Acetabular fractures: Short-term results

V. Estrems-Díaz*, L. Hernández-Ferrando, J. Balaguer-Andrés, A. Bru-Pomer

Servicio de Cirugía Ortopédica y Traumatología, Consorcio Hospital General Universitario de Valencia, Valencia, Spain

Received 23 May 2011; accepted 20 September 2011

Objective: To evaluate the results of surgical treatment of displaced acetabular fractures, and to discern which variables influence the final radiological and clinical outcomes.

Methods: We retrospectively analysed 23 patients who underwent open reduction and internal fixation of acetabular fracture with a mean age of 40.4 years (17–72 years). Mean follow-up was 4 years (1.5–7.5 years). According to Judet and Letournel classification, we operated 10 simple fractures (43.5%) and 13 complex fractures (56.5%), with both-column fractures being the most common type (8 hips). We evaluated the quality of reduction achieved, the clinical results and the occurrence of coxarthrosis.

Results: We obtained anatomic reduction of the lesion in 12 cases (52%), in 7 patients (30%) residual displacement was less than 2 mm, and in 4 patients (17%), it was greater than 2 mm. According to Harris’ score, the clinical outcome was excellent or good in 18 cases (78%) and fair or poor in 5 (22%), getting worse in complex fractures and when we do not reach an anatomic reduction of the injury. Six patients (26%) developed moderate or severe degenerative changes during follow-up. The degree of postoperative reduction obtained was identified as the main predictor of the development of post-traumatic osteoarthritis.

Discussion and conclusions: The acquisition by open reduction and internal fixation of an accurate congruence between the femoral head and acetabulum is essential to achieve good long-term results.

© 2011 SECOT. Published by Elsevier España, S.L. All rights reserved.

PALABRAS CLAVE
Fractura; Acetábulo; Tratamiento quirúrgico; Osteosíntesis

Resumen
Objetivo: Evaluar los resultados del tratamiento quirúrgico de las fracturas desplazadas de acetábulo. Discernir que variables influyen en el resultado clínico y radiológico final.

Material y métodos: Analizamos de forma retrospectiva 23 pacientes intervenidos de fractura acetabular mediante reducción abierta y fijación interna, con una edad media de 40,4 años (17-72 años). El seguimiento medio fue de 4 años (1,5-7,5 años). Según la clasificación de Judet...
Introducción

Las fracturas de la cadera son lesiones relativamente raras. Con una incidencia anual aproximada de 3 casos por 100,000 habitantes, constituyen 0.3-6% de todas las fracturas. Son usualmente vistas en el contexto de pacientes con múltiples lesiones de trauma, siendo la causa más común de tráfico. Aunque el tratamiento conservador con tracción y descarga puedan obtener resultados aceptables en ciertos pacientes y patrones de fractura, la cirugía es la opción de tratamiento de elección en la mayoría de los casos, con indicaciones bien establecidas: fracturas con incongruencia articular, con involucración del ángulo acetabular o su equivalente en cortes axiales de la tomografía computarizada [CAT], o con inestabilidad coxofemoral asociada. El resultado funcional está fuertemente relacionado con la reducción postoperatoria obtenida, pero otros factores, como la edad, el tipo de fractura, el tiempo de retraso quirúrgico, y la presencia de daño articular a la cabeza femoral, han sido sugeridos como variables que modifican el resultado final. La evolución hacia la osteoartritis posttraumática es la complicación más común de lesión de la cadera, con una incidencia cercana al 27%. Otras complicaciones asociadas con este tipo de lesión y su tratamiento son el parálisis nerviosa, desarrollo de heterotópicos y necrosis de la cabeza femoral.

Los objetivos de este estudio fueron analizar los resultados del tratamiento quirúrgico en nuestra primera serie de fracturas de la cadera y identificar las variables que directamente influyeron estos resultados.

Materiales y métodos

Identificamos a 30 pacientes consecutivos que habían sido sometidos a cirugía por fractura de la cadera entre mayo de 2003 y junio de 2009. De estos pacientes, 7 se excluyeron del estudio—2 debido a que previo a la cirugía lesiones en el mismo hombro, 2 porque habían cambiado de lugar, y 3 porque habían sido transferidos de su hospital a otro. Los datos se obtuvieron revisando los registros médicos una vez que el Comité de Ética en nuestra institución aprobó el estudio. Los datos demográficos y tipo de fractura se presentan en la tabla 1. De los 23 pacientes restantes, 15 eran varones y 8 eran mujeres, con una edad media de 40 años, con un rango de 17-72 años. El mecanismo de lesión fue de alta energía en 22 casos (14 accidentes de tráfico y 8 caídas) y de baja energía en 1 caso (una caída al suelo del paciente). Los pacientes presentaron lesiones asociadas en el 69.5% de los casos (Tabla 1). Dos pacientes presentaron síntomas neurológicos al ingreso: en 1 caso, daño permanente a los nervios sacros, con incontinencia de vejiga y parestesia en la L5-S1 radicular, y en 1 caso, lesión del nervio ciático, de la cual el paciente se recuperó completamente 3 meses más tarde. La cadera derecha fue fracturada en 12 casos y la izquierda en 11 casos. Las fracturas fueron clasificadas según Judet y Letournel utilizando proyecciones radiográficas estándar (anteroposterior, oblicua ilíaca y axiales de la escaneografía por tomografía computarizada [CAT]).

