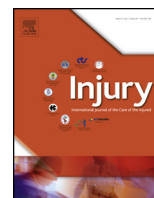




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Modified Stoppa approach for operative treatment of acetabular fractures: 10-year experience and mid-term follow-up

Diederik O. Verbeek^{*,1}, Kornelis J. Ponsen³, Mark van Heijl, J. Carel Goslings²

Trauma Research Unit, Department of Surgery, Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands

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ABSTRACT

Introduction: The (modified) Stoppa approach for acetabular fracture surgery has gained significant popularity and early results have been encouraging but clinical outcome at extensive follow-up is scarce. The purpose of this study is to provide an update on our experience with this approach for operative treatment of acetabular fractures and to assess clinical outcome at mid-term follow-up.

Methods: In this retrospective study, all patients treated operatively for an acetabular fracture using the Stoppa approach over a 10-year period were included. Surgery details were reviewed and patients were contacted and requested to return for follow-up. Primary outcome was native hip survivorship, secondary outcome measures included; functional outcome (Merle d'Aubigné, Harris hip) scores, health-related quality of life (short-form 36) and radiographic outcome (heterotopic ossification, hip osteoarthritis).

Results: Forty-five patients received operative fixation for 47 acetabular fractures using the Stoppa approach. Complications requiring surgical intervention were found in one patient (with a vascular lesion) intra-operatively and 3 patients (with wound infections (2) and diffuse bleeding (1)) post-operatively. Follow-up was 83% and 29/39 (74%) native hips survived at mean 59 months (SD 49) postoperatively. Excellent-good functional scores were found in 88% (Merle d'Aubigné) and 76% (Harris hip) of patients who had retained their native hip. Most (6/8) short-form 36 indices in these patients were comparable to population norms. Of 29 native hips with radiographic follow-up (mean 59 months (SD 49)), 4 (86%) had no-minimal radiographic abnormalities.

Conclusion: This study confirms that the Stoppa approach is a safe and effective technique for acetabular fracture fixation. Moreover, at mid-term follow-up, this approach is associated with satisfactory results in terms of hip survivorship as well as functional and radiographic outcome. As such, our findings reinforce the notion that this less invasive technique presents a valuable alternative to the ilioinguinal approach for the surgical treatment of acetabular fractures.

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Introduction

In recent years, the (modified) Stoppa approach for the operative treatment of acetabular fractures has gained significant popularity. This intra-pelvic approach is particularly useful for

treating acetabular fractures with anterior column involvement and is by some considered to be a superior alternative to the more traditionally used ilioinguinal exposure [1–3].

We previously shared our early experience with the Stoppa approach for the treatment of pelvic and acetabular fractures [4]. Over the past two decades it has been our preferred anterior approach to the acetabulum and has largely replaced the ilioinguinal exposure in our institution.

Advantages of the Stoppa approach have been well described and include its less invasive nature and improved visualization in the area of the quadrilateral plate and the posterior column [1–3,5]. The increased access to the acetabulum specifically allows direct (medial) buttressing of fractures with associated central protrusion of the femoral head. While several authors have reported early (radiographic) results of the Stoppa approach, clinical outcome at more extensive follow-up is scarce [2,5–7].

* Corresponding author at: Trauma service, Department of Surgery, Erasmus University Medical Center, 's-Gravendijkwal 230, 3015CE, Rotterdam, The Netherlands.

E-mail addresses: d.o.f.verbeek@erasmusmc.nl (D.O. Verbeek), k.j.ponsen@mca.nl (K.J. Ponsen), m.vanheijl@amc.uva.nl (M. van Heijl), j.c.goslings@olvg.nl (J. C. Goslings).

¹ Current address: Trauma service, Department of Surgery, Erasmus University Medical Center, Rotterdam, The Netherlands.

² Current address: Department of Surgery, Onze Lieve Vrouwe Gasthuis, Amsterdam, The Netherlands.

³ Current address: The NoordWest Ziekenhuisgroep, Alkmaar, The Netherlands.

The purpose of this study was to provide an update on our experience with the Stoppa approach for operative treatment of acetabular fractures and to assess clinical outcome at mid-term follow-up. We primarily sought to determine native hip survivorship and secondarily evaluated functional outcome scores, health-related quality of life and radiographic outcome.

Methods

After having obtained approval from our hospital's Institutional Review Board (NL 39690.018.12), patients who received operative treatment for an acetabular fracture over a 10-year period in our Level-1 trauma center were identified from our trauma database using operative procedure codes. Based on review of the operative reports, all consecutive patients who received open reduction and internal fixation utilizing the Stoppa approach were included in this study.

General indications for operative treatment of an acetabular fracture included more than 2 mm of displacement in the weightbearing dome and/or an incongruent hip joint.

The Stoppa approach was utilized for the same acetabular fracture types that may otherwise be treated through an ilioinguinal exposure. More specifically, fracture patterns with involvement of the anterior column such as anterior column-posterior hemitransverse, associated both column and isolated anterior column or wall fractures, but also some T-shaped or transverse types were indicated for this surgical approach.

