Epidemiology and treatment of acetabular fractures in a level-1 trauma centre: Retrospective study of 414 patients over 10 years

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ABSTRACT

Background: Epidemiological studies of acetabular fractures (AFs) are scarce and, to our knowledge, the most recent one from France, by Letournel and Judet, dates back to 1993. Studies have suggested a decrease in high-energy AFs contrasting with an increase in low-energy AFs due to the longer life expectancy. However, a French case-series study failed to confirm these data. We therefore conducted a 10-year retrospective study in a level-1 trauma centre to: (1) characterise the epidemiological profile of AF; (2) and to describe the treatment strategy.

Hypothesis: The epidemiological profile of AF in France is consonant with data from European case-series studies.

Method: All patients managed for AF between 2005 and 2014 were included in this single-centre retrospective study. All patients were re-evaluated at our centre or another facility 6 months after the fracture. The epidemiological data were compared in the three treatment groups: non-operative, open and internal fixation (ORIF), and total hip arthroplasty (THA).

Results: Between 2005 and 2014, 1414 patients were admitted for AF. Mean age was 49.4 years (range: 15–101 years). Treatment was non-operative in 231 (56%) older patients, most of whom had low-energy fractures involving the anterior wall. THA with or without acetabular reinforcement and screw-plate fixation was performed in 27% of younger patients, most of whom had posterior-wall fractures and experienced postoperative complications (26/27 patients, 96%). ORIF was used in 156 (38%) younger patients, most of whom had high-energy fractures of greater complexity.

Conclusion: Our results reflect the current indications in AF management. The epidemiological characteristics in our population are comparable to those reported in the few recent European epidemiological studies. To our knowledge, this is the largest French epidemiological study since the landmark work by Letournel and Judet.

Level of evidence: Level IV, retrospective study.

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1. Introduction

Epidemiological studies of acetabular fractures (AFs) are scarce. Road safety efforts have decreased the incidence of high-energy AFs, whereas low-energy AFs are becoming increasingly common due to life expectancy gains [1]. Recent studies suggested changes in AF epidemiology in terms of age distribution, fracture patterns, mechanisms of injury, and management strategies (non-operative vs. operative treatment) [2,3].

No data on the epidemiology of AFs in France have been published in the last few decades. The most recent French study providing meaningful epidemiological information is the work by Letournel and Judet in 940 patients, which was reported in 1993 [4]. Previous reports of epidemiological changes were not confirmed in a French study.

We therefore conducted a 10-year retrospective study in a level-1 trauma centre:

• to identify the epidemiological profile of AF;
• to describe the treatment strategies used.
2. Materials and methods

2.1. Patients

All patients admitted for the treatment of AF between January 2005 and December 2014 were included in this single-centre retrospective study. Patients with fractures of the ilio-pubic rami and/or pelvic ring that did not involve the acetabulum were excluded.

There were 414 patients, 307 (74%) males and 107 (24%) females, with a mean age of 49.4 years (range: 15–101 years) and a mean hospital stay length of 16.7 days (range: 1–78 days). Among them, 105 (25%) had low-energy trauma and 309 (75%) high-energy trauma. Multiple injuries were present in 136 (33%) patients. The mean Injury severity score (ISS) [5] was 11.1 (range: 0–52). The most common fracture pattern was anterior column (n = 92, 22%), followed by posterior wall (n = 80, 19%) and anterior wall (n = 58, 14%). Table 1 lists the main patient characteristics.

2.2. Description of the study method

The following epidemiological data were analysed: sex ratio, age, mechanism of injury (high- vs low-energy), presence of multiple injuries, ISS, hospital stay length, and fracture pattern in the Letournel classification [6,7]. The fractures were described using the Letournel classification to analyse the radiographs and computed tomography (CT) scans. Two independent observers separately classified each fracture. When they disagreed, the fracture was considered non-classifiable (NC). In surgically treated patients, the intraoperative findings served to confirm or modify the classification [6,7].

Depending on the fracture pattern, non-operative treatment consisted either inskeletal traction for 3 weeks with passive hip mobilisation or in simple bed rest followed by active and passive mobilisation without weight bearing for a total of 6 weeks. Operative treatment consisted in either open reduction with internal fixation (ORIF) or total hip arthroplasty (THA), depending on age, co-morbidities, and the fracture pattern. For ORIF, the fracture pattern guided the choice among the posterior Kocher-Langenbeck approach, anterior ilio-inguinal approach, or both in combination. For THA, a cemented or cementless femoral stem was used. In most cases, press-fit cup fixation was not sufficiently stable and a Kerbolli cross-plate was therefore implanted, followed by a dual-mobility cemented cup combined with a posterior screw-plate.

