Total hip replacement (THR) after acetabular fracture presents unique challenges to the orthopaedic surgeon. The majority of patients can be treated with a standard THR, resulting in a very reasonable outcome. Technical challenges however include infection, residual pelvic deformity, acetabular bone loss with ununited fractures, osteonecrosis of bone fragments, retained metalwork, heterotopic ossification, dealing with the sciatic nerve, and the difficulties of obtaining long-term acetabular component fixation. Indications for an acute THR include young patients with both femoral head and acetabular involvement with severe comminution that cannot be reconstructed, and the elderly, with severe bony comminution. The outcomes of THR for established post-traumatic arthritis include excellent pain relief and functional improvements. The use of modern implants and alternative bearing surfaces should improve outcomes further.

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Total hip replacement (THR) after acetabular fracture is a complex procedure and presents the surgeon with unique challenges. THR may be indicated in two distinct clinical scenarios; firstly, if an acute acetabular fracture would result in a predictably poor outcome if treated with open reduction and internal fixation (ORIF), and secondly (and most commonly) after a patient develops post-traumatic arthritis after either non-operative or operative treatment of an acetabular fracture.

The potential technical challenges of THR include pelvic deformity, acetabular bone loss, risk of nerve injury, and difficulty in achieving long-term fixation of the acetabular component. Some of the potential challenges unique to THR after a previous acetabular fracture include nonunited or necrotic fracture fragments, retained metalware and the presence of heterotopic bone.

**Indications for THR in managing acute acetabular fractures**

The indications for this should be placed into context through comparisons with the reported results of ORIF. Numerous studies have demonstrated that failure of ORIF is commonly associated with incomplete fracture reduction, age > 40 years, prolonged hip dislocation, articular cartilage injury to the femoral head, acetabular impaction, anterior hip dislocation or severe posterior pelvic wall involvement. With these results in mind, our typical indications for THR include physiologically older patients with a fracture pattern that either has significant involvement of the posterior wall and comminution (posterior wall, posterior column–posterior wall, or transverse–posterior wall), and/or associated significant impaction of the femoral head articular surface (Fig. 1). This represents a small subset of patients treated for acute acetabular fracture at our institution, as the vast majority respond to accurate ORIF. The authors find a team approach helpful in many cases, with the skills of an experienced traumatologist for the reconstruction of the bony acetabulum, combined with the skills of an experienced THR surgeon for the implantation of the components.

**Technique for THR in acute acetabular fracture**

**Positioning and set-up.** The patient is placed in the lateral decubitus position on a radiolucent table in such a way as to facilitate unobstructed pelvic imaging with intra-operative fluoroscopy. Skin preparation and draping must allow for a more proximal pelvic incision than is typically needed for primary THR. We usually use intra-operative blood salvage, as the blood loss is usually greater than that seen after primary THR.

**Surgical approach.** As the primary indication for THR in this setting is severe posterior wall involvement, the authors almost always use a variation of the Kocher–Langenbeck approach. The posterior soft tissues can be taken directly...
from their femoral insertion as there is no longer a concern for femoral head viability. The incision will need to be extended distally to allow for adequate femoral visualisation during placement of the femoral component. At the time of the exposure, debridement of traumatised or devitalised gluteus minimus muscle is routinely performed in order to minimise the risk of development of heterotopic ossification. The identification and careful retraction of the obturator internus permits access to the lesser sciatic notch and ischium while protecting the sciatic nerve. Dissection between the hip capsule and short external rotators is necessary in order to expose the posterior column and sciatic notches. In cases in which the posterior wall is preserved, the posterior capsule can also be preserved for repair following the procedure. When the posterior wall is excised and reconstructed with femoral head autograft, the posterior joint capsule is excised along with the posterior wall fragments.

**Femoral neck osteotomy.** The femoral neck is osteotomised in standard fashion, and the femoral head is saved for later use as autograft if needed.

**Fracture reconstruction.** The fracture pattern is confirmed and fixation is performed. Where necessary, the posterior column is first reduced and fixed with a 3.5 mm pelvic reconstruction plate and screws. Any posterior wall fracture is then either reduced and fixed, or removed to facilitate eventual femoral head autograft reconstruction. Because posterior wall comminution is one of the most common reasons for choosing to perform an acute THR for an acetabular fracture, reconstruction of the posterior wall...
usually involves using the femoral head as a structural autograft (Fig. 2). The posterior wall defect that remains once the soft tissues and comminution are debrided is filled with a contoured segment of the patient’s femoral head. The irregular surface of the posterior wall defect can be templated by making a mould of the defect with polymethylmethacrylate cement. The cement polymerises until it is doughy, when it can be moulded into the defect to the desired shape of the posterior wall. The cement is then removed and used as a template to guide contouring of the femoral head autograft. This results in a graft that interdigitates with the irregular surface of the posterior wall defect, improving the graft stability.

