Management of Acetabular Fractures by Prosthetic Hip Replacement

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Abstract

Total hip arthroplasty (THA) in the setting of an acetabular fracture remains a difficult reconstructive dilemma. The procedure is much more difficult than a regular THA for degenerative arthritis especially on the acetabular side mainly due to the presence of bone defects, nonunions and may be obstructive hardware and HO.

We Aim to: 1- Express these difficulties and the methods used to overcome them, 2- Report on the early results of these cases regarding the functional outcome, complications and revision surgeries, and 3- Correlate these outcomes with the different variables including the age, previous treatment and method of fixation of the acetabular component.

Patients and Methods: From this view the procedure may resemble a revision surgery and should be dealt with as one.

Results: 44 patients 30 males and 14 females were operated upon with mean age 50.8 years. They were divided into ORIF group (17 cases), non-ORIF group (11 cases) and early THA group (16 cases). We had defects in 41 cases (more in non-ORIF than ORIF group) ranging between cavitary deficiencies in 11 cases, segmental in 10 cases, combined in 12 cases and pelvic discontinuity in 8 cases. Autologous femoral head bone graft was used in 38 cases. Impaction allografts were used to fill defects in 3 cases. Augmentation devices were used in 6 cases; a rim mesh in 4 cases, a floor mesh in 1 case and a Müller ring in 1 case. Other methods used included a high hip center in 1 case and reduction and fixation of the fracture in 9 cases. Moreover, nonunions were more common among the non-ORIF group. Other pre-operative complications included partial sciatic nerve injury in 5 cases, HO in 10 cases and obstructive hardware in 11 cases which mandated its removal. The average post-operative Harris hip score was 83.4 (range 35-95) at the latest follow-up. 33 (75%) patients had good or excellent Harris hip scores at their latest follow-up, 4 (9.1%) had fair scores, and 3 (6.8%) had poor scores.

Conclusion: Our results were comparable to the recently published series; however they are still inferior to the results of THA done for degenerative arthritis.

Key Words: Acetabulum – Fractures – Hip replacement – Bone defects.

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Al Hada Military Hospitals, Taif, Kingdom of Saudia Arabia. The study was registered with the institutional review board (IRB) normally required for retrospective studies and approved from ethics research scientific committee of the institution. Only 40 (91%) of the patients, had a complete pre, peri-, and post-operative record with an average of 3.4 years follow-up (range from 1-9 years). Of the remaining 4 patients, 3 had removal of the implant due to early deep wound infection, and 1 died in the ICU due to post-operative pulmonary embolism.

There were 30 (68.2%) males and 14 (31.8%) females ranging in age from 19 to 72 years at the time of THA with mean age 50.8 years. Fifteen patients had an age less than 50 years and 29 patients had an age more than or equals to 50 years.

High energy trauma was found in 40 (91%) cases (in the form of 20 cases of motor car accidents, 13 pedestrian injuries, 2 motor bike accidents and 5 cases with high energy falls) and low energy trauma in only 4 (9%) cases in the form of minor falls.

Initial fracture pattern was classified by the method of Letournel and Judet, 1993 [4]. Of the 44 patients, 22 (50%) had simple fracture patterns, and 22 (50%) had associated patterns. The most common fracture patterns were isolated posterior wall fractures in 17 (38.6%) cases, transverse posterior wall in 11 (25%) cases, both-column in 4 (9.1%) cases, T-type fracture in 4 (9.1%) cases, and posterior column-posterior wall in 3 (6.8%) cases (Table 1).

Timing of the THA:

According to the classification of Mears and Velyvis [1], 3 patients were done acutely within three weeks of the injury, 13 patients were done within 3-12 weeks from the injury (early THA i.e. within the first 3 months) and the remaining 28 were done lately after three months from the injury (late THA) (Fig. 1). We combined the first 2 groups because although they have some differences regarding the increased difficulty of the operation due to fracture callus but at last the fracture is always incompletely united and can still be manipulated and reduced as a way of management of the defects.

Grouping according to the initial fracture management:

Cases of late THA had been treated initially with open reduction and internal fixation in 17 (61%) patients (ORIF group), and conservatively in 11 (39%) patients (non-ORIF group) (Fig. 2).

In the ORIF group, the average age was 49.6 years (range, 25-72 years). Open reduction and internal fixation were performed on average 8 days after trauma (0-18 days) at King Abd Al-Aziz Hospital in 4 (23.5%) cases and at Al-Hada Hospital in 13 (76.5%) cases. In 3 (17.6%) patients, the pre-THA course was complicated by infection. In these 3 cases deep wound infection prompted the removal of hardware, a thorough debridement including resection of the femoral head and removal of the acetabular cartilage and placement of an antibiotic spacer. All patients were aseptic (by clinical and laboratory standards) at the time of THA. This was confirmed by pre-operative laboratories (i.e., ESR and CRP), and intra-operative cultures.

