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Cup–cage construct for acute fractures of the acetabulum, re-defining indications

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ABSTRACT

Acetabular fractures in the elderly are challenging injuries. The use of a trabecular metal acetabular cage was investigated as the treatment option in a series of elderly patients with acetabular fractures. At a 2-year follow up, 6 elderly patients were found to have mimimum pain, increased function, and increased scores using the Merle d'Aubigné and Postel system modified by Charnley. Radiographically, the areas of morsellised autograft that surrounded the cups were seen to have incorporated uniformly well, and the acetabular fractures were healed within six months after surgery.

No mechanical failure, screw breakage, loosening, or migration was noticed.

This novel indication of the cup–cage construction that uses revision techniques, for selected patients and fractures, to achieve an acute stable reconstruction, should be considered as an alternative reconstruction option in elderly patients presenting with acetabular fractures.

Introduction

The incidence of fractures of the pelvis in the elderly is climbing relentlessly, with a marked predominance in women.[1,2] The majority of pelvic ring fractures in the presence of osteoporosis are the result of low-energy trauma and can be managed conservatively because they are typically stable fractures.[3] Nevertheless, there is a reported higher incidence in the elderly of acetabulum fractures including displaced anterior fracture types, involving anterior column, anterior wall and quadrilateral plate, and of comminuted, impacted posterior wall fracture types, which are more difficult to reconstruct.[4–12] The choice of treatment usually depends on the fracture pattern and the associated medical co-morbidities.[13–18]

Open reduction and internal fixation (ORIF) remains the treatment of choice for displaced acetabular fractures in most patients,[19,20] althought in a recognised subset of patients combined internal fixation with an acute total hip arthroplasty (THA) may be a more appropriate treatment option. This may be due to patient factors (advanced age, osteoporosis, low demands, obesity or previously osteoarthritic hip), fracture pattern (with a poor prognosis which involve the weight-bearing region or posterior wall comminution, associated ipsilateral displaced femoral neck fracture, full-thickness abrasive loss of articular cartilage, subchondral impaction or femoral head damage) or external factors including prolonged posterior dislocation or delay to reconstruction, which has a high rate of avascular necrosis of the femoral head.[21]

The poor clinical outcomes observed with non-operative treatment or internal fixation to reconstruct displaced acetabular fractures in elderly patients have led the authors to explore the use of a trabecular metal acetabular cage, combining the stability provided by the cage and the potential for bone ingrowth of the tantalum cup, applying the revision total hip arthroplasty reconstructive principles in these patients in order to accelerate healing without weight bearing restrictions. The purpose of this study therefore is to evaluate the clinical and radiographic results at a minimum of two years after acute total hip arthroplasties for the treatment of selected acetabular fractures in elderly patients.

Materials and methods

Between 2008 and 2011, elderly patients older than 65 years who were treated in our institution for an acute acetabular fracture with total hip replacement were eligible to participate and had a minimum follow up of 2 years.

Inclusion criteria were having undergone an acetabular arthroplasty with the use of tantalum cups and a follow up of at least 2 years. Exclusion criteria were age under 65 years and pathological fractures.

Out of 10 patients treated with tantalum cups, 6 met both inclusion criteria. Four patients were excluded as their follow up was only 1 year. Demographics, fracture pattern, co-morbidities, complications, and functional output were prospectively documented in a computerised database.

Six patients, 3 males and 3 females, had a minimum follow up of 2 years. The mean age of these 6 patients was 77 year sat the time of the arthroplasty (range 70–85). The aetiology of the acetabular fractures could be classified as low-energy trauma in 5 patients (resulting from a fall while walking) and high-energy trauma in one

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Table 1
Patient demographics, fracture classification, technical details of the surgical procedures and clinical evaluation

Patient	1	2	3	4	5	6	Mean
Gender	Male	Female	Male	Male	Female	Female	1:1
Age (yrs) at fracture	70	72	85	75	79	81	77
Side	Left	Left	Left	Right	Right	Left	4 L/2R
Mechanism (energy)	High	Low	Low	Low	Low	Low	
ASA	III	II	III	II	II	III	
Associated injuries	ISS: 25	No	No	No	No	No	
OA	No	Yes	Yes	No	Yes	No	
Letournel & Judet classification	Posterior column and posterior wall	Transverse	Anterior column	Transverse and posterior wall	Anterior wall and posterior hemitransverse	Posterior wall	
Femoral head impaction	Yes	No	No	Yes	No	No	
Unreduced hip	Yes	No	No	No	No	No	
Surgical delay (days)	21	7	10	3	5	4	8
Surgery duration (minutes)	255	220	200	240	210	220	224
Femoral implant	Cementless Summit®	Cementless Summit®	Cemented Versys®	Cementless Summit®	Cemented Versys®	Cemented Versys®	
Acetabulum (size)	56	56	56	56	56	56	
Screw number	8	8	8	9	9	8	
Bone graft	Femoral head	Femoral head	Femoral head	Femoral head	Femoral head	Femoral head	
No weight-bearing time (days)	10	6	2	4	3	4	5
Hospitalisation time (days)	38	18	17	13	12	12	18
Hospitalisation time after THA (days)	17	11	7	10	7	8	10
HBPM (weeks)	4	4	4	4	4	4	4
AB (hours)	48	48	48	48	48	48	48
Complications	Ossification grade II	Luxation	No	No	No	no	
Follow up (months)	26	25	25	25	24	24	
Merle-d'Aubigné–Postel score (points)	10	7	11	10	10	11	10