Prophylactic low-molecular-weight heparin therapy was given routinely until the return to weight bearing, except in patients who were on anticoagulant therapy for another reason (comorbidities, complications).

2.3. Assessment method

In the non-operatively treated patients, the use of skeletal traction and of secondary total hip arthroplasty (THA) was analysed. In the surgically treated patients, we analysed the surgical approach and type of internal fixation or prostheses. Complications were recorded and analysed. All patients were re-evaluated 6 months after the fracture at our centre or at another facility. The epidemiological data were compared across treatment groups.

2.4. Statistical analysis

The statistical analyses were done using Statview 5.5 software (SAS Institute, Cary, NC, USA). Student's t test was applied to compare quantitative variables and the Chi² test to compare qualitative variables. Values of P lower than 0.05 were taken to indicate significant differences. Our local ethics committee approved this retrospective study.

3. Results

3.1. Epidemiological findings

Of the 414 patients, 231 (56%) were managed non-operatively. There were 162 (70%) males and 69 (30%) females with a mean age of 53.4 years (range: 15–101) and a mean hospital stay length of 13.3 days (range: 1–59 days). The trauma was low energy in 87 (38%) patients, and 75 (32%) patients had multiple injuries. The mean ISS was 11 (range: 0–52). Anterior column fracture was the most common pattern (n = 81, 35%), followed by anterior wall fracture (n = 58, 25%) and posterior wall fracture (n = 39, 17%). Skeletal traction was used in 196 (85%) patients. In 15 (6%) patients, secondary THA was performed after 6 months, because of hip osteoarthritis. Tables 1 and 2 list the main findings.

ORIF was performed in 156 (38%) patients. This group had 126 (81%) males and 30 (19%) females, with a mean age of 40.3 years (range: 17–80 years) and a mean hospital stay length of 20.6 days (range: 6–78 days). A single patient (<1%) had a low-energy fracture and 155 (99%) had multiple injuries. The mean ISS was 10.6 (range: 0–48). The most common fracture pattern was transverse + posterior wall (n = 34, 22%), followed by posterior wall (n = 29, 19%) then by anterior column + posterior hemi-transverse (n = 28, 18%). The Kocher-Langenbeck approach was used in 88 (56%) patients, an ilio-inguinal approach in 38 (24%) patients, a dual approach in 19 (12%) patients, and an ilio-femoral approach in 7 (4%) patients. A pelvic reconstruction plate was implanted in 71 (46%) patients, a reconstruction plate combined with screw.

Table 1

<table>
<thead>
<tr>
<th>Epidemiological data</th>
<th>Overall (n=414)</th>
<th>Non-operative treatment (n=231)</th>
<th>ORIF (n=156)</th>
<th>THA (n=27)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years, mean [range]</td>
<td>49.4 [15–101]</td>
<td>53.4 [15–101]</td>
<td>40.3 [17–80]</td>
<td>69.6 [39–95]</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Males, n (%)</td>
<td>307 (74%)</td>
<td>162 (70%)</td>
<td>126 (81%)</td>
<td>19 (70%)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Females, n (%)</td>
<td>107 (26%)</td>
<td>69 (30%)</td>
<td>30 (19%)</td>
<td>8 (30%)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Hospital stay length, days, mean [range]</td>
<td>16.7 [1–78]</td>
<td>13.3 [1–59]</td>
<td>20.6 [6–78]</td>
<td>23.1 [6–75]</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Mechanism of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low energy</td>
<td>105 (25%)</td>
<td>87 (38%)</td>
<td>1 (0.6%)</td>
<td>17 (63%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>High energy</td>
<td>309 (76%)</td>
<td>144 (62%)</td>
<td>155 (99.4%)</td>
<td>10 (37%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Multiple injuries</td>
<td>136 (33%)</td>
<td>75 (32%)</td>
<td>155 (99%)</td>
<td>9 (33%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Injury severity score</td>
<td>11.1 [0–52]</td>
<td>11 [0–52]</td>
<td>10.6 [0–48]</td>
<td>14 [4–49]</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

ORIF: open reduction and internal fixation; THA: total hip arthroplasty.

* Significant values are in bold type.

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fixation of the contralateral column in 45 (29%) patients, and a reconstruction plate combined with a spring plate in 14 patients (9%). Within 6 months after the fracture, 14 (9%) patients underwent THA because of poor clinical outcomes (including avascular necrosis in 1 patient and recurrent dislocation in 3 patients). Reduction was unsatisfactory in 13 of these 14 patients [8]. Table 1 reports the findings.