The graft is secured with lag screw fixation well away from the surface to be reamed. A buttress plate is contoured to support the graft further, and secured above and below on the ischium and ilium with screws. The anterior column portion of a transverse-posterior wall associated acetabular fracture is often amenable to anterior column screw fixation, with the starting point originating either through the incision, or through a separate stab incision. If a screw is placed down the anterior column, care must be taken to place it far enough away from the acetabulum such that it is not encountered whilst subsequently reaming the acetabulum. Appropriate reduction and fixation of all fractures should be confirmed with a fluoroscopy.

**Acetabular reconstruction.** Prior to reaming, the surgeon must identify internal landmarks to guide component orientation as the acetabular anatomy can be markedly deformed at this stage. Useful landmarks include the anterior wall, ischium, greater sciatic notch, and the transverse acetabular ligament. Also, the surgeon must be careful not to over-ream the typically soft peri-articular bone. The authors favour uncemented fixation in these cases, and always plan for an acetabular component that will accommodate multiple screw fixation similar to a revision THR (Fig. 3). In some cases, an ultra-porous acetabular component that will accommodate customised screw placement...
may be beneficial. In general, maximising the inner diameter of the highly-cross-linked polyethylene liner is a helpful way to maximise prosthetic hip stability.

**Femoral reconstruction.** The femoral canal can be prepared and femoral component inserted in a standard fashion based upon the surgeon’s preference, the femoral shape and its bone quality.

**Stability.** Trial reduction of the components in both extension-external rotation (to evaluate posterior impingement and anterior stability) and flexion-internal rotation (to evaluate anterior impingement and posterior stability) should be performed in all cases. The posterior soft-tissue envelope is frequently deficient and will not accommodate anatomical repair following the reconstruction, which increases the risk of post-operative posterior dislocation. The surgeon should use large-diameter femoral heads and/or elevated or dual-mobility liners, as needed, to optimise stability. The benefit of large diameter femoral heads needs to be weighed against their potential drawbacks, including increased polyethylene wear and potential taper corrosion.

**Post-operative care.** The fracture pattern and quality of acetabular fixation will dictate post-operative weight bearing, but most patients are permitted touch-weight-bearing for two to three months. Patients deemed at high-risk for instability are placed into a hip abduction orthosis for six weeks. All patients are given counselling regarding posterior hip dislocation precautions.

**THR for post-traumatic arthritis**

The indications for THR for post-traumatic arthritis are similar to those for any patient with end-stage hip disease. These include pain and stiffness interfering with daily activities, accompanied by radiological signs consistent with advanced arthritis, articular incongruity or osteonecrosis.

The potential associated challenges facing the surgeon are undetected infection, residual pelvic deformity, nonunited fractures, bone loss, osteonecrosis, retained implanted materials and previous neurological injury. Any or a combination of these challenges may make achieving satisfactory acetabular reconstruction, with sustained long-term survivorship difficult.

In cases of previous ORIF, especially with rapidly progressive joint deterioration, infection should always be ruled out before proceeding with THR. Appropriate baseline tests include an erythrocyte sedimentation rate and C-reactive protein. If these are abnormal or if suspicion for infection remains high despite normal laboratory values, then aspiration of the hip joint should be performed. The fluid should be analysed for synovial cell count with differential, and aerobic and anaerobic cultures.

If infection is confirmed, the surgery should be staged, with removal of any residual implants and debridement of the hip joint including removal of all cartilage as a first stage, with subsequent placement of an antibiotic loaded spacer. Second-stage reconstruction is performed after eradication of the infection. Intra-operative cultures guide the choice of intravenous antibiotics between stages.

At the time of surgery, residual pelvic deformity can lead to distorted anatomy that may make placement of the acetabular component in the ideal position more challenging. When the anterior or posterior walls are absent, the use of autograft bone fixed with a plate or screws, as described earlier, is recommended. In addition, the superior aspect of the dome may also be sufficiently deformed as to predispose the surgeon to place the acetabular component in a more abducted position. In these circumstances an intra-operative x-ray may help in determining appropriate position and anteversion of the acetabular component.