In the non-ORIF group, the average age was 49.3 years (range, 19-63 years). In 6 patients the fracture was treated conservatively for a period ranging from 5 months to 10 years and THA was done for secondary osteoarthritis or AVN of the head of femur. In the other 5 patients, although the fracture required operative management, it was delayed for a period ranging from 3-6 months leading to complete destruction of the bearing surfaces. This delay was due to associated injuries, the patient’s medical condition (renal failure in 1 case) or delayed referral from non-specialized centers.

In the early THA group, the average age was 53.1 years (range, 22-71 years). The decision for an early THA was taken according to the recommendations of Mears and Velyvis, 2002 [8]. The average time between the fracture and the THA was 50 days (range, 15-85 days). The indication was a large impaction fracture of the head in 13 cases (81.3% of this group), unreconstructable hip with markedly comminuted acetabulum in 2 (12.5%) cases, and a neglected subcapital fracture of femoral neck in 1 (6.2%) case. Although the pre-operative films could detect the need for THA in many cases, the THA was an intra-operative change of decision in 4 cases who were initially undergoing fixation of their fractures. THA should be prepared as a stand-by option in the setting of an attempted ORIF especially in delayed cases. In one (6.25%) patient, the pre-THA course was complicated by infection. The patient had a deep infected wound from a Thomas splint which also required serial debridement. Again this patient was aseptic (by clinical and laboratory standards) at the time of THA.

Surgical technique:

We found the posterior approach the most convenient and we used it in all 44 cases. The THA
itself was a complex procedure with various technical difficulties due to complications of the fracture or its management including: Acetabular bone defects, nonunions, obstructive hardware, sciatic nerve palsy and heterotopic bone.

**Acetabular bone defects:**

Acetabular bone stock deficiencies were described using the AAOS classification [6]. No significant defects were found in 3 (6.8%) cases. The remaining 41 (93.2%) cases had defects ranging between cavitary deficiencies in 11 cases, segmental in 10 cases, combined in 12 cases and pelvic discontinuity in 8 cases distributed in the studied groups as seen in Table (2). Except for a single case with a small peripheral segmental defect which was neglected, the acetabular deficiencies of the remaining 40 (90.9%) cases were addressed. Autologous femoral head bone graft was used in 38 cases (95%). In 8 cases it was used as a strut to provide support, in 19 cases as impaction to fill defects and in 11 cases as strut and impaction. Allografts were used only as impaction to fill defects in 3 (7.5%) cases. Augmentation devices were used in 6 (15%) cases; a rim mesh in 4 cases, a floor mesh in 1 case and a Müller ring in 1 case. Other methods included a high hip center in 1 (2.5%) case and reduction and fixation of the fracture in 9 (22.5%) cases.

Pelvic discontinuities (8 cases) were managed by reduction and fixation of the fracture with autografting of the remaining defect. Cavitary defects (1 1 cases) were treated by impaction autografts in 10 cases, one of these was supported by a Müller ring when the cup was found to lie on less than 50% of host bone. In the last case the defect was overcome by using a high hip center and a jumbo cup. Segmental and combined defects (22 cases) needed structural support and were managed by different ways. The support was provided by a strut autograft in 15 cases, a mesh in 5 cases and reduction of a neglected displaced posterior wall in 1 case. This was augmented in some cases by impaction auto or allograft. In one case the peripheral segmental defect was very small and so no reconstruction was required.

**Non-unions:**

The overall incidence of nonunion in the late THA cases was 7 (25%) cases, which includes 5 in the non-ORIF group (45.4% of non-ORIF) and 2 in the ORIF group (11.8% of ORIF). The nonunion was stable in 3 cases and so treated by only grafting the nonunion site. In the remaining 4 cases with unstable non-unions, reduction and fixation of the fracture was done in 3 cases and a floor mesh with impaction grafting was used in 1 case.

**Obstructive hardware:**

In the ORIF group, 11 (64.7%) patients had the hardware removed either in part or entirely and 6 (35.3%) patients retained their hardware. In 3 cases the hardware was removed as a part of a staged procedure due to infection. The decision to remove hardware in the remaining 8 patients was based on its interference with exposure or implantation of the acetabular cup; 4 cases were removed totally and 4 cases partially.

**Sciatic nerve palsy:**

A total of 5 (11.4%) patients had pre-operative symptoms of sciatic nerve injury (all affecting the lateral popliteal part only). This occurred traumatically in 4 cases and iatrogenically (due to previous ORIF) in 1 case. In 2 cases, release and neurolysis of the nerve were performed at time of THA. The first patient had a neglected posterior fracture dislocation for 45 days and the nerve was delivered from inside the acetabulum. It was severely contused but continuous. The other had a neglected associated both column fracture and the nerve was contused and adherent to the displaced fracture fragments.

