



Mid-term outcome of patients with pelvic and acetabular fractures following internal fixation through a modified Stoppa approach

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This retrospective study presents the mid-term outcome of polytrauma patients with pelvic ring and acetabular fractures operated using a modified Stoppa approach. We examined 32 patients (13 women and 19 men ; mean age 44 years) 24 to 40 months after the trauma. We performed a functional assessment of these patients using Majeed's score. Mean Majeed score was 86.9 ± 8.22 with a range from 70 to 100. Excellent clinical results were noted in 59% of cases (in 83% of pelvic fractures and 40% of acetabular fractures) and good clinical results in 41% (in 17% of pelvic ring fractures and 60% of acetabular fractures). Fracture healing with anatomical reduction was achieved in all pelvic ring fractures. Healing with anatomic or satisfactory reduction was achieved in 90% of the acetabular fractures.

Keywords : pelvis fracture ; internal fixation ; modified Stoppa approach ; functional outcome.

INTRODUCTION

Management of polytrauma patients with pelvic ring and acetabular fractures is challenging. Internal fracture fixation provides the best stability and long-term results (15). The ilioinguinal approach is widely used for internal fixation of pelvic ring and acetabular fractures (8,11), but it is a laborious approach. Stoppa described in 1989 a midline approach for

complicated groin and incisional hernia repair with dissection of the retroinguinal space to identify the sac of the hernia (18). This approach has been modified by Cole and Bolhofner and suggested as an alternative to the ilioinguinal approach for the internal fixation of acetabular fractures (2). We have used the modified Stoppa approach for internal fixation of pelvic ring and acetabular fractures. The purpose of this study was to evaluate the mid-term (> 24 to 40 months) outcome of polytrauma patients with

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pelvic ring and acetabular fractures, following internal fixation through the modified Stoppa approach. Using a less traumatic surgical approach in the reduction and stabilization of the pelvic ring and acetabular fractures is very important in the management of patients with severe polytrauma.

PATIENTS AND METHODS

A retrospective study of 77 polytrauma patients with pelvic ring and acetabular fractures, treated in our hospital over the period 2008-2010, was performed. Polytrauma is defined as a syndrome characterized by multiple injuries exceeding a defined severity grade (Injury Severity Score (ISS) ≥ 17) with sequential systemic reactions that may lead to dysfunction or failure of remote organs and vital systems, which have not been directly injured (20). The ISS and New Injury Severity Score (NISS) values were calculated for all of these patients. NISS values were used to evaluate the severity of polytrauma injuries because ISS does not give objective information about the amount of work and resources required if the patient has serious multiple injuries in one of the ISS anatomic regions, particularly orthopaedic injuries (17).

We excluded from the study group 22 patients treated with conservative methods, 11 patients treated by external fixation and 9 patients operated using an ilioinguinal approach.

Polytrauma patients operated in our institution using the modified Stoppa approach during the mentioned period, with > 2 years of follow-up were included in the study. The patients were invited to undergo the outcome evaluation. The patients who did not respond to three phone calls and/or the invitation letter or had lower limb trauma after the index polytrauma, were also excluded from this study.

Three patients were excluded because they did not respond to the phone calls and the invitation letter.

We thus evaluated functional and radiological outcome in a group of 32 polytrauma patients operated using the modified Stoppa approach.

All surgeries were done by the authors. Operations were performed under general anaesthesia in a supine position on a radiolucent operating table. Both hips and knees were slightly flexed to relax the ilopsoas muscle. A midline incision was made between the rectus abdominis muscles from the umbilicus to the symphysis pubis. The rectus abdominis muscles were retracted laterally from the symphysis pubis without sharp dissection. The pre-

peritoneal space was opened and bluntly divided down to the symphysis pubis. The fibres of the transverse abdominis muscle were dissected from the peritoneal sac, which was manipulated upwards and medially from the fracture site. The femoral artery and vein, as well as the spermatic cord in male patients, were identified and encircled with a silastic band. The pelvic ring was exposed, starting from the superior pubic ramus near the symphysis. Vascular anastomoses, including the corona mortis, were looked for and cut after ligation, if detected. After identifying the femoral nerve, the fascia of psoas muscle was incised and the psoas muscle was mobilized, if access was necessary to the pelvic iliopectineal line and the quadrilateral surface up to the cranial and medial border of the sacroiliac joint. This exposure can be extended to the opposite side of the pelvic ring through the same skin incision, as necessary (2,6,21).

