



# Outcomes of acetabular fractures in the elderly: a five year retrospective study of twenty seven patients with primary total hip replacement

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## Abstract

**Purposes** Open reduction and internal fixation (ORIF) in osteoporotic acetabular fractures is quite difficult with high risk of implant failure. Total hip arthroplasty (THA) may be an effective option for treating acetabular fractures in appropriately selected patients, with immediate full weightbearing. The aim of the study was to evaluate the functional outcomes of primary THA for acetabular fractures in elderly patients.

**Methods** Between 2010 and 2015, 27 elderly patients operated for acetabular fractures by primary THA were included. The surgical technique associated plate stabilization of both acetabular columns with THA using an acetabular reinforcement cross-plate. Mean age was 68.5 years (57–84) and mean ASA was 2 (1–3). The mean follow-up was four years.

**Results** The mean Harris score was  $70.4 \pm 23$  (24–90), and the mean Postel-Merle Aubigné (PMA) score was  $14.3 \pm 4$  (7–18). For 17 patients with rank of pre-operative Devane 4, the post-operative rank was unchanged ( $p < 0.05$ ). Twenty patients (74%) were satisfied by the surgical treatment. Twenty post-operative complications (74%) were found. Two patients died during follow-up (7%).

**Conclusions** Primary THA for acetabular fracture in the elderly population might be a good therapeutic option that allows return to the previous daily life activity. Three patients (11%) became bedridden, and four patient's skiers (15%) returned to skiing. However, this surgery is difficult and selection of elderly patients, i.e., with acetabular fractures who are expected to get a poor result with ORIF, i.e., fracture patterns with posterior wall lesion and marginal impaction, for primary THA in an experienced centre provides satisfactory clinical results.

**Keywords** Primary total hip replacement · Acetabular fractures · Elderly patients · Harris score · Osteoporotic fracture

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## Introduction

Acetabular fractures have a reported annual incidence of about three out of 100,000 patients worldwide [1, 2]. These fractures are injuries that usually result from high-energy trauma in which excessive force is placed through the proximal femur into the pelvis [3]. With the population living longer and activity levels rising, osteoporotic fractures (low-energy mechanisms) are being seen with increasing frequency [4, 5]. In 1999, Mears predicted that by 2010 geriatric patients may represent the largest group of acetabular fractures [6]. As for femoral neck fracture surgery in the elderly, we know that immediate full weightbearing is important for keeping functional autonomy and decreasing morbidity/mortality. Traditional management strategies for osteoporotic acetabular fractures in elderly patients have been to enforce bed rest until fracture healing, with or without traction. It increases length of hospital stay, decubitus complications, and so hospital cost.

The results of open reduction and internal fixation (ORIF) for osteoporotic acetabular fractures with posterior pattern fracture are known to be poorer than for younger patient [7–10]. In the context of osteoporosis and fracture instability, we consider this osteosynthesis fragile. Even if, Heare et al. have shown no difference between early and late post-operative weightbearing [11]. Displaced acetabular fractures of the posterior wall create impaction or erosion of the acetabular or femoral articular surface. The patients often required re-operation by total hip arthroplasty (THA) after osteosynthesis from Kreder et al. [12]. Late THR after ORIF or conservative treatment is more difficult and may be complicated by the presence of heterotopic bone, proliferative scar tissue, obstructive hardware, or occult infection.

We suppose that early total hip arthroplasty (THA) in elderly patients with acetabular fractures may be an effective option with good clinical results if THA has been used in appropriately selected elderly patients according to comorbidities and despite complications. The aim of this study is to present the functional and radiological outcomes in a series of elderly patients treated for acetabular fractures with early fracture fixation and simultaneous THA. Our hypothesis is that early THA is a good procedure for selected elderly patients with good functional outcomes.