**Heterotopic bone:**

Radiographic evidence of heterotopic ossification was found in 10 (35.7%) patients of those who had late THA, including 8 patients from the ORIF group (47% of ORIF) and only 2 patients were from the non-ORIF group (18.2% of non-ORIF). Heterotopic bone was classified according to Brooker's classification [7]. We had 5 (50% of patients with HO) patients with class I HO, 2 (20%) with class II, 2 (20%) with class III, and 1 (10%) patient with class IV HO. The 3 cases with class III and IV HO had the excess bone excised at the time of THA. Post-operative radiation therapy was not given in any of our patients but all 10 patients received oral indomethacin 25mg thrice daily for 6 weeks.

**Implants used:**

Cementless acetabular fixation was used in 22 (50%) cases. The average acetabular component diameter was 52mm (range, 42-62mm). In all these patients, cementless acetabular fixation was supplemented with screws. On average, 1.5 screws (range, 1-3) were used. Screw fixation was used even when the initial press-fit was stable after impaction. Cemented cups with an average diameter of 47mm were used in the remaining 22 (50%) cases.
Ceramic-on ceramic bearings were used in 7 (15.9%) cases, ceramic on highly cross-linked polyethylene were used in 2 (4.5%), cobalt chrome heads on highly cross-linked polyethylene were used in 2 (4.5%) cases, and cobalt chrome heads on standard polyethylene were used in the remaining 33 (75.1%). All the 37 (84.1%) polyethylene liners included a 10° elevated rim.

In 24 (54.5%) hips, a cemented stem was used, and in the remaining 20 (45.5%), a cementless stem was used.

Post-operative management:

In general, after the total hip arthroplasty, bed-to-chair transfers are initiated on the first post-operative day, with touch-down or light partial weight-bearing beginning on the second day. Substantial partial weight-bearing is begun at four to six weeks after the arthroplasty, with full weight-bearing at six to twelve weeks. This depended on the presence of bone defect, its size and the structural integrity of the reconstruction. Prophylactic intravenous antibiotics with a third-generation cephalosporin were used routinely for five days. However, in cases with previous infection the appropriate antibiotic according to the results of culture and sensitivity tests was used for a more prolonged period. Prophylaxis against thromboembolism includes the application of elastic stockings and a one week-course of anticoagulation low-molecular-weight heparin. Patients who have previously had heterotopic ossification prior to the belated total hip arthroplasty were managed with indomethacin prophylaxis of 25mg thrice daily for 6 weeks.

Clinical and radiographic evaluation:

Functional outcomes were assessed using the Harris Hip score [8]. Pre-operative Harris Hip score was measured at the last clinical visit that preceded THA and this was applicable only in the late THA cases. Clinical evaluation was performed at 6 weeks post-operatively, then at 3 months, 6 months, 1 year, 2 years, and bi-yearly thereafter. Post-operative Harris Hip score was defined as the one measured at the most recent follow-up examination or the last Harris Hip score to be measured before a revision procedure if applicable.

Complete radiographic record included films taken at the time of injury, after operative fracture management if performed, after the development of post-traumatic arthritis or pre-THA, immediate post-THA films, follow-up films at different visits, and most-recent follow-up films. Complete radiographic examination at each time interval included an antero-posterior radiograph of the pelvis, an antero-posterior and lateral view of the involved hip, and two 45° oblique radiographs. CT scanning was done at the time of injury, and pre-THA to detect and classify the defects. The anatomic restoration of hip center was defined as symmetry between the affected hip center and the contralateral hip center. Six-week post-operative radiographs were used to evaluate component position. Hip center was determined using the method of Martell et al., [9] (Fig. 3). As pain and disability due to loosening become severe enough to require revision arthroplasty, abnormalities in the binding of the cement to the bone or prosthesis are almost always visible radiographically (Figs. 4, 5) [9].

Engh's radiological criteria were used to determine the fixation and stability for non-cemented stems. Fixation is classified as (1) bone ingrowth, (2) stable fibrous fixation, or (3) unstable [10].

Fixation by bone ingrowth is defined as an implant with no subsidence and most of the bone-implant interface appears stable with no radiolucent gaps and minimal or no radiopaque line formation around the stem. Cortical hypertrophy may be present at the distal end of the porous surface, and variable degrees of proximal stress shielding are present [10].

Survivorship analysis:

Survivorship analysis of the total hip reconstructions after acetabular fracture was performed, end points were defined as having had a revision or requiring revision for significant loosening, dislocation, or infection. In addition survivorship was determined for aseptic acetabular loosening.

Statistical analysis of results:

Data were described in terms of range, mean ± standard deviation (±SD), median, frequencies (number of cases) and percentages when appropriate. No statistical calculations were done due to the small number of patients in each group and the low incidence of complications which decreased the significance of the results.