The patients' complaints, functional and radiological assessment were included in the evaluation of outcomes. 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 the 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 (9).

We evaluated hospital case-records, preoperative, postoperative and follow-up radiographs and computed tomography.

Postoperative fracture reduction of pelvic ring fractures was considered anatomic, if displacement was ≤ 1 cm (15).

If displacement of the acetabular fracture after operation was ≤ 1 mm, it was considered an anatomical reduction, ≤ 3 mm satisfactory, > 3 mm unsatisfactory (13,21).

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

Statistical analysis was performed with SPSS program version 20.0. The Majeed score data were expressed as mean \pm standard deviation (SD).

RESULTS

The mid-term functional assessment and radiological results evaluation was conducted on 13 women and 19 men (age range 17-70, mean age 44 years ; ISS 9-48, mean ISS value 20.5 ; NISS 17-

48, mean NISS value 25.9) 24 to 40 months, (mean 27) after trauma. The mechanisms of injury were road traffic accidents in 21 cases (65%) and falls from a height in 11 cases (35%). Twelve patients had pelvic ring fractures, 18 had isolated acetabular fractures and 2 had pelvic ring and acetabular fractures. According to the AO classification there were 12 type B and 2 type C pelvic ring fractures. According to the Judet and Letournel classification of acetabular fractures, there was 1 anterior column, 3 transverse, 1 T-shaped, 3 anterior column and posterior hemitransverse, 12 both-column fractures of the acetabulum. There were 5 associated pelvic injuries : 2 sacral plexus injuries, 3 lumbar plexus contusions with paraesthesia. Other associated injuries included 16 lower limb injuries, 5 upper limb injuries, 2 spine injuries, 4 brain injuries, 4 abdominal injuries and 7 chest injuries. The median time from the injury to surgery was 6 days (range 0-9 days), mainly determined by the patients' general condition. In 10 cases temporary treatment was preceded by external fixation, in 2 cases by a pelvic clamp.

Twenty-four patients had a rehabilitation course after hospital discharge.

We found that in the modified Stoppa group the mean Majeed score was 86.9 ± 8.22 ; range 70-100 ; 19 (59%) excellent and 13 (41%) good clinical grades. The patients with pelvic ring fractures had a mean Majeed score of 91.9 ± 6.09 ; range 80-

100 ; 10 (83%) excellent and 2 (17%) good clinical grades. The patients with acetabular fractures had a mean Majeed score 83.9 ± 7.96 ; range 70-100 ; 8 (40%) excellent and 12 (60%) good clinical grades (Table I).

Fracture healing with anatomical reposition was achieved in 100% of all cases of pelvic ring fractures and with anatomical or satisfactory reduction in 90% of the acetabular fractures : all cases of anterior column, transverse, T-shaped, anterior column and posterior hemitransverse fractures, in 83% of the both-column acetabular fractures (two both-column acetabular fractures healed with displacement 4-5 mm). Mean time to complete healing of pelvic fractures was 18 weeks (range : 16-22).

The radiological result of one patient after polytrauma including pelvic fractures is shown in Fig. 1.

DISCUSSION

The aim of the emergency treatment of polytrauma patients with pelvic fractures is to provide effective control of haemorrhage during the patient's initial evaluation and resuscitation. The goal of the definitive care is to achieve a good functional outcome, which allows patients to return to work and previous activities. In this study we assessed the mid-term functional outcome of polytrauma patients with pelvic ring and acetabular fractures operated using a modified Stoppa approach. This approach

Table I. — Functional assessment based on the Majeed score of patients with pelvic ring or acetabular fractures following internal fixation using a modified Stoppa approach

