Current Concepts Review

Acetabular Fractures in the Elderly

Evaluation and Management

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- Acetabular fracture patterns in the elderly, with increased involvement of the anterior column, quadrilateral plate comminution, medialization of the femoral head, and marginal impaction, differ from those noted among a younger cohort.

- Poor prognostic factors for open reduction and internal fixation (ORIF) are posterior wall comminution, marginal impaction of the acetabulum, a femoral head impaction fracture, a so-called gull sign, and hip dislocation.

- The rate of conversion to total hip arthroplasty following formal ORIF has been reported to be 22% at a mean of twenty-nine months.

- Total hip replacement after an acetabular fracture generally yields good clinical results; however, in the acute setting, it must be combined with proper stable fracture fixation.

Epidemiology and Mechanism of Injury

With an aging population, the prevalence and burden of all osteopenic fractures, especially hip fractures, continue to be a concern. Specifically, in patients over the age of sixty, there has been a 2.4-fold increase in the incidence of acetabular fractures over the past quarter of a century, and geriatric patients are the fastest growing subgroup of patients with acetabular fractures. The mechanism of injury in this age cohort differs substantially in comparison with that in younger adults. Ferguson et al. found that while low-energy falls from a standing height accounted for 50% (117) of 235 acetabular fractures in patients over sixty years of age, high-energy mechanisms accounted for 82% (884) of 1072 fractures in young adults. Additionally, only 30% (seventy) of 235 older patients with an acetabular fracture had associated injuries, likely because of decreased involvement in motor vehicle collisions.

The anterior column-posterior hemitransverse fracture pattern is the classic osteopenic acetabular fracture as it displays a number of features commonly seen in geriatric acetabular fractures (Figs. 1-A and 1-B). In patients with normal bone quality who are involved in high-energy trauma, fracture patterns are typical of those described by the Letournel classification. However, osteopenic patients who fall on their side experience an impact through the greater trochanter, which results in an anteromedial force fracturing and displacing the anterior column and quadrilateral plate. The femoral head then medializes with the anterior column and impacts the postero-medial portion of the roof. At times, the femoral head can be impacted by the intact acetabulum. This mechanism results in...
in the classic features common to geriatric acetabular fractures, which include anterior column displacement, quadrilateral plate involvement, medialization of the femoral head, and superomedial roof impaction, which create the so-called gull sign on an anteroposterior pelvic radiograph.

**Radiographic Evaluation and Fracture Classification**

Radiographic evaluation begins with an anteroposterior pelvic radiograph followed by obturator and iliac oblique Judet radiographs (Figs. 1-A through 1-E). Fractures are then classified according to the Letournel classification of acetabular fractures to assist in treatment planning. The fracture can be further investigated with computed tomography (CT) scans and three-dimensional reconstructions to gain a better understanding of the personality of the fracture and assess articular displacement. Occult acetabular fractures following a low-energy fall can occur and may result in a poor outcome if missed. If radiographs are equivocal in an elderly patient with hip pain following a traumatic injury, a magnetic resonance imaging scan is warranted to rule out both an occult proximal femoral fracture and an acetabular fracture.

Recent systematic reviews and epidemiological studies have revealed that the associated both-column variant is the most frequent fracture pattern (23% to 26%) in this age group. Fractures involving the anterior column are the second most common, with anterior column-posterior hemitransverse.

**Figs. 1-A through 1-E** A patient with an anterior column-posterior hemitransverse fracture of the left hip. **Figs. 1-A and 1-B** Preoperative anteroposterior pelvic radiograph (Fig. 1-A) demonstrating the fracture with a so-called gull sign, representing superomedial dome impaction (large black arrow) and quadrilateral plate displacement (thin white arrow), and a three-dimensional reconstruction (Fig. 1-B) showing oblique views, with a white arrow indicating the plate displacement.
Figs. 1-C, 1-D, and 1-E  The reduction and fixation of the fracture.  