<table>
<thead>
<tr>
<th>Tabla 1: Lesiones asociadas.</th>
<th>Pacientes</th>
<th>Incidencia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UE Fracture</td>
<td>11</td>
<td>47.8</td>
</tr>
<tr>
<td>LE Fracture</td>
<td>8</td>
<td>26.6</td>
</tr>
<tr>
<td>Pelvic Fracture</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>TBI</td>
<td>5</td>
<td>21.7</td>
</tr>
<tr>
<td>Chest Trauma</td>
<td>9</td>
<td>39.1</td>
</tr>
<tr>
<td>Damage to Internal Organs</td>
<td>4</td>
<td>17.3</td>
</tr>
<tr>
<td>Neurological Damage</td>
<td>2</td>
<td>8.6</td>
</tr>
</tbody>
</table>

TBI: daño neurológico.

Resultados: Obtuvo una reducción anatómica de la lesión en 12 casos (52%), en 7 (30%) el desplazamiento residual fue menor de 2 mm y en 4 pacientes (17%) mayor de 2 mm. Según la escala de Harris, el resultado clínico fue bueno o excelente en 18 casos (78%) y aceptable o pobre en 5 (22%), obteniendo peores resultados en fracturas complejas y cuando no alcanzamos una reducción anatómica de la lesión. Seis pacientes (26%) habían desarrollado cambios degenerativos moderados o severos al final del seguimiento. El grado de reducción postquirúrgica obtenida fue identificado como el principal predictor de desarrollo de coxartrosis postraumática.
Table 2  Distribution of clinical results by type of fracture and degree of post-operative reduction.

<table>
<thead>
<tr>
<th>Type of fracture n (%)</th>
<th>Clinical result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent</td>
</tr>
<tr>
<td>Simple injuries 10 (43.5)</td>
<td></td>
</tr>
<tr>
<td>Posterior wall 7 (30.4)</td>
<td>4</td>
</tr>
<tr>
<td>Anterior column 1 (4.3)</td>
<td>1</td>
</tr>
<tr>
<td>Transverse 2 (8.7)</td>
<td>2</td>
</tr>
<tr>
<td>Posterior wall fracture 1 (43.5)</td>
<td></td>
</tr>
<tr>
<td>Anterior column fracture 1 (4.3)</td>
<td></td>
</tr>
<tr>
<td>Transverse fracture 2 (8.7)</td>
<td></td>
</tr>
<tr>
<td>Complex injuries 13 (56.5)</td>
<td></td>
</tr>
<tr>
<td>T-shaped fracture 3 (13)</td>
<td>1</td>
</tr>
<tr>
<td>Transverse + posterior wall 2 (8.7)</td>
<td>2</td>
</tr>
<tr>
<td>Two-column 8 (34.8)</td>
<td>4</td>
</tr>
<tr>
<td>Degree of post-operative reduction</td>
<td></td>
</tr>
<tr>
<td>Anatomical (n = 12)</td>
<td>9</td>
</tr>
<tr>
<td>&lt;2 mm displacement (n = 7)</td>
<td>3</td>
</tr>
<tr>
<td>&gt;2 mm displacement (n = 4)</td>
<td>2</td>
</tr>
</tbody>
</table>

obturator oblique) and CAT scan (Table 2). In 7 cases (30%), the fracture was accompanied by hip dislocation—4 posterior and 3 central—of which 6 underwent closed reduction within 24 h of admission. A case of posterior dislocation, 1 month old, transferred from another hospital, required open reduction and arthrodiastasis via external fixator in the same surgical procedure as osteosynthesis of the fracture (Fig. 1).

Indications and surgical technique

The criteria used to establish the indication for surgery were fractures with joint displacement of more than 2 mm or involving the weight-bearing area of the roof, fractures with associated posterior coxofemoral instability, and fractures with incarcerated fragments between the two articular surfaces.