Majeed score criteria	Majeed score		
	Pelvic ring fractures (n = 12)	Acetabular fractures (n = 20)	All patients (n = 32)
Pain	27.9 ± 3.34	25.0 ± 3.97	26.0 ± 3.96
Work	19.0 ± 1.80	16.9 ± 1.64	17.6 ± 1.99
Sitting	8.6 ± 1.55	7.7 ± 1.34	8.0 ± 1.48
Sexual intercourse	3.2 ± 0.75	3.0 ± 1.07	3.0 ± 0.96
Walking aids	11.6 ± 0.77	11.8 ± 0.61	11.7 ± 0.67
Unaided gait	11.0 ± 1.04	10.6 ± 1.14	10.7 ± 1.10
Walking distance	10.0 ± 1.20	9.5 ± 1.10	9.6 ± 1.14
Total	91.9 ± 6.09	83.9 ± 7.96	86.9 ± 8.22

n-number of patients ; data are expressed as mean \pm SD.

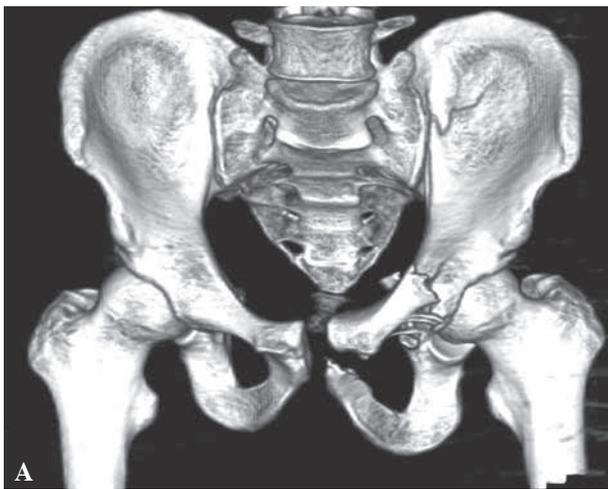


Fig. 1. — Radiological results of a 28-year-old male patient after polytrauma including pelvic fractures: A. computed tomography of the pelvis showing an unstable pelvic injury including left-sided fracture of both columns of the acetabulum (type C2), fracture of both pubic rami and iliac bone fractures, and fracture of the sacrum; B. postoperative radiograph (anteroposterior view) with anatomic reduction and internal fixation using a modified Stoppa approach; C. radiograph (anteroposterior view) at 24 months follow-up with healed and remodeled pelvic bones; the Majeed score was 100, an excellent clinical result; D. radiograph (inlet view) at 24 months follow-up; E. radiograph (outlet view) at 24 months follow-up.

gives a wide view on the bony pelvis (1). It can be used in the surgical treatment of both pelvic ring and acetabular fractures, which is important in the management of polytrauma patients following high-

energy trauma. The modified Stoppa approach saves operation time, reduces intra-operative bleeding and shortens the hospital stay (5,21). In case of acetabular fractures, it allows reduction of the articular fragment impacted into the weight bearing dome area, cancellous bone grafting, addition of bone substitute material and fixation of the fractures

without lateral extrapelvic exposures and without dislocating the joint. As compared to the classical ilioinguinal approach, this approach decreases the risk of scar tissue formation and heterotopic ossification. The anatomical reduction and proper stabilization of fractures allows early beginning of mobilization, rehabilitation and effective functional recovery of the patients (21).

The limitation of the modified Stoppa approach is that there can be difficulties in reduction and internal fixation of the posterior column acetabular fractures and impossibility of visualization of the femoral head, the labrum, the articular surface of the acetabulum and debridement of the joint (2). If it was necessary to reduce a posterior column fracture, we performed further dissection to the quadrilateral surface; the obturator neurovascular bundle was identified and protected with a retractor (2,6). For fixation of the posterior column we used individual cannulated bone screws or an additional plate for fixation and support of the quadrilateral surface as well. In two patients, free bone fragments were identified in the hip joint during the preoperative planning and an additional Kocher-Langenbeck approach was done.

The modified Stoppa approach should of course be performed by an experienced orthopaedic surgeon.

The disadvantages of the modified Stoppa approach are the risk of peritoneal injury, the necessity to avoid injuring the corona mortis, and the possibility of a post operative hernia.

