Low energy fractures of the acetabulum

N Papadakos, R Pearce, MD Bircher

St George's Healthcare NHS Trust, UK

ABSTRACT

INTRODUCTION Acetabular fractures due to high energy injuries are common and well documented; those secondary to low energy mechanisms are less well described. We undertook a retrospective study of the acetabular fracture referrals to our unit to evaluate the proportion of injuries resulting from a low energy mechanism.

METHODS A total of 573 acetabular fractures were evaluated from 1 January 2005 to 31 December 2008. The plain radiography and computed tomography of those sustaining a low energy fracture were assessed and the fracture patterns classified.

RESULTS Of the 573 acetabular fractures, 71 (12.4%) were recorded as being a result of a low energy mechanism. The male-to-female ratio was 2.4:1 and the mean patient age was 67.0 years (standard deviation: 19.1 years). There was a significantly higher number of fractures ($p < 0.001$) involving the anterior column (with or without a posterior hemitransverse component) than in a number of previously conducted large acetabular fracture studies.

CONCLUSIONS Our results demonstrate that low energy fractures make up a considerable proportion of acetabular fractures with a distinctly different fracture pattern distribution. With the continued predicted rise in the incidence of osteoporosis, life expectancy and an aging population, it is likely that this type of fracture will become increasingly more common, posing difficult management decisions and leading to procedures that are technically more challenging.

KEYWORDS

Acetabular – Fracture – Low energy

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CORRESPONDENCE TO

Nikolaos Papadakos, Department of Radiology, St George's Hospital, Blackshaw Road, Tooting, London SW17 0QT, UK
T: +44 (0)20 8725 3033; E: papadakosn@gmail.com

The vast majority of acetabular fractures are a result of high energy (HE) injuries (eg road traffic accidents). Low energy (LE) injuries (such as a simple fall from standing) and insufficiency fractures are far less common.

Few studies have detailed the proportion of acetabular fractures sustained as a result of a LE mechanism of injury. Previous figures range from 0% to 13.5% of the study populations investigated.^{1–3} With the ever increasing prevalence of osteoporosis and an aging population, this type of injury is likely to become far more common.^{4,5}

The aim of this retrospective study was to determine the proportion of acetabular fractures due to LE injuries referred to our regional pelvic and acetabular trauma unit. Furthermore, we sought to detail the epidemiology in this group and assess the available imaging to ascertain the fracture patterns involved.

Methods

St George's Healthcare NHS Trust is the main referral centre for pelvic and acetabular fractures in the southeast of England. Clinical details of all referrals are recorded on the unit's pelvic and acetabular fracture referral proforma, which forms the referral database. All referrals to the unit are reviewed by one or more of the senior acetabular surgeons. A decision is

then made as to the appropriate management of the fracture. A retrospective study of the database was undertaken, assessing all the completed proformas over a four-year period from 1 January 2005 to 31 December 2008.

The proformas were assessed to ascertain the epidemiological and relevant clinical information for all acetabular fracture referrals during this time period. Parameters that were collated included: age, sex, mechanism of injury, date of injury, fracture site and recommended management of the fracture. Incomplete proformas were excluded from the study.

A LE fracture was defined as a fracture sustained from a simple fall from standing height or less. Insufficiency and stress fractures were also included in the LE group. All other mechanisms of injury were included in the HE injury group.

All available radiographic imaging (plain radiography and computed tomography [CT]) for the LE cases was reviewed to confirm the diagnosis and the fractures were categorised according to the Letournel classification.¹ Assessment of the imaging and fracture classification was conducted by a single senior acetabular surgeon. Data analysis was carried out using Excel® (Microsoft, Redmond, WA, US) and SPSS® version 16.0 (SPSS, Chicago, IL, US). Statistical analysis was carried out using a chi-squared test and t-test. A p -value of ≤ 0.05 was considered to be of statistical significance.

Results

A total of 589 acetabular fracture referral proformas completed between 1 January 2005 and 31 December 2008 were reviewed. There were 29 exclusions due to incomplete documentation of data and the remaining 560 cases were analysed. Fifteen patients had documented bilateral acetabular fractures (1 in the LE group and 14 in the HE group). Two further fractures were pathological fractures due to metastatic bone disease and so these cases were excluded. This resulted in a total of 573 fractures for assessment.

