma patients with acetabular fractures, because it appears to provide good radiological and mid-term functional results (10, 20, 21). Since 2008 we have combined the modified Stoppa approach with iliac wing approach if the fracture involves both columns of acetabulum. We also use this combination when there is a difficulty mobilizing and manipulating external iliac artery in order to reach this artery from the lateral side and avoid the risk of thrombosis of femoral vein. Computed tomography was performed before the surgery to plan the steps of operation. The iliac wing approach was performed by using approximately 10 cm long incision along the iliac crest. The external oblique muscle was subperiosteally elevated from the iliac crest. Careful blunt dissection was made to the interior part of the sacroiliac joint, medially to the pelvic ring and proceeding anteromedially at the pelvic rim to the iliopectineal eminence. The sacroiliac joint capsule was identified. The dissection was continued medially to the sacral ala. The L5 nerve root was noted and care was taken not to injure the superior gluteal artery and nerve. To fixate acetabular fractures, reconstruction plate 3.5 was used (1). In case of posterior wall fracture during the preoperative planning an additional Kocher-Langenbeck approach was planned. The control group consisted of polytrauma patients, operated through ilioinguinal approach.

### Outcome evaluation

The patients were invited to participate in evaluation of the outcomes by operating surgeon. All polytrauma patients with acetabular fractures were operated in our department during the mentioned period. Patients' hip function assessment before hip replacement was performed by using the Harris hip score. According to the Harris hip score, outcomes were graded as excellent for 90 to 100, good for 80 to 89, fair for 70 to 79 and poor < 70 points (8). Functional outcome and pelvic trauma-specific quality of life of patients, for those included in the study, was evaluated using Majeed score in patients with more than two years of follow-up (17). Patients functional assessment was performed based on seven criteria: pain (30 points), work (20 points), sitting (10 points), sexual intercourse (4 points), walking aids (12 points), unaided gait (12 points) and walking distance (12 points) according to Majeed score for grading the outcome of pelvic fractures. According to the total Majeed score, outcomes were graded as excellent for a score ≥ 85, good for 84 to 70, fair for 69 to 55 and poor < 55 points (2, 13, 20).

Those who did not respond to three phone calls and/or the invitation letter, or had second lower limb trauma after polytrauma, were excluded from this study. In our study three patients were excluded due to being lost in follow-up. We clinically evaluated functional and radiological outcome in the group of 42 polytrauma patients operated by only the modified Stoppa approach or in combination with iliac wing approach. We evaluated hospital case-records, preoperative, postoperative and follow-up radiographs, and computed tomography.

If the displacement of the acetabular fracture after the operation was ≤ 1 mm, it was considered an anatomical reduction, ≤ 3 mm satisfactory, > 3 mm unsatisfactory (14).

We used the anteroposterior, inlet and outlet radiograph views of the pelvis to determine the reduction of the fracture. The time of healing of pelvic fractures was analyzed.

Statistical analysis was performed with SPSS program version 23.0. The Harris hip score and Majeed score were expressed as mean±standard deviation (SD).

## RESULTS

The study was conducted on 30 males and 12 females (age range 18–58, mean age 44 years; New Injury Severity Score 17–51 (mean value 26.2). The mechanism of injury was road traffic accidents in 29 cases, and fall from height in 13 cases. Thirty patients had isolated acetabular fractures, 12 had pelvic ring and acetabular fractures. According to the Judet and Letournel classification of acetabular fractures, there was 1 anterior column, 6 transverse, 5 transverse and posterior wall, 1 T-shaped, 14 anterior column and posterior hemitransverse, 2 posterior columns, 13 both column fractures of the acetabulum. There were 5 associated pelvic injuries: 2 sacral plexus injuries, 3 lumbar plexus contusions with paresthesia. Other associated injuries included 18 lower limb injuries, 9 upper limb injuries, 2 spine injuries, 3 brain injuries, 3 abdominal injuries and 8 chest injuries. The median time from the injury to surgery was 6 days (range 3−9 days). This interval was mainly determined by the patients' general health condition. In 9 cases temporary treatment was preceded by external fixation. Combination with iliac wing approach was used in all patients with both column fractures and, in one case, with anterior column and posterior hemitransverse fracture of acetabulum.

In 5 cases of transverse and posterior wall fractures we used modified Stoppa approach and the additional Kocher-Langenbeck approach.

Complete weight-bearing was started after healing of acetabular fractures (12-16 weeks). Twenty-nine patients underwent a rehabilitation course after hospital discharge.

The anatomical or satisfactory reduction was achieved in 38 patients (92%), displacement >3 mm – in 4 patients (8%) of the acetabular fractures.

Fracture healing with anatomical or satisfactory reduction was achieved in all cases of anterior column, transverse, transverse and posterior wall, in 13 cases of anterior column and posterior hemitransverse, in 11 cases of the both column, in 2 cases of posterior column acetabular fractures. Two both column, one T-shaped and one case anterior column and posterior hemitransverse acetabular fractures healed with displacement of 4–5 mm.