## Methods

### Patients

Between 2010 and 2015, 27 elderly patients (age > 60 years) operated on for acetabular fractures with component posterior fracture by primary THA in our institution were included. During this period, 21 patients with posterior acetabular fracture patterns were treated non-operatively. The patients with anterior wall fractures, undisplaced anterior column fractures, and severe comorbidities were treated by conservative treatment. The patients younger than 60 years with high-energy trauma were treated by ORIF when it was possible according to the fracture pattern. Ten fractures were due to low-energy mechanisms, and 17 fractures were due to high-energy mechanisms (ski, fall > 3 m, and road traffic accidents). Fracture patterns according to Letournel classification are summarized in Fig. 1 [13].

The mean age was 68.5 years  $\pm$  8.1 (60–84), with 23 men (85%) and 4 women (15%). Mean American Society of Anesthesiologists (ASA) score was 2  $\pm$  0.8 (1–3). Nine patients were treated in an intensive care, because their medical condition was unstable (multiple injuries, ASA = 3). The median follow-up was four years  $\pm$  1.7 (1–7). Twenty-five patients had complete follow-up at that interval, and two patients died in the hospital shortly after surgery. Main demographic data of the series are summarized in Table 1.

### Methods

Between 2010 and 2015, all elderly patients operated upon for acetabular fractures with component posterior fractures by primary THA in our institution were included. The fracture patterns according to Letournel classification were determined according to pre-operative X-rays, CT-scan, and pre-operative findings [13]. Total hip replacements were performed by a senior surgeon. Prevention of anaemia due to haemorrhage was made by using cell saver (12 patients) and tranexamic acid Exacyl® protocol (6 patients).

The surgical technique has been reported on in detail and was similar in the literature [9]. In four patients, the anterior column was stabilized initially through a modified Stoppa approach before the posterior column was stabilized and a THA was performed by a Kocher-Langenbeck approach (Figs. 2, 3, and 4). For two patients, the outer window of the ilioinguinal approach in conjunction with the Stoppa approach was used. A good bone contact was ensured in all patients. Anatomic reduction of columns was not sought systematically.

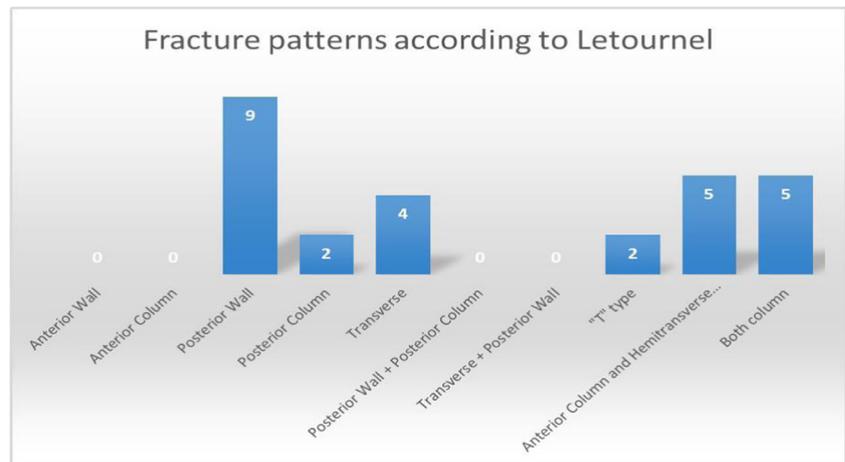
For all patients, a cemented femoral stem (Avenir Zimmer Biomet®) and a cemented dual mobility acetabular (Tornier®) were used. The acetabular reinforcement (Kerboull cross-plate) was impacted in whatever position achieved maximal stability of the implant, generally wherever maximum bone coverage was possible. The liner was then cemented into the acetabular reinforcement aiming for 45° of inclination and 15° of anteversion. Six patients had an uncontained defect at the acetabular and needed autograft from the femoral head. Acetabular Kerboull cross-plate was used to bridge this defect in 23 cases. ORIF was performed with standard reconstruction plate (Synthes®).

Post-operative management allowed full weightbearing as soon as possible. In our clinical practice, early THA is associated with full weightbearing, whereas ORIF is not because of osteoporosis. All patients were medicated with Enoxaparin 4000 UI per day or Calciparine 2000 UI twice a day for 45 days as thromboprophylaxis.