**Fig. 1-C**  The superomedial dome fragment is reduced via a bone tamp through an ilioinguinal approach.  

**Fig. 1-D**  The quadrilateral plate is reduced via an offset clamp.  

**Fig. 1-E**  Anterior column plating and periarticular screw fixation permit an acceptable radiographic result.
fractures representing 15% to 19% and isolated anterior column injuries accounting for 11% to 19%. Of note, with posteriorly directed forces, isolated posterior wall fractures (8% to 13%) are relatively common and are often associated with marginal impaction (38%) and fracture comminution (44%). Isolated posterior column fractures (0.4% to 2%) are quite rare as these fractures generally occur in more robust bone. However, when they do occur, they are associated with posterior wall injuries (8% to 13%).

Radiographic signs associated with a poor outcome are posterior wall comminution, marginal impaction, the so-called gull sign representing superomedial roof impaction, hip dislocation, impaction injuries to the femoral head, femoral head or neck fractures, and preexisting arthritic changes (Table I). Anglen et al. described the gull sign, which refers to a specific type of marginal impaction of osteopenic bone resulting in superomedial dome impaction from medialization of the femoral head. In their series, all fractures with this radiographic finding experienced inadequate reduction or early loss of reduction, medial subluxation of the femoral head, and medial and/or superior joint narrowing, with a 100% rate of failure of open reduction and internal fixation (ORIF). These findings were confirmed by Laflamme et al. in a series of twenty-one patients, in which six patients with the gull sign had a poor reduction and progressed early to total hip arthroplasty. However, in a larger study, Carroll et al. found no association between the gull sign and the need for subsequent arthroplasty, stating that the failure rate was largely related to the overall quality of the reduction and fixation.

**Treatment Options**

Before treatment options are considered, a full history and physical examination should be completed with a focus on the patient’s associated injuries, medical history, ambulatory status, functional demands, living situation, and history of arthritic hip pain. Patients with an acetabular fracture should be treated as any other older patient with a fragility fracture; the vitamin-D level along with other factors related to osteoporosis should be evaluated and a follow-up dual x-ray absorptiometry scan scheduled with appropriate referral to a clinician comfortable in the evaluation and treatment of low bone density. Factors affecting the survival of the native hip should also be considered when choosing treatment options. In their series of 816 acetabular fractures followed over twenty-two years, Tannast et al. revealed that an age of greater than forty years,
anterior dislocation, posterior wall involvement, femoral head cartilage impaction fractures, marginal impaction, acetabular impaction, and initial articular displacement of >2 cm were correlated with a future need for total hip arthroplasty.

Nonoperative Treatment
Historically, the nonoperative management of geriatric acetabular fractures has yielded poor results. In the past, reductions were attempted via lateral trochanteric or longitudinal skeletal traction and prolonged bed rest. In a study of thirty-two displaced fractures managed nonoperatively, only 56% (eighteen) of the fractures were reduced and 44% (fourteen fractures) had a poor clinical outcome. In a review of the cases of twenty-five patients over sixty-five years old who had an acetabular fracture that was managed nonoperatively, Spencer reported that 30% had poor results associated with severe pain on walking or with incapacitation. However, in specific situations, nonoperative management may be indicated.

Nonoperative management is indicated in both-column fracture patterns that exhibit so-called secondary congruence. In the both-column fracture, all fracture fragments are separate from the intact ilium, allowing the femoral head to act as a template such that each osteochondral fragment may settle around the femoral head and achieve a congruent reduction. Letournel originally reported very good to excellent results in eleven of thirteen fractures with secondary congruence at 4.3 years. Most recently, Gansslen et al. reviewed the cases of thirty-five patients of all ages with both-column fractures who required nonoperative treatment and found that 88% healed with secondary congruence. Overall, 80% had no to slight pain and 77% had good to excellent functional results on the basis of the Merle d’Aubigné scoring system. In an elderly, low-demand patient, secondary congruence may provide acceptable functional outcomes (Figs. 2-A and 2-B).