The remaining 27 (6%) patients were managed with primary THA. There were 19 (70%) males and 8 (30%) females with a mean hospital stay length of 23.1 days (range: 6–75 days). The trauma was low energy in 17 (63%) patients, and 9 (33%) patients had multiple injuries. The mean ISS was 14 (range: 4–49). The most common fracture type was posterior wall (n = 12, 44%), followed by posterior column (n = 5, 19%). Standard THA combined with a reconstruction plate was performed in 6 (22.2%) patients, including 5 (83%) with posterior wall fractures and 1 (17%) with a posterior column and posterior wall fracture. The remaining 21 (77.8%) patients underwent THA with acetabular reconstruction using a Kerboull cross-plate. Fracture patterns in these 21 patients were posterior wall (n = 7, 33.3%), posterior column (n = 5, 23.8%), both columns (n = 5, 23.8%), transverse (n = 2, 9.5%), and T-shaped (n = 2, 9.5%) (Tables 1 and 2).

3.2. Non-operative treatment vs. surgery

The epidemiological data were compared between the groups treated non-operatively and surgically. Mean age was older in the non-operative group (53.4 years vs. 44.6 years, P < 0.001), which had a shorter hospital stay length (13.3 days vs. 21 days, P < 0.001) and a smaller proportion of multiply injured patients (75/231 [32%] vs. 164/183 [90%], P < 0.001). The non-operative group had lower proportions of complex fractures (32/231 [14%] vs. 115/183 [63%], P < 0.001) and of fractures involving the posterior wall (53/231 [23%] vs. 59/183 [32%], P < 0.01), contrasting with a higher proportion of fractures involving the anterior wall (134/231 [60%] vs. 11/183 [6%], P < 0.001) (Table 2). The ISS was not significantly different between the two groups (Table 1).

3.3. ORIF vs. total hip arthroplasty (THA)

The epidemiological data were also compared between the ORIF and THA groups. The ORIF group had a younger mean age (40.4 years vs. 69.6 years, P < 0.001), shorter hospital stay duration (20.6 days vs. 23.1 days, P < 0.001), and higher proportion of multiply injured patients (155/156 [99%] vs. 9/27 [33%], P < 0.001). The ORIF group had lower proportions of posterior wall fractures (29/156 [19%] vs. 12/27 [44%], P < 0.001), posterior column fractures (1/156 [1%] vs. 5/27 [19%], P < 0.001), and fractures involving the posterior wall (41/156 [26%] vs. 18/27 [67%], P < 0.001) (Table 2). The ISS was not significantly different between the two groups (Table 1).

3.4. ORIF vs. non-operative treatment

A third comparison of epidemiological data was performed between the ORIF and non-operative groups. Mean age was higher in the non-operative group (53.4 years vs. 40.3 years, P < 0.001). The ORIF group had a shorter mean hospital stay length (13.3 days vs. 20.6 days, P < 0.001) and higher proportions of multiply injured patients (155/156 [99%] vs. 75/231 [32%], P < 0.001) and of complex fractures (107/231 [69%] vs. 32/231 [14%], P < 0.001), contrasting with a lower proportion of fractures involving the anterior wall (11/156 [7%] vs. 139/231 [60%], P < 0.001) (Table 2). The proportion of fractures involving the posterior wall was similar in the two groups (41/156 [26%] vs. 53/231 [23%], P = 0.05). The ISS was not significantly different between the two groups (Table 1).

3.5. THA vs. non-operative treatment

Finally, the epidemiological data were compared between the THA and non-operative groups. Mean age was higher in the THA group (69.6 years vs. 53.4 years, P < 0.001). The non-operative group had a longer hospital stay length (23.1 days vs. 13.3 days, P < 0.001), a higher proportion of fractures involving the anterior wall (139/231 [60%] vs. 0/27 [0%], P < 0.001), and a lower proportion of fractures involving the posterior wall (53/231 [23%] vs. 18/27 [67%], P < 0.001). The two groups showed no significant differences for the proportion of multiply injured patients, ISS, or energy of the trauma (Table 1).

3.6. Complications

The 414 patients managed for acetabular fractures between 2005 and 2014 had a total of 186 complications. Of the 12 (2.9%) patients who died during the immediate postoperative period, 8 were managed non-operatively. Mortality was highest in the THA group (3/27, 11.1%, P = 0.06), which also had the highest complication rate (26 complications in 27 patients [96%] vs. 78 complications in 156 patients [50%] with ORIF and 82 complications in 231 patients [35%] with non-operative treatment, P < 0.001). The most common complications varied across treatment groups: in the non-operative group, pressure sores (9%, 21 patients), lower respiratory tract infections (4.3%, 10 patients), and deep vein thrombosis (4.3%, 10 patients); in the ORIF group, deep vein
thrombosis (9%, 14 patients), screw malposition within the joint cavity (7.6%, 12 patients), nerve injuries (5.7%, 9 patients), and haemorrhagic shock related to multiple injuries (5.7%, 9 patients); and in the THA group, surgical-site infections (22.2%, 6 patients), pulmonary embolism (14.8%, 4 patients), and lower respiratory tract infections (11.1%, 3 patients). Table 3 reports the complications.