The mean time to complete healing of acetabular fractures was 17 weeks (range: 16 - 20 weeks).

Seven patients (16.6%) had total hip replacement due to PTOA – 5 patients (13%) with anatomical or satisfactory reduction and 2 patients (50%) with displacement of >3 mm of all reductions of acetabular fractures. The PTOA developed in 5–48 months during the follow-up after polytrauma. The total hip replacement was used to decrease the pain and improve the functional result. Patients before hip replacement had a mean preoperative Harris hip score of 71.1± 5.98 points; range 58–76. Cases with hip replacement were summarised (Table 1).

The patients with acetabular fractures operated with only the modified Stoppa approach or in combination with iliac wing approach had a mean Majeed score 83.7±7.71; range 70–100; 17 (40.4%) excellent and 25 (59.5%) good clinical grades.

We compared the functional outcome and radiological results of patients in the study group with the control group of twenty-four polytrauma patients with acetabular fractures which consisted of 5 women and 19 men, age range 17 – 65 (mean 37 years); New Injury Severity Score 17–41 (mean 23.8). According to the Judet and Letournel classification of acetabular fractures, there was 1 anterior column, 4 transverse, 3 transverse and posterior wall, 1 T-shaped, 9 anterior column and posterior hemitransverse, 2 posterior columns, 4 both column fractures of the acetabulum. Patients operated by the ilioinguinal approach in the control group had fracture healing in the anatomical or satisfactory reduction in 87% of the acetabular fractures (three acetabular fractures healed with displacement 4–6 mm). In the control group the mean Majeed score was was 76.5±6.77; range 61–88; 1 (4.1%) excellent, 18 (75.0%) good and 5 (20.8%) fair clinical grades (p=0.000) (Table 2).

In the control group five patients (20.8%) had total hip replacement due to PTOA – 2 patients (40%) with anatomical or satisfactory reduction and 3 patients (60%) with displacement of >3 mm of all reductions of acetabular fractures. Mean Harris hip score before hip replacement of these patients was 67.8±6.72; range 56 – 72.

*Table 1. Summary of analysis of seven cases with total hip replacement due to the osteoarthritis after acetabular fractures in patients after polytrauma operated only with modified Stoppa or in combination with iliac wing approach in the current study*

| N | Age | Gender | Type of fracture | Surgical approach | Type of internal fixation | Reduction | HHS (before endoprothesis) | Type of endoprothesis | Time from trauma till endoprothesis (months) |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 57 | M | anterior column and posterior hemitransverse | modified Stoppa | RP | S | 72 | uncemented prosthesis | 21 |
| 2. | 41 | M | anterior column and posterior hemitransverse | modified Stoppa | RP | S | 74 | hybrid prosthesis | 15 |
| 3. | 53 | M | anterior column and posterior hemitransverse | modified Stoppa | RP | S | 76 | hybrid prosthesis | 5 |
| 4. | 48 | M | t-shaped | modified Stoppa | RP | U | 72 | uncemented prosthesis | 9 |
| 5. | 40 | M | anterior column and posterior hemitransverse | modified Stoppa | RP | S | 74 | uncemented prosthesis | 11 |
| 6. | 54 | F | both column | combined | RP | U | 62 | uncemented prosthesis (18) | 18 |
| 7. | 46 | M | transverse | modified Stoppa | RP | S | 72 | uncemented prosthesis (48) | 48 |

N – number of patients; RP – reconstruction plate; S – anatomical or satisfactory reduction (≤ 3 mm); U – unsatisfactory reduction (> 3 mm); HHS – Harris hip score; M – male; F – female.

*Table 2. The outcome according to the Majeed score of patients with acetabular fractures operated only with modified Stoppa or in combination with iliac wing approach in comparison with control group operated with ilioinguinal approach*

| Majeed score criteria | Majeed score | |
|---|---|---|
| | Modified Stoppa or in combination with iliac wing approach group (n=42 ) | Control group (n=24) |
| Pain | 24.2±3.59 | 21.6±3.51 |
| Work | 16.7±1.59 | 15.0±2.12 |
| Sitting | 7.6±1.34 | 7.6±0.96 |
| Sexual intercourse | 3.0±1.06 | 2.5.2±0.77 |
| Walking aids | 11.8±0.59 | 11.5±1.06 |
| Unaided gait | 10.6±1.14 | 9.9±0.71 |
| Walking distance | 9.5±1.03 | 8.7±0.98 |
| Total | 83.7±7.71 | 76.5±6.77 |

n – number of patients; data are expressed as mean±SD

## DISCUSSION

In our study, we evaluated the outcome in polytrauma patients with acetabular fractures operated by using only the modified Stoppa or in combination with iliac wing approach.