Although indications specific to the geriatric population do not exist, literature on acetabular fractures in adults has shown that nonoperative management is indicated in fractures that simultaneously meet all of the following criteria: <2 mm of displacement, an intact roof arc angle of 45°, superior 10 mm of the subchondral ring intact on CT, posterior wall fractures involving <20% of the posterior wall, hip joint stability and congruity, and an absence of the poor prognostic factors listed earlier. Lastly, in patients who are medically unfit for surgery or functionally incapacitated, nonoperative management may be a necessity.

Our nonoperative management protocol consists of a short period of bed rest for pain control followed by early mobilization with toe-touch weight-bearing for six weeks with physiotherapy supervision depending on fall risk. Prophylaxis against deep vein thrombosis should be used during this period. Anteroposterior radiograph made six months after the injury showing acceptable radiographic results.
period, and fall prevention measures should be instituted via allied health-care workers. The patient is seen at two, six, and twelve weeks for pelvic radiographs to monitor for displacement. Bed rest is specifically contraindicated for these patients, given the morbidity and mortality associated with prolonged bed rest. On the rare occurrence that the patient is too uncomfortable to mobilize, we recommend surgical stabilization of the fracture to allow early mobilization.

**Operative Management**

While it was previously suggested by Tile that attempts at osteosynthesis of geriatric acetabular fractures be abandoned because of poor bone quality, Letournel reported that 76% (forty-four) of fifty-eight patients over sixty years old with acetabular fractures treated by ORIF had good to excellent outcomes. Matta reported that achieving a reduction with <3 mm of intra-articular incongruity was key to obtaining a good clinical result in all acetabular fractures. However, numerous authors have shown a limited ability to achieve an acceptable reduction in these patients in comparison with a younger cohort. Both Matta and Miller et al. were only able to achieve anatomic reduction in 44% (thirteen) of twenty-nine patients over sixty years old and in 58% (twenty-six) of forty-five patients over fifty-five years old, respectively. Before deciding on treatment, one should consider whether an acceptable reduction can be achieved and whether bone quality is sufficient for the implants to maintain articular reduction.

**Choice of Operative Approach**

With the exception of most transverse and T-shaped patterns, any fracture pattern involving the anterior column may be approached via an ilioinguinal approach or the intrapelvic Stoppa approach. Fractures involving the posterior wall or isolated posterior column necessitate a Kocher-Langenbeck approach. In geriatric fractures involving the anterior column and displacement of the quadrilateral plate, the use of the Stoppa approach provides direct access and visualization of these fragments for reduction and fixation. For surgeons who prefer the ilioinguinal approach, dissection can be limited to the lateral two windows to minimize blood loss and operative time, with similar outcomes in comparison with the traditional three windows. When an acute total hip arthroplasty is combined with ORIF, an ilioinguinal or Stoppa approach may be utilized for fracture fixation followed by repositioning and total hip arthroplasty via a Kocher-Langenbeck approach. Alternatively, surgeons who are comfortable with anterior total hip arthroplasty may prefer the Levine anterior approach in fractures without posterior wall comminution (Fig. 3).

**ORIF**

**Formal ORIF**

The reduction sequence generally begins with disimpaction of the medialized femoral head via lateral traction using a Schanz pin in the proximal part of the femur, allowing lateralization of the femoral head back under the acetabular dome. Via the lateral window of the ilioinguinal approach, reduction and lag screw and/or plate fixation of high anterior column fractures can be completed. Deformity correction often requires internal rotation of the anterior column, and antiglide plate techniques can be very useful in achieving and maintaining the reduction without blocking the reduction of the medial articular fragments or quadrilateral plate. The impacted roof segments can then be disimpacted via a bone tamp placed through a cortical window on the inner table during an ilioinguinal approach. Alternatively, the Stoppa approach can be used to hinge open