ASA: American Society of Anesthesiologists score; OA: osteoarthritis.

patient. The patient with major trauma sustained additional injuries (abdominal and chest trauma).

The initial evaluation included a plain anteroposterior radiograph, Judet views and a computed tomographic scan.

Preoperatively, the fractures were classified using the Letournel classification.[22] Three fractures were included in the elementary fracture group and 3 fractures were included in the associated fracture group (Table 1).

Three patients had pre-existing degenerative arthritis with loss of cartilage and loss of hip joint congruity, and 2 patients had abrasive loss of the articular cartilage or impaction of the femoral head, including the weight-bearing area. One hip was unreduced at the time of the arthroplasty. The mean time from the injury to the arthroplasty was 8 days (range 3–21).

Surgical technique

The same surgical team performed all surgeries, with an experienced hip revision surgeon and a pelvic trauma surgeon working together. All patients were placed in the lateral decubitus position for surgery. We always used a posterior approach. The acetabular bone loss, fracture patterns, type of deficiency (segmental or contained) and remaining bone stock were analysed. Displaced column fractures and supratectal transverse patterns were reduced with tenaculum forceps and stabilised with screws that extended through the acetabular component. Our primary objective when performing the reduction was to achieve a stable construct rather than a truly anatomical restoration. The acetabulum was prepared with acetabular reamers with medialisation to the floor of the foveal notch, but in those fractures affecting the quadrilateral plate it was sequentially reamed with a progressive increase of 1 mm in the desired location to find the dimension of the cavity until 2 points of fixation were found and the size of the cavity assessed. The hip centre was identified and we used the acetabular reamers to size and shape the acetabulum for the trabecular metal revision shell. The resected femoral head was used as morsellised cancellous bone autograft in all the patients. The objective of the reaming was to create a hemispherical acetabulum, with bleeding bone in wich to fit the tantalum cup, trying to maximise the contact area with native bone. The amount of press fit used was determined at the time of surgery based upon bone quality and fracture pattern. When primary stability was not possible the defect area was grafted, the graft impacted and reamed in a reverse fashion and trabecular metal revision cup (trabecular metal; Zimmer, Warsaw, IN, USA) of the same size as the last reamer was inserted and then fixed with 6.5 mm screws in the remaining host bone.

The cage was contoured to obtain proper flange shape to accommodate the curve of the ischium and iliac wing. The superior flange was usually bent towards the ilium. The inferior flange was also slightly bent and then spiked into the ischial notch in order to increase its purchase, tension and resistance to proximal migration. Once the cage was in the proper position, screws were inserted through the holes in the superior flange of the cage. After insertion of the antiprotrusio cage, vertical screws were inserted to fix the cup to the cage. This usually requires the tantalum cup to be drilled with a high-speed metal tip burr through the pre-existing holes of the cage (Fig. 1). The cage was used to provide additional initial stability until biological ingrowth within the trabecular metal material was achieved in order to provide long-term stability. Bone cement was applied to the dome of the cage and inner part of the revision tantalum cup. Then a polyethylene was cemented into the revision shell in the desired position with the liner rim fully seated on the face of the cage and trying to avoid overhanging of the rim of the metal construct. No additional posterior or anterior plating was performed. Regarding the femoral component, a cemented technique was used in 3 cases and an uncemented stem in the other 3 cases.

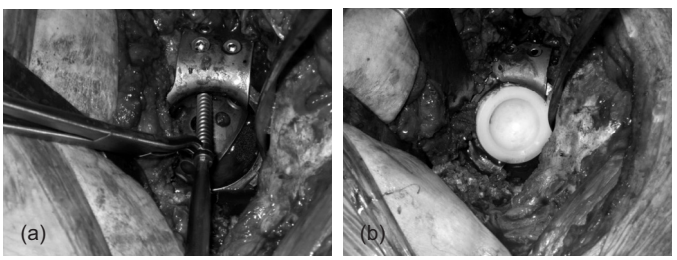

Fig. 1. Intraoperative pictures showing the cage in its proper position, screwed to the perforated tantalum cup (a), and the liner cemented into the desired position (b).