Results

Harris hip score: For the forty cases, the average post-operative Harris hip score was 83.4 (range 35-95) at the latest follow-up. Thirty three (75%) patients had good or excellent Harris hip scores at their latest follow-up, 4 (9.1%) had fair scores, and 3 (6.8%) had poor scores (Fig. 6). From the 3 patients with poor Harris hip score, 2 were doing fine and their scores were 83 and 78 but their
scores deteriorated due to acetabular loosening (1 septic and 1 aseptic). The third patient had multiple injuries and long pre-operative ICU stay following MCA. This patient had head trauma, haemothorax, ARDS, fracture of the contralateral acetabulum which was fixed 1 month following the trauma, followed by pulmonary embolism, another period of ICU stay and inferior vena cava filter insertion. THA was done 2.5 months after the trauma, however, the patient's very bad general condition and associated skeletal and non-skeletal injuries led to the poor function and a low hip score of 40.

In the early THA group (16 patients), the average hip score was 84.36. Thirteen (81.3%) patients had good or excellent scores, 0 had fair scores and 1 (6.3%) had a poor score. Two patients in this group had no score calculated as one died from pulmonary embolism and the other had early removal due to deep sepsis.

In the non-ORIF group (11 patients), the average hip score increased from 26.5 to 82 (55.7 points increase). Nine (81.8%) patients had good or excellent Harris hip scores, 1 (9.1%) had fair scores, and 1 (9.1%) had a poor score (Fig. 7-A,B).

In the ORIF group (17 patients), the average hip score increased from 26.5 to 83.4 (56.9 points increase). This group had the least percentage of good and excellent scores; only 11 (64.7%) patients. Three (17.6%) patients had fair scores, and 1 (5.9%) had a poor score. The remaining 2 patients had no score calculated as they had early removal due to deep sepsis.

Final Harris hip score did not correlate with age at the time of the THA. Patients with age <50 years (15 patients) had an average hip score of 81.1, with 11 (73.3%) patients having good or excellent hip score. Patients with age >50 years (29 patients) had an average score 84.6; with 22 (75.9%) patients having good or excellent hip score.

**Radiological results:**

**Hip center restoration:** Was achieved within 10 mm in 43 patients. In only one (2.3%) patient the hip centre was displaced vertically by 18mm and laterally by 5mm.

**Restoration of limb-length:** The post-operative limb-length varied from +1cm to –1cm with a mean of +0.3mm. The limb-length was restored to within 0.5cm in 38 cases (86.4%). The limb was shorter by 1 cm in 3 cases. This included the one with high hip center despite the use of a long neck length. The other 2 cases had pre-operative proximal migration and the reduction was tight which forced the use of a short neck length. The limb was longer by 1 cm in 3 cases, all of which belonged to the early THA group. We noted increased soft tissue laxity in these cases and lengthening of the limb was done to achieve good tension in the abductors to augment stability.

**Acetabular component:** Periacetabular radiolucencies 2mm wide or more were seen in 9 (20.5%) patients. Six of these exhibited radiolucent lines in 1 DeLee and Charnley zone, 1 patient demonstrated radiolucent line in 2 zones, and 2 patients demonstrated evidence of radiolucent lines in all 3 zones with change of the cup position. The last 2 cases were loose and had revision. Three patients with cemented cups (13.6%) had radiolucent lines, 1 patient had radiolucent line in 1 zone, 1 patient had radiolucent line in 2 zones and the last patient had radiolucent line in all 3 zones with change in cup position. Six patients with cementless cups (27.3%) had radiolucent lines, 5 patients had radiolucent lines in 1 zone and the sixth patient had radiolucent line in all 3 zones with change in cup position.

**Femoral stem:** All femoral stems were radiologically stable at the latest follow-up. Four patients with cemented stems (24 patients) had radiolucent lines. Three of these had radiolucent line involving 2 Gruen zones and in the fourth case the radiolucent line involved only 1 zone. However, all these four cases were stable. Fourteen patients with cementless stems (20 patients) had bony stability and 5 patients had fibrous stability (The last patient died in the early post-operative period from fatal pulmonary embolism).

**Complications:** We had one or more complications in 14 of our cases. These were 3 from the early THA group (18.8%), 8 from the ORIF group (47.1%), and 3 from the non-ORIF group (27.3%). These complications were:

**Acetabular loosening:** The 2 (4.5%) patients with displaced acetabular components and complete radiolucent lines were revised for loosening. One of these 2 cases was from the ORIF group (5.9% of the ORIF) with a cemented cup (4.5% of cemented cups) and had aseptic loosening. The other was from the non-ORIF group (9.1% of the non-ORIF) with a cementless cup (4.5% of cementless cups) and had septic loosening.