### Table I Poor Prognostic Factors for ORIF of Geriatric Acetabular Fractures

<table>
<thead>
<tr>
<th>Poor Prognostic Factors</th>
<th>ORIF = open reduction and internal fixation.</th>
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<tbody>
<tr>
<td>Gull sign</td>
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<tr>
<td>Femoral head impaction</td>
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<td>Marginal impaction</td>
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<td>Hip dislocation</td>
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<tr>
<td>Preexisting osteoarthritis</td>
<td></td>
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<tr>
<td>Femoral head and neck fractures</td>
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<tr>
<td>Posterior wall comminution</td>
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Fig. 3 The Levine approach with an incision along the iliac crest to the anterior superior iliac spine and extending distally over the Smith-Petersen interval. (Reproduced, with permission, from: Beaule PE, Griffin DB, Matta JM. The Levine anterior approach for total hip replacement as the treatment for an acute acetabular fracture. J Orthop Trauma. 2004 Oct;18[9]:623-9.)
the quadrilateral plate and directly reduce the impacted articular fragments. Last, the quadrilateral plate can be reduced using offset pelvic clamps or ball-spike pushers with a spiked disc attachment to avoid penetrating the thin cortex in this location (Figs. 1-C, 1-D, and 1-E).

Achieving rigid fixation of the often fragile quadrilateral plate can be the most difficult part of the procedure. Attempts at buttressing the quadrilateral plate through the ilioinguinal approach via a spring plate or T-plate placed under a pelvic reconstruction along the pelvic brim have resulted in late displacement. A biomechanical anterior column-posterior hemitransverse fracture model using a cadaveric pelvis showed that the addition of three long periarticular screws to standard reconstruction plating along the pelvic brim provided increased resistance to displacement of the quadrilateral plate, while use of an H plate, which hangs over the pelvic brim down the quadrilateral plate, did not. We favor direct buttressing of the quadrilateral plate through the Stoppa approach. Lafamme et al. described a technique for direct reduction of the fragment whereby the quadrilateral plate fragment was mobilized, reduction of the impacted dome fragment was achieved under direct visualization, and subchondral raft screws were placed above the dome. In a series of twenty-one elderly patients with quadrilateral plate displacement and protrusion, Lafamme et al. outlined the use of a contoured infrapéctineal pelvic reconstruction plate placed through the Stoppa window with two screws just anterior to the sacroiliac joint and two screws into the superior pubic ramus. With this configuration, substantial loss of reduction was only seen in two patients.

**Percutaneous Reduction and Fixation**

In order to minimize the risks of postoperative infection and blood loss and to offer potentially quicker recovery, some have advocated percutaneous fixation. It should be noted that this technique requires considerable expertise and comfort with fluoroscopic anatomy of the pelvis, and it would likely only be applicable for acetabular trauma surgeons making the transition from open to percutaneous techniques. In the elderly population, this technique may be used to allow sufficient stability to facilitate early mobilization, and if arthritic progression occurs following consolidation, it allows for a routine total hip arthroplasty. Percutaneous fixation of acetabular fractures has been popularized by the work of Starr et al. on the development of the techniques for column fixation using large cannulated 6.5 or 7.3-mm screws. In their review of eighty

<table>
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<tr>
<th>Study</th>
<th>Patient Age (yr)</th>
<th>No. of Fractures</th>
<th>Mean Duration of Follow-up</th>
<th>Mean Functional Scores (points)</th>
<th>Conversion to Total Hip Arthroplasty</th>
<th>Rates of Death/Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIF</td>
<td></td>
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<tr>
<td>Carroll et al. (2010)</td>
<td>&gt;55</td>
<td>84</td>
<td>5 yr</td>
<td>20.6 on MFA; 28.3 after conversion to THA</td>
<td>30.95% at 28 mo</td>
<td>–/40%</td>
</tr>
<tr>
<td>Archdeacon et al. (2013)</td>
<td>&gt;70</td>
<td>39</td>
<td>34 mo</td>
<td>16 on Merle d’Aubigné system</td>
<td>19%</td>
<td>20% at 20 mo/–</td>
</tr>
<tr>
<td>Miller et al. (2010)</td>
<td>&gt;55</td>
<td>45</td>
<td>72.4 mo</td>
<td>46 on SF-36 PCS; 50 on SF-36 MCS</td>
<td>28.9% at 31.5 mo</td>
<td>NA</td>
</tr>
<tr>
<td>Anglen et al. (2003)</td>
<td>&gt;60</td>
<td>48</td>
<td>37 mo</td>
<td>37.26 on SF-36 PCS; 57.38 on SF-36 MCS</td>
<td>17% at 7.5 mo</td>
<td>21%/–</td>
</tr>
<tr>
<td>Lafamme et al. (2011)</td>
<td>&gt;55</td>
<td>21</td>
<td>4.2 yr</td>
<td>86.2 on HHS</td>
<td>10%</td>
<td>NA</td>
</tr>
</tbody>
</table>

