

# Fix and replace; an emerging paradigm for treating acetabular fractures

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## Summary

**Although technically challenging even for the experienced surgeon, simultaneous open reduction and internal fixation (ORIF) of acetabular fracture and total hip replacement (THR) have some potential advantages over the more traditional treatment options in specific patient subgroups; theoretically allowing immediate weight bearing and faster rehabilitation, reducing the cost of inpatient stay, and reducing the risks of early and late local complications associated with standard treatment for this type of injury. We review the evolution of the indications and techniques, outline the surgical challenges, and discuss implant options and outcomes for this treatment paradigm.**

*KEY WORDS:* acetabular fractures; hip arthroplasty; fragility fracture; osteoporosis; trauma.

## Introduction

The treatment of choice for displaced acetabular fractures in younger patients involves open reduction and internal fixation, as joint restoration helps to reduce the risk of post-traumatic arthritis. Despite the complications involved [degenerative changes, avascular necrosis (AVN), heterotopic ossification (HO), failure of fixation necessitating THR] (1-4), anatomical restoration offers the optimal choice for most displaced fractures.

The incidence of acetabular fractures in patients over the age of 60 has increased markedly in the last quarter of a century (5), and the rate of increase is rising faster than for any other subgroup of acetabular fractures (6). In the elderly low energy injuries predominate, making injury profiles different from younger patients with acetabular fractures, both for the mechanism of injury and other associated injuries. Falls from standing height accounted for 50% of acetabular fractures in patients over 60 years old, while 82% of fractures in younger patients was as a result of high energy mechanisms of injury (5). The rate of other associated injury is much less for the elderly group (less than 30%) than for younger patients

due to the decreased rate of RTAs (7). Although these elderly patients frequently have poor bone quality, multiple medical co-morbidities and an increased peri-operative risk profile- all of which may reduce the expectation of a favourable outcome- with prompt diagnosis, careful monitoring of the physiological parameters of injury, optimisation of pre-operative status, involvement of experienced teams, and a highly specific patient-tailored management programme (8-11), successful outcomes can be achieved. Associated injuries, previous medical history of cardio-respiratory, neurological or cognitive issues, ambulatory status, functional demands, and a previous history of arthritic hip pain must be elicited and documented. Osteoporosis and fragility fracture treatment should be undertaken as for any fragility fracture of the elderly.

## Simultaneous acetabular fixation and total hip arthroplasty - evolution of the concept

Non-operative treatment of acetabular fractures is really only a treatment option for minimally displaced fractures, or for those unable to successfully tolerate the surgical intervention (12). These are the very patients who are most likely to benefit from early mobilisation and weight-bearing (13). ORIF remains the treatment of choice for displaced acetabular fractures (13), however failure rates for acetabular fracture ORIF are high; in the general population a 10% failure rate has been reported (14). In a more elderly cohort, a failure rate – requiring re-intervention with a THR – has been reported in over 30% of patients (15).

## Indications, limitations, technical challenges

First advanced by Westerborn in 1954 as a treatment modality for central dislocations (16), both the nomenclature and indications have evolved with time. The procedure has been known as, among other names, simultaneous ORIF and THR, combined internal fixation with acute THR, the combined hip procedure, and acute THR for acetabular fractures. The Authors have, for brevity, coined the term 'Fix and Replace'. Indications for this treatment option are based around a number of factors, including:

- Patient factors: age, osteoporosis, obesity, low functional demand, pre-existing ipsilateral osteoarthritis of the affected hip, or previous arthroplasty to the contralateral hip
- Fracture pattern factors: severe posterior wall comminution, articular cartilage damage to femoral head, marginal impaction of the acetabulum, ipsilateral displaced femoral head or neck fractures, anterior head dislocation
- External factors: prolonged hip dislocation (which has a high association with AVN, and sciatic nerve palsy), and delay to reconstruction (which is associated with higher rates of AVN, HO, infection) (15, 17-22).