In addition to the problems with cup position, deformity could lead to bony impingement between the trochanter and the pelvis, leading to a high risk of post-operative dislocation. The authors recommend using larger head
diameters to enhance stability, understanding that there are potential drawbacks to their use as discussed previously. The use of dual mobility acetabular components has gained popularity in Europe in complex primary hip replacement in order to decrease dislocation rates, and may be an option in high-risk cases (Fig. 4).

In the presence of acetabular bone loss, necrosis or nonunion, the surgeon should be ready to apply principles of revision THR. In the majority of patients, the use of an uncemented hemispherical acetabular component is all that is required. The femoral head may be used as autograft, in either bulk or particulate form, when larger defects are encountered. Bulk graft autograft bone from the femoral head is mainly used in cases of protrusio or when columnar defects are present. Posterior plating should be reserved for cases of pelvic discontinuity and/or if the graft requires supplemental fixation (Fig. 5).

Retained metal components are selectively removed and in the majority of cases, removal of only one or two screws may be required at the time of reaming. If the metalware is not in the way of the placement of the acetabular component, it can be left except in cases of infection. Occasionally, screws that are encountered during reaming may be cut off with a high speed burr, rather than finding the screw head and removing the entire screw. The risks of sciatic nerve injury are important especially if previous injury has occurred. In the majority of cases, staying well away from the sciatic nerve is the best option. When the sciatic nerve is at especially high risk during surgery, intra-operative electromyography (EMG) monitoring may be considered.

Patients undergoing THR after acetabular fracture often have post-operative heterotopic ossification related to the previous injury or surgery. The surgeon should be ready to excise it if it is causing symptoms, impeding the operative
approach, or leading to impingement after the components have been implanted. If heterotopic ossification has formed previously, it is recommended that the surgeon use prophylaxis against recurrence. In these cases the authors recommend appropriately shielded prophylactic radiation therapy within 12 hours pre-operatively or 72 hours post-operatively. A single dose of 800 cGy is the usual dose. In extremely high-risk patients, the authors prefer the addition of a non-steroidal anti-inflammatory drug (NSAID), for additional protection.

The clinical results of THR after acetabular fracture achieve excellent pain relief and functional improvement in the majority of patients. The biggest historical problem has been acetabular component fixation. Romness and Lewallen reported a failure rate of cemented fixation of 50% at ten years, which is not currently recommended. Subsequently, Berry and Halasy reported on the results of uncemented acetabular components. Of 34 hips performed between 1984 and 1990 with a minimum ten-year follow-up, nine (26%) required acetabular revision: two for loosening or wear, and seven for osteolysis. More recently, newer generation acetabular components have shown increased durability. Although the follow-up is short, Bellabarba et al. showed one revision out of 30 components at five years, and Ranawat et al. reported two revisions in 32 acetabular components at a mean of 4.7 years.

**Conclusion**

When preforming THR after acetabular fracture, the surgeon must be prepared for a difficult operation. The goal of the intervention is to improve pain and function while minimising complications. A careful pre-operative assessment to rule out infection and to assess bone loss or nonunion should be completed. The surgeon must anticipate more than routine blood loss and, therefore, intra-operative blood salvage is recommended, and type- and cross-matched allogenic blood should be available. Longer operative times and challenging exposures are common in these circumstances and the surgeon should prepare accordingly. The type of exposure should be chosen based on the surgeon's preference, the presence of heterotopic ossification and potential need for removal of retained hardware. The surgeon should anticipate special needs and tools during surgery and have available pelvic reconstruction plates and metal cutting instruments, and be prepared occasionally to use auto or allograft bone graft. In addition the surgeon must plan for heterotopic ossification prevention via thorough debridement of devitalised tissue and post-operative prophylaxis with radiation or NSAIDs.

In order to avoid the historical problems with long-term acetabular component fixation seen with cemented acetabular components, uncemented acetabular components with supplementary screw fixation are the implants of choice. In the young, active post-traumatic arthritis population, alternative bearing surfaces should reduce the problems associated with polyethylene wear and osteolysis that have been present in previous studies using conventional, non-highly cross-linked polyethylene. In selected cases with poor bone stock, highly porous revision components may enhance primary stability, and allow for customised screw placement.

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**References**