Acute THA and ORIF

<table>
<thead>
<tr>
<th>Study</th>
<th>Patient Age (yr)</th>
<th>No. of Fractures</th>
<th>Mean Duration of Follow-up</th>
<th>Mean Functional Scores (points)</th>
<th>Conversion to Total Hip Arthroplasty</th>
<th>Rates of Death/Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouhsine et al. (2002)</td>
<td>&gt;65</td>
<td>12</td>
<td>2 yr</td>
<td>NA</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Mears and Velyvis (2002)</td>
<td>&gt;50</td>
<td>48</td>
<td>8.1 yr</td>
<td>89 on HHS</td>
<td>NA</td>
<td>0/9.5%</td>
</tr>
<tr>
<td>Herscovici et al. (2010)</td>
<td>&gt;60</td>
<td>22</td>
<td>29.4 mo</td>
<td>74 on HHS</td>
<td>NA</td>
<td>–/59%</td>
</tr>
<tr>
<td>Chakravarty et al. (2013)</td>
<td>&gt;57</td>
<td>19</td>
<td>22 mo</td>
<td>NA</td>
<td>NA</td>
<td>26% at 1 yr/42%</td>
</tr>
<tr>
<td>Rickman et al. (2014)</td>
<td>&gt;63</td>
<td>24</td>
<td>24 mo</td>
<td>NA</td>
<td>NA</td>
<td>14% at 1 yr/8%</td>
</tr>
<tr>
<td>Boraiah et al. (2009)</td>
<td>&gt;55</td>
<td>18</td>
<td>3.9 yr</td>
<td>88 on HHS</td>
<td>NA</td>
<td>–/11%</td>
</tr>
<tr>
<td>Lin et al. (2014)</td>
<td>&gt;60</td>
<td>33</td>
<td>5.6 yr</td>
<td>17 on OHS</td>
<td>NA</td>
<td>–/15%</td>
</tr>
</tbody>
</table>

*ORIF = open reduction and internal fixation, MFA = Musculoskeletal Functional Assessment, THA = total hip arthroplasty, SF-36 = Short Form-36, PCS = Physical Component Score, MCS = Mental Component Score, NA = not available, HHS = Harris hip score, and OHS = Oxford hip score.*
patients over the age of sixty, they performed surgery on displaced unstable acetabular fractures, with 56% (forty-five) of the eighty fractures being displaced both-column or anterior column-posterior hemitransverse fractures. Twenty-five percent (twenty) of the eighty fractures underwent closed reduction with percutaneous use of Cobb elevators or ball-spike pushers using fluoroscopic guidance. Seventy-five percent (sixty fractures) required mini-open access to the quadrilateral plate via a small 3-cm portion of the lateral window along the iliac crest. Of the seventy-five patients available for follow-up at a mean of 3.9 years, nineteen (25%) had conversion to total hip arthroplasty at a mean of 1.41 years postoperatively. Loss of reduction with medialization of the femoral had occurred in 6% (five) of the eighty patients. In a follow-up study that reviewed the same patient series, Gary et al. commented on the functional outcome of percutaneous fixation. Of the forty-three patients available for follow-up, thirty-five provided Short Musculoskeletal Functional Assessment (SMFA) scores at a mean of 6.8 years postoperatively. No significant difference in the SMFA scores was found between those who retained their native hip and the population norms for patients over sixty years old. Of the thirty-six patients, eleven (31%) had a subsequent total hip arthroplasty. In their conclusion, they noted that functional scores were not significantly better than those in other series of formal ORIF.