Sierra et al. describe their indications for THR with these factors in mind, and include physiologically older patients with significant posterior wall involvement, and or significant impaction of the femoral head articular surface (23). Chana-Rodriguez et al. also add the-

se factors into their indications, using the description of patients who fall into the 'recognised subset' of patients for whom 'combined internal fixation with THA may be a more appropriate treatment option' (22). In the review article by Herscovici et al., inclusion criteria for the 'Combined Hip Procedure' (defined as ORIF and THR performed during the same anaesthetic) includes elderly patients with significant ipsilateral OA of the hip, osteoporosis producing poor stock, or those presenting with associated femoral head fractures (24). Guerado et al. elegantly describe their treatment algorithm for acetabular fractures in the elderly (8), dividing patients into three groups – those with good general health, those who are senile, and those with poor general health. Those considered suitable for acute THR include patients with non-easily reducible fracture within the good general health group, and those suitable for ORIF & acute THR include all patients in the senile group, and some of those in the poor general health group. De Bellis et al. conclude that 'physicians' practice and expertise are the most useful tools in clinical practice' (25).

### **Surgical options: approaches, techniques**

Careful planning of surgical approach is essential. Fractures of the anterior wall may require ORIF through an anterior approach, either using the ilioinguinal (II) approach or through the modified Stoppa approach. Herscovici et al. describe their operative management as stabilization of the fracture using standard ORIF techniques, approached via either the KL (n=19) or II (n=3) approach, with patients having II approach being repositioned and re-draped to allow placement of a THA through a posterior or posterolateral approach. The II approach was selected when posterior approach alone was deemed pre-operatively insufficient to provide stability of the columns or of the acetabular component (24). Recently the modified Stoppa approach has become popular, with a traditional Pfannensteil incision coupled with the lateral window of the ilioinguinal approach. This approach, described by Hirvensalo (26) and later Cole (27), is a modification of the intrapelvic approach described by Stoppa et al. (28), and avoids the dissection of the middle window of the ilioinguinal approach, sparing dissection of the femoral neurovascular bundle. Visualization through this approach is adequate for access for most of the inner true bony pelvis (29-31). The lateral window – common to both approaches – is relatively uncomplicated and gives excellent access across the pelvic brim and SI joint. Plating is often required for infrapectineal buttressing of the quadrilateral plate, though loss of reduction over time is common. Where the anterior approach can be avoided, good results can be achieved through the KL approach combining use of morcellised graft impacted onto the denuded face of the anterior wall – using the technique common in revision hip arthroplasty – followed by either a cemented or uncemented cup.

Osteosynthesis for fractures involving the posterior column is crucial to achieve a degree of joint stability. The KL approach is suitable for managing access to isolated fractures of the posterior column, and the associated type transverse with posterior wall components. Osteosynthesis with neutralisation and buttressing plates is essential before proceeding to the arthroplasty section of the case. Regardless of approach, as has been demonstrated in multiple series, instability of the bone fragments/columns integrity can threaten implant fixation, hence primary stability of fixation is of paramount importance (8, 32).

### **Treatment options for Fix and Replace**

Implant choices and combinations must be planned carefully, tailored to the specific patient and their respective fracture pattern,

be ordered in when necessary, and be compatible where modularity is available. Reconstructive options have been described from simple to highly complex, using the full panoply of implants (and adjuncts such as graft) for both the acetabular and proximal femoral components respectively. Prosthesis alone were used in one study (33), prostheses with anti-protrusion cages and bone grafting for others (22, 34), some studies report on cable fixation for fracture fixation (35-37), another describes standard ORIF without cable fixation (24), while a variety of options were described over a twenty year period by Sarker et al. (38) ranging from standard plate fixation to reinforcement with anti-protrusion cage devices.

Treatment of these fractures with THR is challenging due to the need to ensure primary stability of the acetabular component, which is threatened by unstable bony fragments/columns. Strong osteosynthesis is vital, and even if initial fixation is obtained, hip arthroplasty components may subside as a result of subsequent instability at the fracture site (24, 35, 39). Percutaneous reduction and fixation has been advocated using large cannulated 6.5 mm or 7.3 mm screws (40, 41). This technique requires considerable expertise, but in the elderly may have a role to allow sufficient stability to allow early mobilisation (7).

The Authors' preference is, where possible, for stable osteosynthesis using a single KL approach. If the anterior column is unstable, the anterior column is plated using a modified Stoppa approach. For the posterior elements, a standard KL approach is used, with a trochanteric osteotomy used only when necessary for proximal access. Once a stable construct has been achieved with standard plate fixation, the acetabular defect is addressed. If graft is required, the patients' femoral head, supplemented with allograft femoral head, is then bone mill morcellised and impacted. A revision-type cup can then be implanted. A highly porous metal cup with multiple screw options is preferred. These screws are placed in both columns and the use of a cemented polyethylene liner, to accommodate a 28 mm or ideally a 32 mm metal head, effectively creates an intra-acetabular locking plate (Figures 1 and 2). A dual mobility metal-backed shell can also be cemented into this porous cup, depending on clinical need. For the stem, a cemented highly polished double-tapered primary hip prosthesis is favoured. Routine cell salvage, use of tranexamic acid and consideration of an IVC filter preoperatively is employed. Full weight bearing with crutches is commenced the day following surgery unless otherwise contraindicated.