Figure 1  (A and B) Posterior wall fracture with associated 1-month-old coxofemoral dislocation. (C) Post-operative obturator X-ray. An external fixator was added to the osteosynthesis. (D) 20-month post-operative anteroposterior X-ray of the pelvis, no osteoarthritis of the hip, Brooker II heterotopic ossifications.
The mean time elapsed between injury and surgery was 11 days (range: 5–31). In only 5 cases (22%), the surgery was delayed more than 2 weeks because of either severe multiple traumas involving a lengthy stay in Intensive Care or the patient being transferred from another hospital.

A posterior Kocher–Langenbeck approach was used in 11 cases (mean time: 116 min), an anterior ilioinguinal approach in 7 cases (167 min), and a combined anterior–posterior approach in 4 cases (230 min). All patients on whom a combined approach was used had a both-column fracture (Fig. 2); the combined approach was done in a single surgical procedure in 2 cases and on a deferred basis in the other 2 cases. In a case of T-shaped acetabular fracture accompanied by sacral fracture, we performed a percutaneous fixation of both fractures. For the osteosynthesis, we used AO materials with reconstruction plates and 3.5-mm titanium screws. We did not use intra-operative neuropsychological monitoring.

The mean length of admission was 23.6 days (12–53 days, median 19 days), and the mean length of stay postoperatively was 14.5 days (4–38 days, median 11 days). None of the patients received indomethacin prophylaxis or low-dose radiation to prevent the appearance of heterotopic ossifications. Progressive weight-bearing ambulation was initiated in the third month, depending on radiographic healing of the fracture.

Post-operative evaluation

The patients were clinically and radiographically evaluated at 4 weeks, 12 weeks, 6 months, and annually thereafter. The mean follow-up period was 4 years (1.5–7.5 years).

We used Harris’ functional evaluation scale for the clinical evaluation. The radiographic assessment included classic projections of the acetabulum. The degree of reduction achieved was divided into 3 categories: anatomical reduction, displacement less than 2 mm, and displacement more than 2 mm. Heterotopic ossifications appearing were evaluated and classified according to Brooker et al., and for the degree of radiographic osteoarthritis of the hip, the Tönnis classification was used.

Statistical analysis

We used the SPSS program for Windows (version 15.0, SPSS, Chicago, IL). The non-parametric chi-square test and the T-test for independent data were used to detect possible association between variables. A P value of <.05 was considered statistically significant.

Results

Complications

Intra-operative: an injury due to traction on the femoral cutaneous nerve, from which the patient has not recovered, having an area of hypaesthesia on the lateral aspect of the thigh.

Post-operative: a superficial Staphylococcus epidermidis infection of the surgical wound and a generalized sepsis, the latter in a patient with both-column acetabular fracture and bilateral open humerus fractures. Both infections resolved with specific intravenous antibiotic therapy.

Post-operative reduction

We obtained anatomical reduction of the fracture in 12 cases (52%); in 7 patients (30%), the displacement was less than 2 mm, and in 4 patients (17%) it was greater than 2 mm.

We found an association between the type of fracture and the degree of reduction obtained, the probability of achieving an anatomical reduction being reduced in complex injuries (P = .019). Anatomical reduction was achieved in only 23% of complex injuries, compared to 90% of simple injuries.

The percentage of anatomical reductions was lower in patients over 40 years of age due to their poorer bone quality, but this was not a statistically significant difference (P = .059). Only 4 out of 12 fractures (33%) were anatomically reduced in patients over 40 years of age, compared to 8 out of 11 (73%) in patients under 40 years of age. We also found that, following injury, the surgery delay time made no significant difference in the degree of reduction obtained.
Acetabular fractures: Short-term results

Clinical results

According to the Harris scale, the results we obtained were excellent in 14 patients (61%), good in 4 patients (17%), acceptable in 2 patients (9%), and poor in 3 patients (13%) (Table 2). At the end of the follow-up period, 4 patients had moderate or severe pain (17%), 9 had limited mobility in the hip (39%), 5 were routinely using a cane (22%), and 16 were able to walk a distance of more than 6 blocks (70%).

In our study, simple fractures had a better functional prognosis than complex fractures: while the simple fractures scored a mean of 92 points on the Harris scale, the mean score for complex fractures was 84.5 points (P = .04).

The degree of reduction obtained was also a determining factor in the final clinical results (P = .016), the percentage of good and excellent results being higher for anatomically reduced fractures (Table 2). Neither the patient’s age nor the presence of associated injuries made significant differences in the functional evaluation.