**Infection:** Infection complicated the post-operative course of 6 (13.6%) patients in this study, 1 (6.25%) from the early THA group, 1 (9.1%) from the non-ORIF group and 4 (23.5%) from the ORIF group. Post-operative infections were deep
in 5 (83.3%) cases (3 early during the first 2 weeks and 2 late 3 months or more after THA) and superficial in 1 (16.7%) case. One of the 2 cases with late infection had stable implants and the other had septic loosening.

The 3 patients with early deep infections required ex-plantation of the prosthesis. Implantation of an antibiotic spacer was done in 2 patients. Although the infection resolved in all three cases, implantation of another prosthesis was not done in any patient till now.

The two cases of late infection required explantation of the prosthesis and the implantation of an antibiotic spacer. This was planned to be a part of staged revision but both cases did not have the second stage although the infection resolved in both cases.

The case with superficial wound infection was effectively managed with appropriate antibiotic therapy.

**Recurrent dislocation:** Recurrent dislocation was the cause for revision surgeries in 2 (4.5%) patients. Of these 1 (5.9% of ORIF) patient was from the ORIF group and the other was from the non-ORIF group (9.1% of non-ORIF).

**Heterotopic ossification:** Heterotopic ossification did not dramatically change post-operatively. We had a total of 5 (12.2%) patients with recurrent (2 recurrences out of 3 cases with excised HO), increased (1 case) or newly developed HO (2 cases). However, all the 5 cases were of low grade; 2 had a Brooker class of I (40% of patients with postoperative HO), and 3 (60%) with class II. Three of these cases were from the ORIF group (17.6% of ORIF), 1 was from the non-ORIF group (9.1% of non-ORIF), and 1 from the early THA group (6.3% of early THA).

**Sciatic nerve palsy:** Partial sciatic nerve palsy affecting the lateral popliteal part occurred in only 1 case (2.3% of all cases and 5.9% of the ORIF group). This was a 28 years old female who sustained an associated column fracture following a RTA and was fixed through a combined ilioinguinal and posterior approaches. THA was done 1.5 years later for severe secondary OA. Scarring was extensive and the sciatic nerve could not be dissected at the time of the THA; however the dissection was kept to the side of the femoral shaft to avoid injury of the sciatic nerve. Partial sciatic nerve injury with foot drop recovered completely after 6 months.

**Deep venous thrombosis and pulmonary embolism:** Deep venous thrombosis and fatal pulmonary embolism occurred in 1 (2.3% of all cases and 6.3% of the early THA group) patient.

**Survivorship and revision surgeries:** The survivorship score based on having any revision surgery as an end point was 81.8% at an average of 3.4 years. Scores for different groups were 93.8% for the early THA cases, 81.8% for the non-ORIF group and 70.6% for the ORIF group.

The survivorship score improved to 97.7% when aseptic acetabular loosening was designated as the end point, giving an acetabular aseptic loosening rate of 2.3% (1 case). Regarding cemented cups the survivorship score for aseptic loosening was 95.5% and it was 100% regarding cementless cups. Ultimately, 8 (18.2%) revision surgeries were necessary in all patients. The causes for revision were early deep wound infection in 3 patients, late deep infection with stable implants in 1 patient, septic loosening in 1 patient, aseptic loosening in 1 patient, recurrent dislocation in 2 patients (Table 3).

The Five patients with deep infection had debridement and removal of the prosthesis. Revision of the acetabular cup was done for the patient with aseptic acetabular loosening. The 2 patients with recurrent dislocation had revision surgeries. The first had revision with change of the ceramic liner with an elevated rim highly cross-linked polyethylene liner and change of the head with another one of longer neck length. The second had a prolene mesh inserted and fixed by two plates to the acetabulum and the femur.

### Table (1): Distribution of the different fracture patterns among the different groups of patients.

<table>
<thead>
<tr>
<th>Fracture patterns</th>
<th>ORIF</th>
<th>Non-ORIF</th>
<th>Early THA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior wall</td>
<td>9</td>
<td>1</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>Posterior column</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Transverse</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal (elementary fracture types):</strong></td>
<td>9</td>
<td>5</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>Posterior column-posterior wall</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>T-type</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Transverse posterior wall</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Associated both columns</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Subtotal (associated fracture types)</strong></td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17</td>
<td>11</td>
<td>16</td>
<td>44</td>
</tr>
</tbody>
</table>

N.B: These groups are explained later.
Table (2): Distribution of acetabular deficiencies among different groups of patients.

<table>
<thead>
<tr>
<th>Causes of Revision</th>
<th>ORIF</th>
<th>Non-ORIF</th>
<th>Early THA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavitary</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Segmental</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Combined</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Pelvic discontinuity</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>11</td>
<td>16</td>
<td>41</td>
</tr>
</tbody>
</table>

Table (3): Revision surgeries.