In several publications, the PTOA is reported as the main late complication after displaced acetabular fractures (9, 11, 12, 18). Wu et al showed that PTOA of the hip can develop in 12–57% of patients after an acetabular fracture (23). Wang et al reported PTOA in 23 of 33 acetabular fractures, with pre-operative Harris hip score 45.9 ± 12 (22). In the Mears' et al. study excellent or good clinical outcomes were recorded in 249 of 282 patients (89%) with an anatomical reduction (15).These late complications give a conversion rate to total hip arthroplasty of between 8% and 23% (7, 15).

In our study seven patients, who had hip replacement after acetabular fractures, had different reasons why symptomatic PTOA developed. One of these patients had diabetes mellitus type I, and severe PTOA developed during 5 months follow-up after acetabular fracture surgery. One patient during operation by using the modified Stoppa approach started massive presacral venous bleeding, with estimated blood loss of 2500 ml, which was controlled with difficulty by using the iliac wing approach and venous vessel ligation. On second day after the operation, this patient developed left femoral vein thrombosis, which was treated with anticoagulant therapy. The patient had total hip replacement 18 months after the trauma because of severe PTOA of the left hip joint. The patient had lymphostasis of the left leg after femoral vein thrombosis. Twenty-six months after polytrauma the patient returned to work. Another patient was overweight (body mass index 29.3) and early weight-bearing after acetabular fracture fixation led to PTOA development within 9 months. Four patients developed symptomatic PTOA after 11 to 48 months follow-up and total hip replacement was performed due to severe pain in the hip joint.

The Harris hip score was selected to decide on the hip replacement as it is a joint-specific score that consists of 10 items covering the domains of pain, function, functional activities, deformity and hip range of motion (7). There are several publications about the outcome after acetabular fractures treated with only modified Stoppa approach and its combination with iliac wing approach. Rocca at al reported that anatomic or satisfactory reduction was achieved in 94% of the acetabular fractures (16). In the Chen's et al study 90% of all reductions were good to excellent (4). Kilinc's et al study showed that the use of modified Stoppa approach gave excellent results in 27 (47.4%), good in 23 (40.3%), fair in 4 (7%), poor in 3 (5.3%) patients, with mean Harris hip score 86.6 (12). Verbeeck's et al study excellent-good functional Harris hip scores were found in 76% of patients after acetabular fractures surgery with this approach (19).

In our study only one of 13 patients with both column acetabular fractures, operated with using modified Stoppa approach in combination with iliac wing approach, had total hip replacement due to severe symptomatic PTOA. The remaining 12 patients had no severe symptomatic PTOA in follow-up.

The combination of these approaches also helps to prevent prolonged compression of the external iliac vein during surgery and decreases the risk of complications in cases when the length of reconstruction plate is necessary to the sacroiliac joint or in case of massive presacral venous bleeding. The modified Stoppa approach in combination with iliac wing approach enables the surgeon to fix the posterior column with screws by using pelvic reduction clamp.

The functional outcomes after severe pelvic trauma depend not only on the radiological result, but also on the type of fracture, severity and extent of soft tissue damage, associated injuries, time of operation and comorbidities (11).

We evaluated patients in a significant range of time after polytrauma. Most of clinical recovery outcomes of severe lower extremity trauma are attained after one

year, therefore two years after trauma was considered to be within the period when the outcome does not change significantly in the future (3).

Our study has some limitations. One limitation was due to the relatively small number of patients. Other limitation is that our study was conducted on polytrauma patients with high-energy caused tissue damage and severe associated injuries that may also be the reason for the increased number of development of late complications as well, including severe PTOA. Limitation is also a retrospective design of the study. Objective examination was performed as far as possible in follow-up. Nevertheless, patients' different functional demands and ability to recall information, might affect anamnesis and complaints interpretation during examination, using assessment scales.

The fact that all patients in our hospital were operated by the same surgeon, using modified Stoppa approach in combination with iliac wing approach might be considered as the strength of the study.

## CONCLUSIONS

Our experience with using the modified Stoppa approach and its combination with iliac wing approach shows that these techniques provide better fracture reduction, gain mostly good radiological and functional results, may decrease the risk of development of severe symptomatic hip PTOA and hip replacement in polytrauma patients with both column acetabular fractures. Further studies on a larger group of patients are needed to confirm this.

Our results suggest that unsatisfactory (>3 mm) reduction of an acetabular fracture is a strong predictor of symptomatic severe PTOA, which is treated by using total hip arthroplasty.

Nevertheless, in polytrauma patients, the risk of the development of severe PTOA is increased because of high-energy trauma impact and a satisfactory reduction of acetabulum does not always protect against severe PTOA with following necessity for total hip replacement. The patients should be followed-up and warned about the risk of development of symptomatic PTOA.

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**Corresponding author:**
Ruta Jakusonoka, MD, PhD
Riga Stradins University, Department of Orthopaedics
18 Duntes street
LV-1005, Riga, Latvia
E-mail: ruta.jakusonoka@rsu.lv