### Methods of assessment

Clinical evaluation was based on operative time (minutes), intra-operative blood loss (ml), post-operative complications, Harris Hip Score (HHS), Postel-Merle Aubigné (PMA), and the scale of activity of Devane (levels from 1 to 5) before surgery and at last follow-up [14–16]. The mean time from fall to surgery, the mean hospitalization time, and the mean mobilisation time were recorded.

**Fig. 1** Fracture patterns according to Letournel classification [13]



## Statistical analysis

The Student's *t* test was used to make comparisons between different outcomes and functional scores (Harris and Postel Merle d'Aubigné). ANOVA test used for comparisons between different types of fractures and functional scores. Stata 14.0 (Stata Corporation, College Station, TX, USA) software was used for statistical analysis.

All statistical procedures were performed with a significance level of  $\alpha = 0.05$ .

## Ethical approval

This study was approved by our local ethic committee. All individual participants included in the study was informed and consented.

**Table 1** Main epidemiological data and surgical management

Epidemiological data	Whole series, <i>n</i> (%)
Age (years)	68.5 years
Female	4 (15%)
Male	23 (85%)
Length of hospital stay (days)	18 days
Mechanism of injury	
Low energy	10
High energy	17
ASA grade	2
Surgical approach	
Kocher-Langenbeck	12 (44%)
Moore	15 (66%)
Anterior approach	6 (22%)
Operative time (min)	110
Blood loss (ml)	827

ASA American Society of Anesthesiologists

## Results

### Clinical results

The mean Harris Hip Score (HHS) for the whole series was  $70.4 \pm 23.6$  (24–90), with an average Postel Merle D'Aubigné (PMA) of  $14.3 \pm 4.2$  (7–18). Harris Score and PMA score decreased with advanced age ( $p < 0.05$ ). Median age of the series was 68 years. For patients older than 68 years, the HHS was  $62.3 \pm 24.9$  (24–90) and the PMA was  $13.1 \pm 4.5$  (7–18), respectively. For younger patients (<68 years), the HHS was  $83.2 \pm 10.3$  (63–90) and the PMA  $16.3 \pm 2.5$  (11–18). The differences were statistically significant ( $p < 0.05$ ).

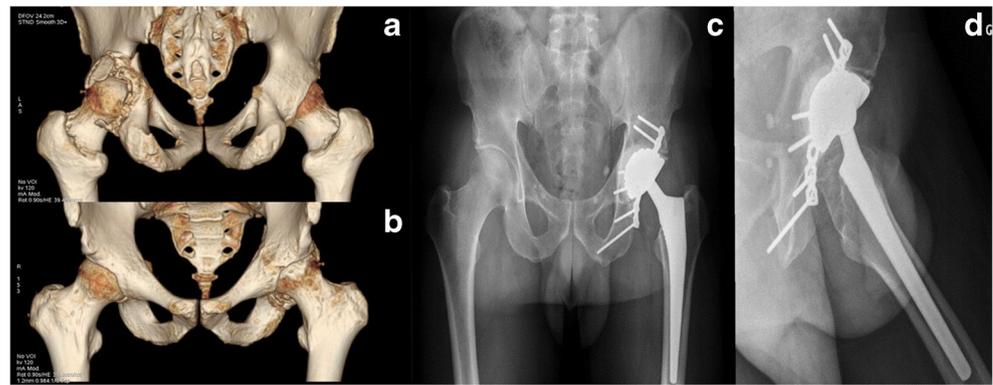
Fourteen patients showed excellent results (80–90 points); two had good results (70–79 points), three had fair results (60–69 points), and six had poor results (<59 points).

For patients with ASA 3 (10 patients), the HHS was  $48.9 \pm 22.1$  (24–90) and the PMA was  $10.3 \pm 3.5$  (7–18), versus HHS  $80.4 \pm 15.3$  (39–90) and PMA  $16.1 \pm 3.0$  (9–18) for patients with ASA  $\leq 2$  (17 patients). The differences were statistically significant. Patients with high-trauma injury had better functional score than patients with a low-trauma injury ( $p < 0.05$ ). The Harris score was, respectively,  $83.8 \pm 9.3$  versus  $46.8 \pm 23$ . The PMA score was  $16.4 \pm 2.3$  and  $10.4 \pm 4.1$ . The differences were statistically significant. The multiple injuries were not pejorative items ( $p > 0.05$ ). ANOVA test did not show significant difference between different type of fractures ( $p = 0.18$ ) (Table 2).