4. Discussion

Between 2005 and 2014, 414 patients with a mean age of 49.4 years (range: 15–101 years) were admitted to our level-1 trauma centre for AF [9]. Non-operative treatment was chosen in older patients, usually with low-energy fractures involving the anterior wall (56%, 231 patients). THA with or without acetabular reinforcement and screw-plate fixation was performed in older patients who usually had fractures involving posterior wall (7%, 27 patients) and subsequently experienced a high rate of complications (26 complications in 27 patients, 96%). ORIF was used in younger patients with high-energy trauma and complex fractures (156 patients, 38%). These data reflect our indications for the management of AF [10].

The main limitations of this study are the retrospective design and short follow-up (6 months). However, although the data were collected retrospectively, case-ascertainment was complete and no patients were lost to follow-up. Delayed complications (e.g., secondary THA) were probably underestimated due to the short follow-up, but they were not the objective of our study. The sample size was large: to our knowledge, this is the second largest epidemiological cohort study conducted in France, after the study of 940 patients by Letournel and Judet (third version published in 1993) [4]. Our work is the largest French case-series study reported recently in the medical literature.

Our findings are consistent with previously published epidemiological studies. Mean age was 47.3 years in a recent multicentre study of 1266 AFs conducted in Germany [2], 46.8 to 53.7 years in a recent single-centre study of 351 cases in the UK [3], and 40 years in the US vs. 44 years in China in an epidemiological study comparing these two countries [11]. Our results regarding the sex-ratio, mechanism of injury, ISS, and mean hospital stay length are consonant with those found previously in the US and in Europe [2,3,11]. The distribution of fracture patterns in our cohort was similar to that in the European literature, with a predominance of posterior wall fractures, anterior column fractures, and both-column fractures (23.3%, 14.7%, and 13.5%, respectively [3]; and 19.4%, 12.3%, and 19.3%, respectively [2]). Our results on the surgical strategy agree with those reported by Laird et al. [3] (56% patients treated non-operatively and 44% by ORIF). The distribution of treatment methods was different in the study by Ochs et al. [2], with non-operative treatment in 32.2% of patients, ORIF in 65%, and THA in 3%. This discrepancy may be ascribable to their higher proportion of both-column fractures requiring ORIF. Our results indicate good compliance with current recommendations about AF, which state that non-operative treatment should be preferred in older patients with low-energy trauma and minimally displaced fractures, and ORIF in young or active patients with high-energy trauma and major fracture displacement. ORIF is preferred in active patients with fractures involving the anterior wall and THA in active older patients with posterior wall fractures [10,12].

Complication rates in the study by Laird et al. [3] were similar to ours, with death in 4.8% of patients, nerve injury in 7.8%, deep vein thrombosis in 3%, and surgical-site infection in 6.5% of surgically treated patients. Ochs et al. [2] found a lower complication rate of only 16% and a mortality rate of 2.9% overall (5.3% without non-operative treatment and 2% with surgery). In the surgically treated group, the results were similar to those in our ORIF group regarding the rates of deep vein thrombosis (2.7%), pulmonary embolism (1.2%), and surgical site infection (1.4%). The low complication rate in this earlier study [2] may be ascribable to the use of primary THA in only 3% of patients.

Our THA group had a significantly higher complication rate of 96% (26 complications in 27 patients) and a higher mortality rate (11.1%, 3 patients, \(P < 0.06\)) compared to the ORIF group (50%, 78 complications in 156 patients) and non-operative group (35%, 82 complications in 231 patients, \(P < 0.001\)). These differences may be ascribable to the longer operative time, greater blood loss, and longer hospital stay with THA reported by Boeckel et al. [13]. Earlier studies found lower complication rates for primary THA with or without acetabular reconstruction to treat AF, but their sample sizes were smaller [14,15]. Furthermore, the complication rate remained higher with THA than with ORIF [13]. Percutaneous management of AF may constitute an alternative in patients with severe comorbidities [16]. The proportion of patients managed non-operatively can be expected to decline with the development of percutaneous and minimally invasive techniques [17].

5. Conclusion

Our findings reflect the current indications for managing AF. The epidemiological features of our cohort are consistent with those
of the few recent epidemiological studies done in Europe. To our knowledge, this cohort is the largest epidemiological study conducted in France since the landmark work by Letournel and Judet [4].

Disclosure of interest

The authors declare that they have no competing interest.

References