### **Outcomes**

In a systematic review comparing studies on the outcome of patients (mean age of 71.8 years, range 55 to 96 years) managed with simultaneous ORIF and THR and studies with patients undergoing ORIF, alone operative times were longer, and blood loss was greater for the former group, but no difference was noted in mortality between the groups (42). In De Bellis et al. systematic review (25), outcomes, complications and failure rates for acute THR were analysed in studies meeting their pre-defined criteria, noting that in studies looking at Harris Hip Scores (HHS) outcomes were good (Mears, Tidemark, Herscovici reporting HHS of 89, 85 and 74 respectively) (24, 34, 35). Heterotopic ossification (HO) was a problem in 6 studies, with a range of HO between 10-40%. Dislocation, a significant problem for THR surgery, is particularly relevant for the patients with cognitive impairment or neurological impairment. Sarkar et al. recommend THR for patients suffering neurological impairment or psychiatric conditions due to poor compliance with postoperative instructions (38). Although the highest dislocation rate was reported by Herscovici et al. at 14%



Figure 1 - AP pelvis of a 73-year-old man (fall from standing height, symptomatic left osteoarthritis before fall), presenting with a left acetabular fracture. He had plating of his anterior column via a modified Stoppa, then posterior plating, before acute THR using a highly porous metal cup with screws through both columns, into which a cemented DM cup was inserted, and a cemented femoral stem with a 32 mm head. The patient mobilised fully weight bearing the following day, and was discharged on post op Day 7.

(24), Sarkar et al. report the highest rate of radiographic loosening (21%) (38). A growing body of evidence indicates that Dual Mobility cups reduce dislocation rates in primary and revision total hip arthroplasty and, when used with prudence, in selected tumour cases (43). Sierra et al. note that these components are gaining popularity in Europe and consider them an option in high risk cases (23). In a study comparing the results of primary THR (mean age 78 years) to delayed THR (average age 53 years) for acetabular fracture, Sermon et al. noted – although not statistically significant – a reduced revision rate (8% compared to 22%) and reduced HO (28% compared to 41%) for those treated with acute THR, but noted better HHS scores for the delayed THR group (33).

Late complications are frequent in this patient cohort. Younger patients experience reduced levels of activity and a reduced qua-

lity of life following acetabular fractures (14), while the elderly experience more significant morbidity from both fracture and treatment (44, 45). For patients treated non-operatively, post-traumatic arthritis, non-union, protrusion and HO formation are common. For those treated with ORIF, the standard post operative complications in elderly patients are *de rigueur*, in addition to the late local complications, including HO, sciatic nerve palsy, prominence of metalwork or failure of fixation and infection. Risk factors for surgical site infection include high BMI, presence of Morel-Lavallée lesions and stay in the intensive care (46). Given the paucity of studies comparing directly the outcomes between acute THR for acetabular fractures and those treated with ORIF in the elderly cohort, further randomised control trials are needed to determine optimal therapy in this extremely challenging cohort of patients, in addition to delineating the effects of comorbidities, as-