Although the outcomes of the above case series appear comparable with those after formal ORIF, the literature supporting this comparison is sparse. Specific contraindications to this technique include posterior wall fractures with hip joint instability and lack of expertise with percutaneous column fixation. Although Starr et al. utilized their technique for all displaced acetabular fractures, we favor using percutaneous techniques to stabilize the columns in minimally displaced fractures in patients who are too uncomfortable to begin our early mobilization and/or toe-touch weight-bearing protocol.

Postoperative Management
Patients should be treated with prophylaxis against deep vein thrombosis during the postoperative course. Protected weight-bearing is maintained for three months until fracture consolidation occurs; however, patients may self-limit during this period.

Outcomes of ORIF
In a 2014 systematic review of eight studies on acetabular fractures in patients over fifty-five years old, similar failure rates, as measured by conversion to total hip arthroplasty, were noted, with 22% of the fractures treated with formal ORIF and 25% of those treated with percutaneous fixation having conversion to total hip arthroplasty. An acceptable reduction of <3 mm was found in 86% of the fractures treated with formal ORIF; however, an anatomic reduction was only achieved in 45%. The mean blood loss was significantly different at 891 mL in the ORIF group and 70 mL in the percutaneous fixation group (p < 0.001). Of note, the mortality rate in the percutaneous group was 31% compared with 15% in the ORIF group; however, the percutaneous group was significantly older at 74.4 years versus 69.5 years (p < 0.001), imparting potential bias. Nonfatal complications were similar at 39%. The Harris hip score averaged 87.9 points in the group treated with formal ORIF.

Acute Total Hip Arthroplasty
The indications for acute total hip arthroplasty have not been fully developed, but generally include the poor prognostic factors listed above. The majority of studies on acute total hip arthroplasty have cited indications such as severe non-reconstructible comminution related to poor bone density, femoral head lesions, impaction fracture of >40% of the dome, femoral head and/or neck fractures, and preexisting severe degenerative arthritis.

Surgical goals when this fracture is approached include the achievement of rigid stabilization of the fracture such that an acetabular component can be inserted with good initial stability to allow fracture site healing and long-term stability of the component. Achieving these goals involves overcoming many technical challenges, and one should be careful not to assume that a total hip arthroplasty is a simpler solution to a complex fracture pattern as it can be more difficult than open ORIF.

Several techniques of fracture reduction and stabilization (cables, formal ORIF, or percutaneous ORIF) can be used prior to performing the total hip replacement. During reduction, the goal is not to achieve anatomic reduction, but to reduce the columns such that they will provide stability to the acetabular component. The use of anterior column and iliac wing fixation combined with braided cerclage cabling of the acetabulum and quadrilateral plate to prevent protrusio was popularized by Mears et al. and Mouhsine et al. in the late 1990s and early 2000s. The Combined Procedure has since become a popular method of fixation in which the acetabulum is stabilized using formal ORIF techniques, followed by implantation of an acetabular component. During this technique, bone loss may occur from posterior wall fracture comminution, which may hinder the ability to achieve a rim fit with a press-fit component. In these situations, the osteotomized native femoral head is used as a structural graft to provide primary stability of the component similar to a figure-7-shaped graft. Alternatively, with the popularization of percutaneous stabilization, large cannulated screws can be used in the place of formal ORIF. Efforts should be made to utilize a single incision for both procedures to reduce operative time and blood loss. Surgeons who are comfortable with the anterior total hip arthroplasty technique may use the Levine modification of the Smith-Petersen approach in the setting of isolated anterior column or associated anterior column-posterior hemitransverse fracture.