<table>
<thead>
<tr>
<th>Causes of revision</th>
<th>No. of patients</th>
<th>Type of surgery</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early deep wound infection</td>
<td>3</td>
<td>Debridement, removal of implants ± antibiotic spacer</td>
<td>3</td>
</tr>
<tr>
<td>Late deep wound infection with stable implants</td>
<td>1</td>
<td>Debridement, removal of implants and antibiotic spacer</td>
<td>1</td>
</tr>
<tr>
<td>Septic acetabular loosening</td>
<td>1</td>
<td>Debridement, removal of implants and antibiotic spacer</td>
<td>1</td>
</tr>
<tr>
<td>Aseptic acetabular loosening</td>
<td>1</td>
<td>Revision of the acetabular cup</td>
<td>1</td>
</tr>
<tr>
<td>Recurrent dislocation</td>
<td>2</td>
<td>Change of the liner and head</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolene mesh fixed by 2 plates</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. (1): Chart showing the distribution of cases according to timing of the THA.

Fig. (2): Chart showing the distribution of cases according to initial fracture management.

Fig. (3): Markup for the calculation of hip center symmetry. A goniometer was used to estimate the center of femoral head, and then horizontal and vertical distance was measured from the hip center to the inferior point of the ipsilateral teardrop. For the statistical analysis, we measured the difference of each horizontal and vertical component in the involved and contralateral hip. The limb-length was also measured on the post-operative radiographs. As a pelvic reference, the inter-teardrop line was used, and as a femoral reference, the lesser trochanters were used. (Ranawat et al., 2009).

Fig. (4): Assessment of acetabular component loosening by either A) DeLee and Charnley zones or B) Martell et al., modification (Martell et al., 1993).
Fig. (5): Assessment of femoral component loosening by Gruen zones (Gruen et al., 1979).

Fig. (6): Chart showing the distribution of cases according to post-operative hip score.

Fig. (7-A): Chart showing the pre and post-operative hip score of different patient groups.

Fig. (7-B): Chart comparing different groups according to the post-operative hip score.

Discussion

The current study tried to express the THA difficulties and the methods used to overcome them. We also reported the early results of these cases regarding the functional and radiological outcome, complications and revision surgeries. We tried to correlate these outcomes with the different variables including the age, previous treatment and method of fixation of the acetabular component.

The age of our patients ranged from 19 to 72 years at the time of THA with mean age 50.8 years. This largely matches with the series of Weber and Ranawat [11,12]; both had a mean age of 52 years. However, this age is significantly less than those undergoing THA for degenerative arthritis. This may partially explain the inferior results of THA following an acetabular fracture compared to patients with degenerative arthritis. In contrast, Mears and Velyvis had a mean age of 69 years [2].

Males were about 68.2%. The higher percentage of males matches with the series of Ranawat [12] (72%), Weber (78.8%) [11], and Mears and Velyvis (53%) [2]. This is understandable especially in our community as males are more active and so more prone to accidents.

High energy trauma was found in 40 (91%) cases which is higher than the percentage described by Weber (86.7%) [11], Ranawat (69%) [12], and Mears and Velyvis (53%) [2] and would affect the outcome of the arthroplasty and should be taken in consideration when comparing our results with the other series. This could be explained by the higher incidence of motor vehicle accidents in KSA compared to the western community.
Regarding the fracture patterns; 22 (50%) of our patients had simple fracture patterns, and 22 (50%) had associated patterns. The most common fracture patterns were isolated posterior wall fractures in 17 (38.6%) cases, transverse posterior wall in 11 (25%) cases, both-column in 4 (9.1%) cases, T-type fracture in 4 (9.1%) cases, and posterior column-posterior wall in 3 (6.8%) cases very similar to series of Ranawat, Weber and Mears and Velyvis [2, 11, 12].

We should emphasize that during attempted ORIF of neglected fractures or those with marked comminution especially in elderly patients with marked osteoporosis we sometimes found ourselves forced for a primary hip replacement. This was the case in 4 patients in which the decision was changed intra-operatively despite that the pre-operative X-rays and CT scans did not predict this. And so we need to express the importance of an available total hip prosthesis during an attempted ORIF in neglected cases and highly comminuted fractures especially in osteoporotic elderly patients.

We found the posterior approach the most convenient and we used it in all 44 cases. It is the approach we routinely use for THA. Besides, it also gave us an access to reduce (partially or totally) and fix the posterior and possibly the anterior column in cases of unstable non-unions and acute fractures managed by an early THA. The posterior approach also made the best access to assess and manage acetabular bone defects both posterior and anterior. Removal of obstructive posterior hardware could also be done easily via this approach. While Ranawat [11] did not mention the approach he used, Weber [12] used an antero-lateral approach in nineteen (28.8%) patients, a trans-trochanteric approach in thirty-six (54.6%), and a postero-lateral approach in eleven (16.6%). Mears and Velyvis [2] used a postero-lateral approach for sixteen patients (28%) with a posterior injury pattern; an antero-lateral exposure for thirty-eight patients (67%); and an extended lateral approach for the three remaining patients (5%), two of whom had a triradiate incision and one of whom had an extended iliopsoas femoral incision.