The scale of activity of Devane (levels from 1 to 5) pre-operative and post-operative were unchanged for 17 patients (63%). Three patients (11%) became bedridden, and four patient's skiers (15%) returned to skiing.

The mean time from fall to surgery was  $9.2 \text{ days} \pm 8.3$  (1–39) median seven days. For patients with a delay under seven days (14 patients) HHS was  $72.2 \pm 25.1$  (24–90) and PMA was  $14.7 \pm 4.3$  (7–18). For patients with a delay more than seven days (13 patients), HHS was  $68.5 \pm 22.9$  (24–90) and

**Fig. 2** Case number 1: a 65-year-old patient with posterior wall fracture. 3D reconstructions showing the anterior view (a) and posterior view (b) before surgery. Post-operative standard X-rays with antero-posterior view (c) and profile view (d) at last follow-up



PMA was  $13.8 \pm 4.2$  (7–18). There were no significant differences ( $p = 0.7$  and  $p = 0.6$ , respectively).

The mean hospitalization time was  $23.6$  days  $\pm 14.1$  (8–58). The median was 18 days. For patients with more than 18 days (16 patients) of hospitalization, HHS was  $65.6 \pm 25$  (24–90) and PMA was  $13.5 \pm 4.4$  (7–18). For patients with a shorter hospitalization time (< 18 days, 11 patients), HHS was  $77.7 \pm 20.5$  (29–90) and PMA was  $15.4 \pm 3.9$  (7–18). There were no significant differences according to the hospitalization time ( $p = 0.3$  and  $p = 0.2$ ).

There were no significant differences between patients that required mobilisation (10 patients) and patients that required conventional hospitalization (17 patients) regarding functional scores, with Harris score  $66.1 \pm 13.4$  (24–90) versus  $72.9 \pm 22.7$  (26–90,  $p = 0.5$ ) and PMA score  $13.4 \pm 4.4$  (7–18) versus  $14.8 \pm 4.1$  (7–18,  $p = 0.5$ ).