Radiographic results

Of the 23 patients evaluated, 5 patients (22%) developed heterotopic ossifications that were Brooker class II or more. Heterotopic ossifications appeared more frequently in those cases where we approached the fracture via the external table of the ilium (Kocher–Langenbeck and combined approach). Of the 15 cases where we used one of these approaches, 8 (53%) developed heterotopic ossifications (3 Brooker class I, 3 class II, and 1 class III), compared with only 2 (28%) of the 7 cases where an ilioinguinal approach was used (1 Brooker class I and 1 class II).

On the final radiographic evaluation, no degenerative changes were seen in 12 cases (52%), minimal osteoarthritic changes (Tönnis I) in 5 cases (22%), moderate changes (Tönnis II) in 4 cases (17%), and complete loss of the joint space (Tönnis III) in 2 cases (9%).

Post-operative reduction of the fracture is associated with the development of osteoarthritis of the hip (P < .001). Only 2 out of 18 cases (11%) that had a satisfactory reduction (anatomical or displacement less than 2 mm) developed moderate to severe degenerative changes, but all patients (100%) with a post-operative displacement of more than 2 mm progressed toward an advanced osteoarthritis (Fig. 3).

Among our patients, there were no cases of avascular necrosis of the femoral head. At this time, none of the patients who have developed an obvious osteoarthritis of the hip are showing enough clinical signs to warrant replacement with a prosthesis.

Discussion

Congruence between the femoral head and the acetabulum is crucial to preserving good joint function and preventing
the development of a post-traumatic osteoarthritis of the hip.\textsuperscript{7} The objective of surgical treatment should be to achieve a stable anatomical reduction of the fracture.\textsuperscript{6}

Proper classification of the fracture is essential for surgical planning, has prognostic value, and facilitates the comparative analysis of results from different hospitals. The classification system proposed by Judet and Letournel\textsuperscript{14} is the most extensive and has good inter- and intra-observer concordance.\textsuperscript{21}

There is no unanimity as to the appropriate length of time until surgery. There is evidence, however, that anatomical reduction is more difficult to achieve and that clinical results are worse if surgical treatment of the fracture is delayed more than 2 or 3 weeks after the initial trauma.\textsuperscript{22,23} In our series, the degree of reduction obtained was independent of how long it was delayed.

Of the 23 fractures, 19 (83\%) were resolved via a single surgical approach. In the remaining 4 cases, we were not able to reduce all the fractures via a single approach and opted for a combined anterior and posterior incision, avoiding wide approaches such as the iliofemoral approach because of their higher morbidity.

In only 1 case was a CAT scan used to assess post-operative reduction (Fig. 3). This could constitute a limitation of our study, in view of the evidence that reductions classified radiographically as anatomical show displacement at the articular surface when evaluated by CAT scan.\textsuperscript{7} We achieved anatomical reduction of the fracture in 12 cases (52\%). Although these results are slightly inferior to those of more extensive series that have been published,\textsuperscript{4-9} they are consistent with those published by Matta and Merritt,\textsuperscript{24} who report anatomical reductions in close to 50\% of their first 20 surgical cases.

The development of osteoarthritis is the most common complication of acetabular fractures\textsuperscript{8} and is directly related to the post-operative reduction obtained. The incidence of moderate to severe osteoarthritis of the hip in our series was 26\%—very close to the 26.6\% published by Giannoudis et al.,\textsuperscript{3} in their meta-analysis but lower than that in series with a lengthier follow-up, such as that of Briffa et al.,\textsuperscript{9} who report 38\% having osteoarthritis at 11.3 years. We believe that, given a longer follow-up period, osteoarthritis of the hip may develop with perfectly reduced fractures.

Our clinical results are comparable to those of other authors, even having achieved a lower rate of anatomical reductions (Table 3). We believe it is possible to obtain excellent functional results—even if the reduction is not satisfactory—as long as the joint displacement is situated outside the weight-bearing surface of the acetabulum. Some authors\textsuperscript{7,9} have suggested that an anatomical surgical reconstruction does not always correlate to a good clinical result, owing to factors beyond our control, such as chondral damage caused by the initial trauma.

Conclusion

In acetabular fractures, the primary objective of surgical treatment is anatomical reduction of the fracture. Added to the difficulty this involves is the relative infrequency of these fractures. Establishing referral centres specialized in the management of these patients should be a short-term priority, for this would facilitate the creation of treatment protocols and minimize the detrimental effects of the learning curve.

Level of evidence

Evidence Level IV.

Conflicts of interest

The authors have no conflicts of interest to declare.

Ethical Disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this investigation.

Confidentiality of Data. The authors will declare that they have followed the protocols of their work centre on the publication of patient data and that all the patients included in the study have received sufficient information and have given their informed consent in writing to participate in that study.

Right to privacy and informed consent. The authors must have obtained the informed consent of the patients and /or subjects mentioned in the article. The author for correspondence must be in possession of this document.
References