Defects were seen in 41 (93.2%) of our cases. These ranged between cavitary deficiencies in 11 (26.8%) cases, segmental in 10 (24.4%) cases, combined in 12 (29.3%) cases and pelvic discontinuity in 8 (19.5%) cases. Ranawat [12] reported defects in only 50% of cases. These were 6% cavitary, 81% segmental, 13% combined. Weber [11] reported defects in 30% of cases. These were 40% cavitary, 35% segmental, 25% combined.

Mears and Velyvis [2] did not report on their defects (they just reported their fracture patterns). Also while we reported 8 cases of pelvic discontinuity, these authors did not report any. This had a significant impact on the methods adopted for reconstruction of the defects and the functional and radiological results. Moreover, the overall incidence of nonunion in our late THA cases was 7 (25%) cases, which is higher than that reported by Ranawat (3%) [12] and Weber (0%) [11].

We found defects in 100% of the non-ORIF group while only 82.3% of the ORIF group patients had bone defects. The defects were also smaller in cases with previous ORIF and no case of pelvic discontinuity was described in these cases. We also discovered by revising the pre-THA radiographs, that accurate initial reductions led to smaller defects. The 3 cases of the ORIF group with no defects had anatomical reduction at the orthopedic surgery. Moreover, the non-ORIF group had 5 cases of nonunion (45.4%) compared to 2 cases in the ORIF group (11.8%). This again emphasizes the benefits of the open reduction surgery. These results are not supported by Ranawat who found no difference between the ORIF and the non-ORIF groups [12].

Autologous femoral head bone graft was used in 38 cases (95%). Allografts were used only as impaction to fill defects in 3 (7.5%) cases. Augmentation devices were used in 6 (15%) cases; a rim mesh in 4 cases, a floor mesh in 1 case and a Müllerr ring in 1 case. Other methods included a high hip center in 1 (2.5%) case and reduction and fixation of the fracture in 9 (22.5%) cases. Ranawat and Weber [11, 12] used no augmentation devices and adopted more simple reconstructions which reflect the smaller defects they faced. Ranawat addressed his defects with autologous femoral head bone graft (94% of cases), acetabular reamings (6%), and allografts (17%) [12]. Weber used bone grafts in 75% of his defects [11]. The grafts he used were autogenous in 87%, and allogenic in 13% of cases. Mears and Velyvis reduced and fixed their fractures using cables, plates and interfragmentary screws. They also used autografting for residual defects [2].

Hardware from previous operations was removed either in part or entirely in 11 (64.7%) patients out of the 17 patients who underwent prior open reduction of an acetabular fracture. This is comparable to the results of Ranawat and Weber who reported removal of hardware in about 60% of their patients. Removal of the hardware added extra time to the THA averaging about 30 minutes.
progressive decrease in the scores with advancing years was a significant risk factor for poor outcome.

Regarding aseptic loosening, we had only one case of aseptic loosening resulting in survival rate of 97.7% at a mean follow-up of 3.4 years (short term) which is comparable to other series with short and intermediate periods of follow-up [2,11-14].

We used cementless acetabular fixation in 50% and cementless stems in 45.5% of cases. Weber used cementless cups in 33.4% and cementless stems in 30.3% of his cases [11]. All cases of Ranawat’s series were cementless on both sides. Variability in the models of acetabular and femoral components used at THA was one of the limitations of our study and it was mainly due to availability and financial issues [12].

With regards to the functional outcome of the arthroplasty, our average post-operative Harris hip score was 83.4. Thirty three (73%) patients had good or excellent scores at 3.4 years postoperatively, 4 (9.1%) had fair scores, and 3 (6.8%) had poor results. These results are slightly inferior to the results Weber and Ranawat [11,12]. This could be explained by higher incidence of high energy trauma and its consequences in our study. In the early THA group the average hip score was 84.36 with good or excellent hip scores in 81.3% of the patients. Mears and Velyvis reported similar results with an average Harris hip score of 89 points with excellent or good scores in forty-five patients (79%) [2].

In the ORIF group 64.7% of the patients had good or excellent Harris Hip scores while 81.8% in the non-ORIF group. This difference may be attributed to the more severe initial injury and fracture displacement mandating fixation. Besides the complications of the previous surgery; as tissue scarring, HO, obstructive hardware and may be infection, added to the difficulty of the operation, post-operative complications and so poorer results. However, Ranawat reported few differences between patients in the non-ORIF and ORIF groups, specifically with regard to clinical outcomes [12].

Regarding the effect of the patient age on the functional outcome, there is a great controversy. We found few differences between the two age groups. This was the same result of Ranawat series [12]. Weber reported that an age of less than fifty years was a significant risk factor for poor outcome [11]. Mears and Velyvis found that the younger patients had the highest scores, and there was a progressive decrease in the scores with advancing age [2].