In situations in which rigid fixation of the acetabular component cannot be achieved with ORIF of the columns, antiprotrusio cages can be used to stabilize fractures by virtue of the screws that attach the cage to the intact ilium, bridging the fracture and providing a stable environment for cup insertion. This technique can be used for all acetabular fractures, with the exception of the both-column type of fracture since there is no intact ilium to anchor the cage. In this technique, the articular surface is left unreduced; the articular cartilage of
the acetabulum is carefully removed using reamers or curets, with the native femoral head used as morselized graft; the cage is implanted using numerous screws; and finally a polyethylene bearing is cemented in place (Figs. 4-A and 4-B)\(^49\). Full weight-bearing is not begun until fracture union at six weeks. In the largest reported series, to our knowledge, on acute total hip arthroplasty, Mears and Velyvis reported on fifty-seven patients with a mean follow-up period of 8.1 years\(^19\). Superior anterior column fragments were reduced and fixed with percutaneous lag screws through the anterior inferior iliac spine, while the remainder of the acetabulum and the displaced quadrilateral plate were stabilized with a cabling technique. Press-fit acetabular components were used, and patients were mobilized at six weeks. The mean Harris hip score was 89 points (range, 69 to 100 points). Although early migration of <3 mm was noted, there were no cases of late aseptic loosening\(^19\). Similarly, a trabecular metal cup-cage construct may be used to provide stability in appropriate fracture patterns\(^50\).

In a systematic review comparing studies on the outcome of patients managed with acute total hip arthroplasty and studies involving patients who had ORIF, it was noted that operative times were shorter, blood loss was greater, and mortality was not significantly different between the two groups\(^17\). The mean Short Form-36 score was better for acute total hip arthroplasty (57.9 versus 48.5 points; \(p < 0.001\)); however, the mean Harris hip score was better for the ORIF group (87.9 versus 74.0 points; \(p < 0.001\))\(^17\). A summary of the available literature is given in Table II.

### Delayed Total Hip Arthroplasty

Delayed total hip arthroplasty is offered in the setting of post-traumatic arthritis following failure of ORIF or nonoperative treatment. Total hip arthroplasty in this setting involves a number of obstacles and should be approached as a revision arthroplasty. These obstacles include scarring, heterotopic bone, retained hardware, acetabular deformity, acetabular nonunion, potential quiescent infection, and osteonecrosis of the femoral head\(^51\).

Historically, the issues with arthroplasty in this setting have revolved around fixation of the acetabular component. Romness and Lewallen reported on fifty-five total hip arthroplasties performed with cement and noted a 50% rate of radiographic acetabular loosening and a 15% rate of component revision\(^52\). Weber et al. described sixty-three patients with failure after ORIF who had conversion to total hip arthroplasty\(^53\). Of the forty-one prostheses inserted with cement, fifteen (37%) went on to loosen and nine required revision. By comparison, none of the press-fit components loosened\(^53\). Contemporary literature has been more supportive of the press-fit acetabular revision type of components with multiple screw options. Bellabarba et al.
reported on thirty patients with posttraumatic osteoarthritis treated with cementless acetabular components and noted a Kaplan-Meier ten-year survival rate of 97%\textsuperscript{54}. In their series, fifteen patients had a previous failed ORIF, and fifteen had failed nonoperative treatment. They noted that those with previous ORIF had significantly longer operating-room times (p < 0.001), more blood loss, and higher transfusion rates; however, given the restored pelvic anatomy, there was a decreased need for bone-grafting\textsuperscript{54}.

Comparison of delayed total hip arthroplasty after acetabular fracture and primary total hip arthroplasty has yielded varying results. In their series, Bellabarba et al. compared their patients with a consecutive series of patients who had primary total hip arthroplasty\textsuperscript{54}. Component survival based on revision or radiographic loosening was similar between the groups at 97% and 99% at a mean follow-up of thirty-six months (range, twenty-four to 140 months)\textsuperscript{54}.

**Overview**

Acetabular fractures in the elderly are becoming increasingly common and require advanced surgical skills for management. ORIF can provide acceptable outcomes when a concentric, congruent joint reduction is obtained. However, there remains a 22% conversion rate to total hip arthroplasty at a mean of twenty-nine months\textsuperscript{17}. For patients with poor prognostic factors, primary treatment of the injury with acute total hip arthroplasty following stabilization of the fracture provides excellent outcomes. Caution should be employed when approaching delayed total hip arthroplasty as this procedure can be substantially more complex in comparison with primary total hip arthroplasty. In general, future research efforts should focus specifically on the low-energy, osteopenic fracture patterns rather than chronologic age to remove the existing heterogeneity of fracture patterns in the literature.\textsuperscript{17}
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References