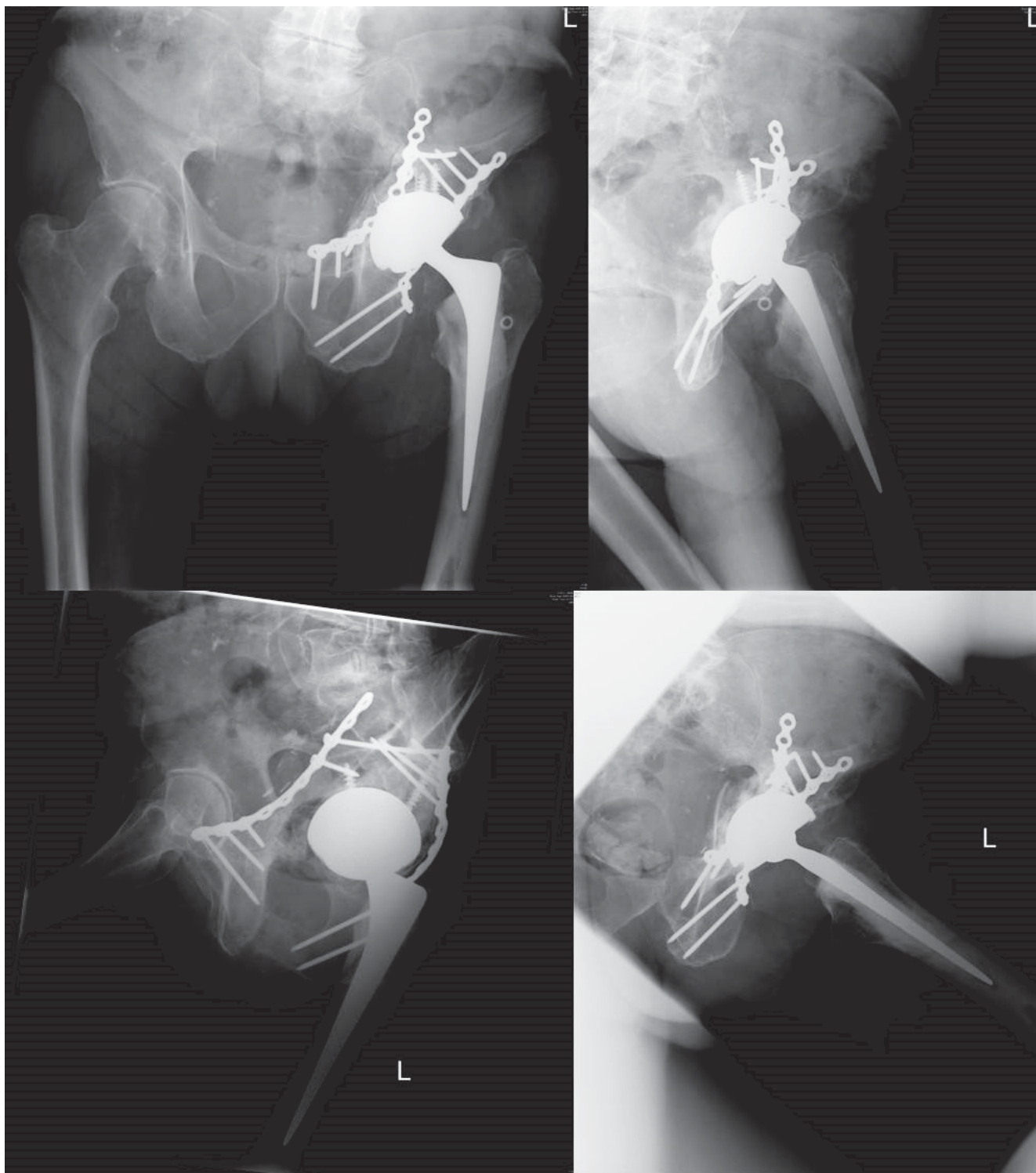


Figure 2 - Interval radiographic views at 6 months post surgery.

sociated injuries and the timing of surgery in specific patient groups (8).

### Conclusion

Although ORIF is widely considered to be the standard of care for younger and middle aged patients with acetabular fractures, in el-

derly patients with concomitant chronic disease acute THR may be a more suitable option. Specific factors relating to the patient (osteoporosis, obesity, low functional demand, pre-existing ipsilateral OA of the affected hip), the fracture pattern (posterior wall comminution, articular cartilage damage to the femoral head, marginal impaction of the acetabulum, ipsilateral displaced femoral head or neck fractures, anterior head dislocation) or external factors (prolonged dislocation, delay to fixation) are all relative indications.



Acute THR is a technically demanding intervention, not without significant risks to the patient. Challenges include longer anaesthetic times, higher blood transfusion rates, and technical difficulties (24). The risks of surgery of this magnitude are certainly front-loaded to the patient, but must be seen in the context of the risks to the patient from other forms of treatment – for ORIF the risk of failure is relatively high, frequently necessitating further surgery at a future date. For non-operative treatment, historically the more likely option, the inevitable decubitus-related risks for this patient cohort are well documented. Acute simultaneous ORIF and THR theoretically allows immediate weight bearing and faster rehabilitation, reduces the cost of inpatient stay, and reduces the risks of early and late local complications associated with standard treatment for this type of injury. Although the evidence base is to date limited, ‘fix and replace’ is emerging as a treatment paradigm in specific patient groups.

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