Regarding cemented cups the short-term survivorship score for aseptic loosening was 95.5% (1 case) versus 100% in cementless cups which matches matches other recent series where cementless acetabular fixation was also used. Very similar to Bjørgul et al., [18]. However, cemented cups are generally used with more complex reconstructions and this may partially explain their inferior results.

Infection complicated the post-operative course of 6 (13.6%) patients in this study which is higher than other series [2,11-14,16]. Except for one case with superficial wound infection, infection led to revision surgery in the other 5 patients (11.4%). Despite our extensive pre-operative and intraoperative evaluation. The high incidence may be related to: 1) the severe injury patterns with more severe soft tissue injuries and the more complex defects in our series with increased operative time, 2) The operative field setup, 3) cases of pre-operative infection included in our study, which is not the case with the other series except Ranawat’s [12]. Of the 4 patients that had an infection before their arthroplasty, 2 (50%) had a post-THA infection compared to 4 (10%) patients had deep post-operative infection without a prior history of infection. A history of infection was clearly associated with a high risk of developing deep post-operative infection very similar to the results of Ranawat et al., [12]. The infection rate is also significantly higher in the ORIF group compared to the other groups, which matches Jimenez et al., findings [17].

In regards of heterotopic ossification, it did not dramatically change post-operatively as we had a total of 5 (12.2%) patients with recurrent, increased or newly developed HO, all of which were grade I to II. The ORIF group (17.6%) had a significantly higher incidence than the non-ORIF group (9.1%) and early THA group (6.3%). This does not match with both: 1) Ranawat who reported an incidence of more than 40% and found no difference between the ORIF and non-ORIF groups [12,2] Mears and Velyvis who reported six cases (10.5%) of acute THA cases [2], with HO.

Regarding the dislocation rate, it was 4.5% in our cases (2 patients dislocated both revised). This dislocation rate is higher than dislocation rates previously published by Weber et al., [12] (3%) (3
hips dislocated 1 revised), Bellabarba et al., (0%) [13], and Williams et al., in 1982 [18] (for primary THA in patients with degenerative arthritis (0.6%)) but lower than those described by Ranawat et al., [11] and Berry et al., 2002 [14], who reported dislocation rates of 9 and 5% respectively. While we had no dislocations in the early THA group, Mears and Velyvis, 2002 [2] reported that 2 patients (4%) had dislocations and one of them was revised. We found no significant difference between the ORIF and the non-ORIF groups. However, Jimenez et al., [17] reported that the dislocation rate was significantly higher in the ORIF group. No clear conclusions could be deducted regarding the role of elevated liners in reducing dislocation rates. Bellabarba et al., [13] used 20º elevated liners in 30% of cases, Ranawat [11] used 10º liners in 59% of the cases, compared to 3 7 (84.1%) elevated liners used to enhance stability in our 44 cases. We also used ceramic liners in 7 of our cases which are known to be shallower than polyethylene liners and with no elevated rims. The varying dislocation rates could be attributed to different surgical approaches and surgical technique regarding the component positioning.

Regarding nerve injuries, we had a single case of partial sciatic nerve palsy affecting the lateral popliteal division (2.3% of all cases and 5.9% of the ORIF group). This case recovered completely after 6 months making our rate of permanent nerve damage equals zero. Weber [12] also reported a single case (1.5%) and Jimenez et al., [17] found that the rate of sciatic nerve palsy was significantly higher in the ORIF group.

Ultimately, 8 (18.2%) revision surgeries were necessary in all patients. The causes for revision were early deep wound infection in 3 patients, late deep infection with stable implants in 1 patient, septic loosening in 1 patient, aseptic loosening in 1 patient, recurrent dislocation in 2 patients. Revision rate was also much higher among the ORIF group compared to the other 2 groups due to the higher complication rates. Our revision rates are comparable to those reported in other series. Ranawat [11] reported a revision rate of 19% at 5 years and Weber reported 25% at 10 years [12]. Berry et al., [14] had much higher rate at 41%, and Bellabarba et al., [13] reported their revision rate of 3% at 5 years. Our revision rate in the early THA group was only 6.2%. Mears and Velyvis [2] reported in thier series of acute THA that they had only three late procedures (6%): One for revision of a mal-aligned cup because of recurrent dislocations, one for removal of hardware from the greater trochanter, and one for excision of heterotopic bone.

Study limitation: After discussing our results it is important to note that this work is underpowered to make definitive statements, due to the small number of patients in each group, the absence of non-traumatic THA controls, and the short follow-up period. The small number of patients and the low incidence of complications decreased the significance of the results. Other limitations of this study include variability in the models of acetabular and femoral components used at THA, method of acetabular and femoral fixation, and articular bearing used.

References