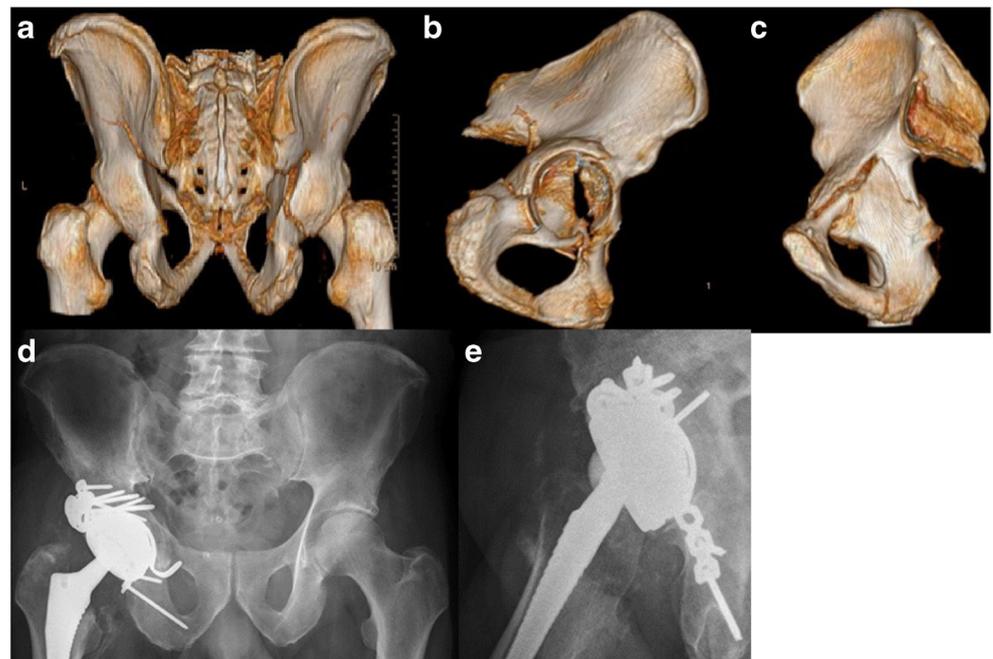
### Complications

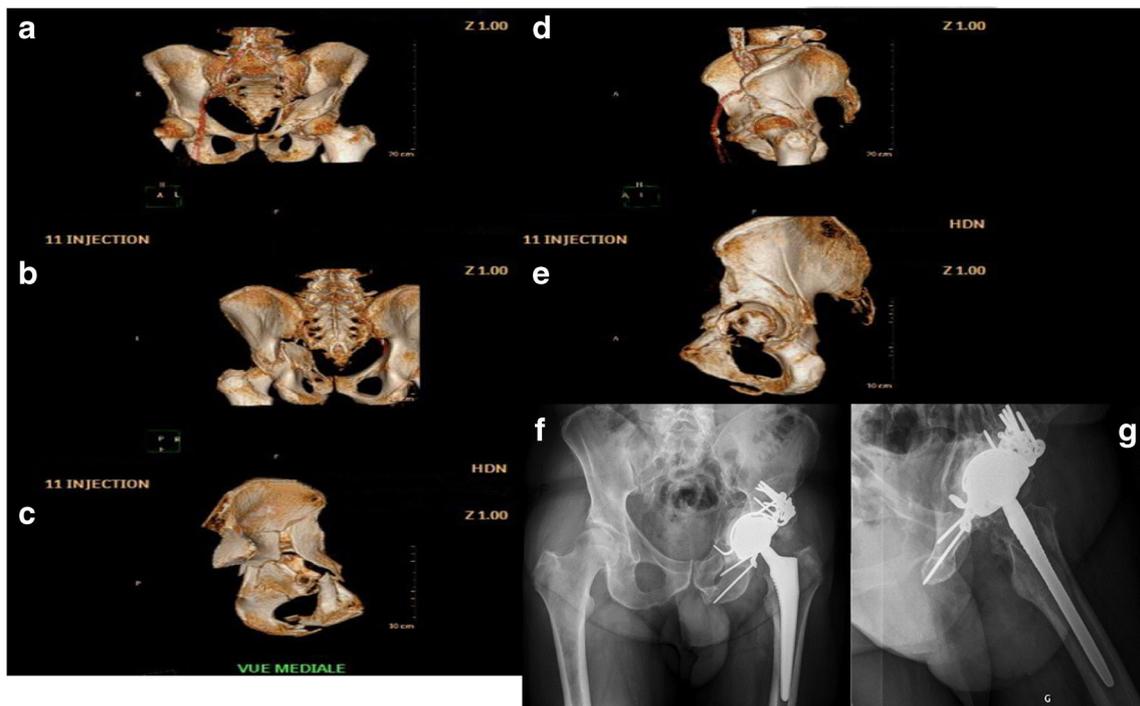
The mean operative time was 110 minutes  $\pm 29$  (65–170). The mean total blood loss was 827 ml  $\pm 688.8$  (152–3019) (Table 1). No intra-operative complications were notified.

The blood loss was correlated with operative time ( $p < 0.05$ ). For operative time more than 110 minutes (13 patients), the blood loss was  $1155.1 \pm 902.3$  (250–3019) versus  $565.4 \pm 298.2$  (300–1300) when the surgery lasted less or equal 110 minutes (14 patients). There were no significant differences for operative time less at 110 minutes and for surgery superior at 110 minutes regarding functional scores ( $p = 0.7$ ).