The surgical technique for the Stoppa approach as utilized in our institution has previously been described in detail [4]. In contrast to earlier descriptions, we routinely use a midline incision and isolate the femoral artery and vein. Also, the psoas muscle is mobilized circumferentially as needed. Our technique obviates the need for a separate lateral window in the majority of cases. All surgeries were performed by three experienced fellowship-trained surgeons including two of the senior authors (KP, JG).

Medical records of all included patients were reviewed for baseline characteristics, injury severity score (ISS), mechanism of injury (high or low-energy), time to surgery, duration of surgery, blood loss, transfused packed red blood cells, cell saver reinfusion, major complications (requiring surgical intervention), length of hospital stay and in-hospital mortality. Acetabular fractures were classified according to Letournel's system based on preoperative imaging [8].

The amount of residual displacement was measured on direct postoperative pelvic radiographs in the three standard (anteroposterior and iliac and obturator oblique) views by one of the co-authors (DV) who was not involved with the initial care of patients. Reductions were subsequently graded as anatomic (0–1 mm), imperfect (2–3 mm) or poor (>3 mm) based on Matta's criteria [9].

Outcome measures

For the primary outcome of hip survivorship, patients were contacted through repeat mailings and by telephone to determine the most recent status of their operated hip. In patients who could not be reached, the most recent available pelvic radiographs were used for this purpose. To determine native hip survivorship, only patients were included with ≥ 1 year of follow-up or early (<1 year) conversion to total hip arthroplasty (THA).

For the secondary outcomes of physical function and quality of life, patients who had retained their native hip and had ≥ 1 year follow-up were invited for clinical evaluation. Physical examination was performed by one of the co-authors (DV) and an investigator and functional outcome was assessed utilizing the Merle d'Aubigné and Harris Hip score [10,11]. According to the Merle d'Aubigné system, total scores for pain, gait and motion

indicate an excellent (17–18 points), good (15–16 points), fair (13–14 points) or poor (<13 points) result. Similarly, for the Harris Hip score, results are graded as excellent (>90 points), good (80–89 points), fair (70–79 points) or poor (<70 points). Patients were also requested to complete the short form (SF)-36 as a measure of quality of life [12]. The SF-36 is a validated survey containing 36 health-related questions with higher scores in the various dimensions representing superior outcome. Additionally, patients who returned to clinic underwent pelvic radiography in the three standard views.

For radiographic outcome, the most recent available pelvic radiographs were examined by one of the co-authors (MH) for the presence of heterotopic ossification and osteoarthritis of the operatively treated hip. Patients with less than 1 year follow-up and those who had converted to THA were excluded from this analysis. Heterotopic ossification was classified utilizing the Brooker classification on the anteroposterior pelvic radiographs (Class I: Islands of bone within the soft tissues about the hip, Class II: bone spurs from the pelvis or proximal end of the femur, leaving at least 1 cm between opposing bone surfaces, Class III: bone spurs from the pelvis or proximal end of the femur, reducing the space between opposing bone surfaces to 1 cm and Class IV: apparent ankylosis of the hip) [13]. The presence of hip osteoarthritis was noted according to the Kellgren-Lawrence Grading Scale (Grade 1: doubtful narrowing of joint space and possible osteophytic lipping, Grade 2: definite osteophytes, definite narrowing of joint space, Grade 3: moderate multiple osteophytes, definite narrowing of joints space, some sclerosis and possible deformity of bone contour and Grade 4: large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone contour [14].

Statistical analysis

Continuous variables are presented as mean (standard deviation; SD) or as median (interquartile range; IQR) depending on data distribution (Kolmogorov-Smirnov test) and nominal data as total numbers (n) with percentages (%). Independent *t*-tests were performed for comparing continuous variables, and chi-square tests or Fisher's exact tests were used for nominal variables (depending on frequency of occurrence within each subgroup). Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 19.0 (IBM Software, Armonk, NY). A *p*-value of <0.05 was considered to indicate a statistically significant result.

Results

In total, 45 patients who received operative fixation for 47 acetabular fractures utilizing the Stoppa approach were included in the study. Mean age was 51 years (SD 17), 71% were male and the median ISS was 16 (IQR 21). Most patients (69%) had a high-energy mechanism of injury and the most common fracture type was an associated both column (68%), followed by T-shaped (16%), Transverse (8%), anterior column-posterior hemitransverse (5%) and anterior wall (3%).

Surgery details of all included patients are listed in Table 1. One patient required multiple transfusions for intra-operative bleeding resulting from an iliac vein injury.

Three patients had at least one major postoperative complication. One patient had ongoing postoperative bleeding requiring surgical exploration (no obvious source was found). A further 2 patients developed a deep wound infection requiring multiple washouts. Prior to this, one of these patients had loss of reduction of the posterior column requiring revision surgery. Overall, patients remained admitted for a mean duration of 23 days (IQR 13) and no patients had deceased in hospital.

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