Most of our patients underwent internal fixation through a modified Stoppa approach within the first week: 2 patients, who had a bladder injury were operated on the day of admission, 8 patients within 2-3 days and 20 patients within 4-7 days. The operation was delayed for 9 days in one patient due to his unstable general condition and associated injuries.

We compared our patients' outcomes with literature data on the outcomes of patients with pelvic fractures, operated using an ilioinguinal approach.

Regarding the quality of reduction of pelvic ring fractures, Mardanpour and Rahbar reported less satisfactory radiological results using the ilioinguinal approach than with the modified Stoppa approach

(excellent in 73%, good in 18%, and poor in 9% of patients with type B fractures; excellent in 27%, good in 18%, intermediate in 27% and poor in 27% of patients with type C pelvic ring fractures) (10). Regarding acetabular fractures, Letournel reported perfect reduction in 85% of anterior column and hemitransverse fractures, and in 73% of both-column acetabular fractures (8); Moroni *et al* reported long-term radiographic results which were excellent in 50%, good in 27.8%, fair in 11.1% and poor in 11.1% of both-column acetabular fractures, operated using an ilioinguinal approach (14).

Comparing functional results of the modified Stoppa group in the current study with functional results after operation using the ilioinguinal approach, as described in literature, there were in our study no functional results graded as fair or poor in patients with pelvic ring or acetabular fractures (Table II).

Suzuki *et al* using the Majeed score in the long-term functional outcome evaluation of patients following unstable pelvic ring fractures, found that neurologic injuries negatively influence the long-term outcomes (19). Nine patients in our study group had neurologic injuries; their mean Majeed score (mean: 64.2 ± 5.26) was less than for those without neurologic injuries (mean: 77.5 ± 5.56), but the sample was too small to achieve statistical significance.

The Majeed score was used for the evaluation of mid-term functional results as they show functional criteria reflecting patients' satisfaction, possibility to perform work and to walk. Kabak *et al* reported that associated injuries alter the functional outcome of patients with unstable pelvic injuries (7).

The limitation of our study was that, owing to the relatively small number of patients, analysis of outcome in relation to the lower extremities injury type, location and treatment methods was not performed. The functional outcome after severe pelvic trauma depends not only on the radiological features of the pelvic ring fracture, but also on the severity and extent of soft tissue damage (16).

The fact that all patients in our hospital were operated by the same surgeon, using a modified Stoppa approach, may be regarded as a strength of the study.

Table II. — Functional results of the modified Stoppa group in the current study in comparison to literature data for functional results of patients operated using an ilioinguinal approach

Reference	Functional result				Mean follow-up (months)
	Excellent (%)	Good (%)	Fair/moderate (%)	Poor (%)	
Mardanpour <i>et al</i> (10) (pelvic ring fractures)	66 type B 46 type C	15 type B 27 type C	11 type B 27 type C	7 type B 0	45.6
Matta <i>et al</i> (12) (acetabular fractures)	37	47	14	2	36
Gänsslen <i>et al</i> (3) (acetabular fractures)	65	29	6	0	24
Moroni <i>et al</i> (14) (acetabular fractures)	44.4	38.8	5.5	11.1	53.2
Hessmann <i>et al</i> (4) (acetabular fractures)	73-85		15-27		48
Current study: <i>pelvic ring fractures</i>	83	17	0	0	27
<i>acetabular fractures</i>	40	60	0	0	
<i>total</i>	59	41	0	0	

Our experience with the modified Stoppa approach shows that it can be used as an alternative to the ilioinguinal approach in polytrauma patients with pelvic ring or acetabulum fractures, including bilateral pelvic fractures with internal organ damage, when open reduction and internal fixation is indicated, because it provides good functional and radiological result. The modified Stoppa approach allows to improve fracture reduction and functional outcome of polytrauma patients with pelvic ring and acetabular fractures. The findings in the present study, with rating of the outcome of pelvic fractures based on the Majeed score and radiological findings, show that the modified Stoppa approach may be a good option in the treatment of polytrauma patients with pelvic ring fractures, as it appears to provide better radiological and mid-term functional results than the ilioinguinal approach, while being less invasive. Further studies on larger patients series will be needed to confirm this.

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