Twenty post-operative complications (74%) were recorded. There were two deaths (7%) during the hospitalization. Since leaving hospital, no patients died within follow-up four years of surgery from unrelated causes. Four patients were treated in

**Fig. 3** Case number 2: a 72-year-old patient with anterior column and hemitransverse posterior wall fracture of the right acetabulum. 3D reconstructions showing the posterior view (a), endopelvic view (b), and exoplevic view (c) before surgery. Post-operative standard X-rays with antero-posterior view (d) and profile view (e) at last follow-up





**Fig. 4** Case number 3: a 70-year-old patient with both column fracture. 3D reconstructions showing the anterior view (a), posterior view (b), exoplevic view (c), profil view (d), and endopelvic view (e) before

surgery. Post-operative standard X-rays with antero-posterior view (f) and profile view (g) at last follow-up

an intensive care after the surgery. There were patients with an ASA grade 4, and significant blood loss (> 1500 ml). The complications are summarized in Table 3.

When comparing patients with complications (20 patients) and patients without complications (7 patients), HHS was  $64.6 \pm 25.3$  (24–90) versus  $85.4 \pm 7.2$  (71–90), and the PMA score was  $13.3 \pm 4.5$  (7–18) versus  $16.9 \pm 1.7$  (14–18). The differences were statistically significant ( $p < 0.05$ ).

**Conservative treatment versus THA**

During the study period, 21 patients with posterior acetabular fractures were managed non-operatively. There were 12 (57%) males and nine (43%) females with a mean age of 77 years  $\pm$  11.3 (60–101) and a mean hospital stay length of 14 days (1–47). The trauma was low energy in 15 patients (71%). Mean American Society of Anesthesiologists (ASA) score was more higher than THA patients  $2.5 \pm 0.5$  (2–3) versus  $2 \pm 0.8$  (1–3), respectively,  $p < 0.05$ . Regarding functional

outcomes, mean HARRIS score after conservative treatment was  $65.6 \pm 13.6$  (38–90), and mean PMA score was  $12 \pm 4$  (5–18) at last follow-up. The differences were statistically significant in comparison with patients with early THA ( $p < 0.05$ ). Mortality rate was higher in the non-operative group (8/21, 38%,  $p < 0.05$ ), while THA group had the highest complication rate with 20 complications in 27 patients (73%) versus 15 complications in 21 patients (56%) with conservatively treatment,  $p < 0.05$ .

**Discussion**

Management of acetabular fractures in elderly people remains controversial without consensus and guidelines [17, 18]. The good choice in term of surgical management (THA, ORIF, or conservative treatment) according to the patients and the fracture patterns is important. With the numbers given and based on our experience, we suggest that early THA for posterior

**Table 2** Relationship between fracture types and functional outcomes

	Posterior wall	Both column	Anterior column + hemitransverse posterior	Posterior column	Transverse	“T” type	p (ANOVA)
Harris Hip score	67.3 $\pm$ 22.4	83.5 $\pm$ 13	55 $\pm$ 24.4	74.5 $\pm$ 16.3	90	52.5 $\pm$ 40.3	p > 0.05
Poste Merle d’Aubigné score	13.4 $\pm$ 3.9	17 $\pm$ 2	12.2 $\pm$ 4.9	14 $\pm$ 4.2	18	10.5 $\pm$ 4.9	p > 0.05

**Table 3** Complications rate in the whole series

Complications	Whole series, <i>n</i> = 27 (%)
Death	2 (7.4%)
Anemia	17 (63%)
Hemorrhagic shock	2 (7.4%)
Deep vein thrombosis	2 (7.4%)
Pulmonary embolism	3 (11%)
Nerve injuries postoperative	2 (7.4%)
Surgical site infection	4 (15%)
Lower respiratory tract infection	2 (7.4%)
Cardiac distress	3 (11%)
Cicatrizization disorder	3 (11%)
Pressure sores	2 (7.4%)
Urinary tract infection	3 (11%)
Early dislocations	3 (11%)

acetabular fracture in the elderly population might be a good therapeutic option (Figs. 2, 3, and 4) that allows return to the previous daily life activity.

Recent studies offer their own decision algorithms according to team habits, fractures, and patient characteristics [17–20]. However, the current trend is evolving more and more towards surgical management. As idea was introduced by Letournel, our results indicate a good compliance with current recommendations about acetabular fractures, which state that non-operative treatment should be preferred in older patients with many comorbidities or dependent or weakly active or minimally displaced fractures, and surgical treatment in active patients or major displacement [13]. ORIF has been established as the standard treatment for acetabular fractures in younger patients [21]. Conservative treatment in elderly patients is associated with bad functional outcomes according to Spencer et al. [18]. In this study, 23 patients received non-surgical treatment for acetabular fractures and were reviewed. Two patients died during hospitalization due to decubitus complications. The fracture was not reduced in 14 cases (61%), and seven patients (30%) had an unacceptable functional result with a return to previous poor autonomy. In our series, the functional outcomes of patients with early THA are significantly better than conservatively treatment functional outcomes. Conservative treatment is known to lead to disappointing outcomes and decubitus complications [5, 18].

For some authors, THA might be better for patients with expected post-operative mobilization issues than ORIF [19]. Thus, elderly patients present with poor bone quality and often have pre-existing osteoarthritis. Kreder et al. reviewed 128 patients with posterior wall fractures treated with ORIF. They concluded that an immediate hip replacement should be considered for patients aged > 50 years with marginal impaction and comminution of the wall. Of their patients, 54% required re-operation with a THA after a 2.9 years mean of

follow-up [12]. Daurka et al. have noted a high rate of conversion from ORIF to THA of 23% [17]. Boelch et al. have reported better results with early THA than ORIF in elderly patients: 87% (20/23) patients had not good mobility at the follow-up of 12 months. The rate of conversion from ORIF to THA was 45% in this study [19].

In our opinion, THA for acetabular fractures should be performed for the elderly patients with posterior patterns fractures and marginal impaction because of the high rate of complications and conversion to THA with ORIF [12]. THA allows a quickly weight bearing. In elderly patient, we should be balanced with the rate of complications.

This study is consistency with literature [20, 22–24]. Tidemark et al. have reported favourable outcomes in patients who had acute management with THA using either an anterolateral approach or a posterior approach. The authors report a mean HHS of 85 points (range, 69–100 points) at a mean follow-up of 38 months (range, 11–84 months) [20]. Patients older than 68 years have presented lower functional outcomes results than younger. The comorbidities were represented by ASA score. This score confirms that patients have presented fair or poor results, when ASA score was 3 or higher [22, 23].

Recently, Salama et al. have confirmed favourable outcomes for simultaneous open reduction and internal fixation and total hip arthroplasty for the treatment of osteoporotic acetabular fractures. For 100% cases, HHS score was excellent or good. This satisfaction is due to return to earlier the previous daily life activity [24].

The surgery delay, the mean time of hospitalization, the mean operative time, and hospitalization in mobilisation were not associated with bad functional outcomes. Many complications were recorded (74%) and two patients died during hospitalization (7%). This surgery is quite difficult and so experience with technical skills in trauma and hip surgery are required. Herscovici et al. have reported a 59% overall complications rate with 23% dislocations (11% in our series) [23]. Rickman et al. have reported a 29% complications rate without deep infections (15% in our series) [9]. Helfet et al. have reported a 41% complications rate with 11% pulmonary emboli (19% in our series) [25]. Increased blood loss is also expected when performing THA after an acetabular fracture [9, 25]. Factors contributing to this higher blood loss may be an increased surgical time, a combined hip procedure during the same anaesthesia, and the overall compromised health presented by these polytrauma and/or elderly patients. The reviewed articles had an overall mean blood loss that ranged between 580 and 1163 ml that is comparable to our findings [22–25].

Some limitations can be pointed out. Firstly, our follow-up period is relatively short. Secondly, fracture bone healing and component migration were only assessed on standardized AP radiographs. This study did not find statistical association

between fracture patterns and functional outcomes. We suppose that the number of patients in each fracture patterns group were not enough to show significant differences. The last limitation is due to the retrospective design.

Primary THA for acetabular fracture in the elderly population might be a good therapeutic option that allows return to the previous daily life activity. In an experienced centre, it provides satisfactory clinical results. However, this surgery is difficult with many complications and requires surgical skills and experience. We selected for primary THA, elderly patients with acetabular fractures who are expected to get a poor result with ORIF, i.e., fracture patterns with posterior wall lesion and marginal impaction.

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### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** This study was approved by our local ethic committee.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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