Of the fractures assessed, 71 (12.4%) were documented as having been sustained from a LE mechanism. The mean age of the patients was 67.0 years (standard deviation [SD]: 19.1 years), with a male-to-female ratio of 2.4:1. The remaining 502 cases (87.6%) were categorised as a HE fracture, with a male-to-female ratio of 4.9:1. (The patient's sex was not recorded in six of the HE cases.) The mean age was 40.5 years (SD: 17.4 years), which was significantly lower than the LE group ($p<0.001$).

Of the 71 LE fractures, 60 (85.0%) were a result of a simple fall from a standing height or less. The mechanisms of injury involved in the remainder of the cases were recorded as: seizure ($n=4$, 5.6%), seizure with a fall from standing (whether the seizure or subsequent fall caused the fracture is not clear) ($n=4$, 5.6%) and an insufficiency type mechanism (while running, playing table tennis and forced flexion of the knee) ($n=3$, 4.2%).

The radiography or CT for 65 of the 71 fractures (91.5%) was available for review during the assessment. Anterior column fractures with posterior hemitransverse fractures accounted for 35.2% of the cases, anterior column fractures accounted for 15.5% and T-shaped fractures accounted for 12.7%. The remainder of the fracture types each made

up between 2.8% and 8.5% of cases. Table 1 includes comparative figures from three other large studies detailing the frequency of acetabular fracture patterns sustained as a result of HE or LE mechanisms of injuries.^{1,6,7}

The patients requiring open reduction and internal fixation (ORIF) were transferred to our unit for surgery. ORIF was recommended in 51.0% of the LE cases. In the remaining cases, either conservative management (39.4%), total hip arthroplasty (THA) (7.0%) or conservative management with or without delayed THA (21.1%) were recommended.

Discussion

Acetabular fractures are relatively uncommon, with the incidence reported to be 3 patients per 100,000 population per year.⁸ Previous studies have generally either focused on HE injury fractures or not defined the different mechanisms of injury accurately.^{9–12} The term ‘fall’ as a mechanism of injury has often been used but few studies specify the exact height of the fall and some may therefore encompass falls from greater heights.^{6,10–12}

The three studies that detailed all mechanisms of injury reported LE fractures to account for 0%, 2.7% and 13.5% of their study populations.^{1–3} The wide variation in the proportions may be due to the relatively small number of cases in two of these studies and differing referral patterns to the individual units. In the largest of these studies, 2.7% of the fractures (25/940) were reported to be due to a ‘simple fall’ (assumed to be a fall from standing),¹ which is markedly lower than our result of 12.4%. As the data collection in this study began over 20 years ago, some of the differences may be attributed to improved fracture detection with CT or different referral patterns. The more recent centralisation of specialist pelvic orthopaedic services to larger

Table 1 Proportion of fracture types according to the Letournel classification for the low energy (LE) fracture group with comparative figures from three other large studies ^{1,6,7}					
Fracture pattern	LE group (n=71)	Ferguson: >60 years (n=235)	Ferguson: total population (n=1,309)	Letournel (n=940)	Giannoudis (n=3,670)*
Posterior wall	8.5%	13.2%	14.4%	23.7%	23.6%
Posterior column	4.2%	0.4%	2.1%	3.2%	3.5%
Anterior wall	2.8%	3.4%	0.8%	1.9%	1.7%
Anterior column	15.5%	19.2%	9.3%	4.1%	3.9%
Transverse	5.6%	0.9%	3.9%	7.4%	8.3%
T-shaped	12.7%	10.2%	12.5%	7.0%	9.3%
Posterior column with posterior wall	0.0%	3.4%	3.0%	3.4%	5.7%
Transverse with posterior wall	2.8%	8.1%	16.3%	19.5%	17.4%
Anterior column with posterior hemitransverse	35.2%	14.9%	8.9%	6.9%	5.0%
Both-column	4.2%	26.4%	27.7%	22.7%	21.7%
Unknown	8.5%	0.0%	1.1%	0.1%	0.0%
*meta-analysis that included some of Letournel's study data					

tertiary centres has also likely resulted in the increased referral rates to our unit.

Seizure related and insufficiency type fractures accounted for up to 15.4% of the LE fracture group. Fractures as a result of these mechanisms are relatively uncommon but have been described previously in a number of case reports and case series.^{13–18}

Letournel *et al* postulated that fractures involving the anterior acetabulum resulted from a force applied to the greater trochanter in the axis of the femoral neck or a 'blow on the greater trochanter'.¹ This would be consistent with an injury sustained from a fall from standing and potentially explain the high number of fractures involving the anterior acetabulum in our study. They also reported a higher incidence of anterior column (and both-column) fractures in elderly patients probably related to a fall with a blow to the greater trochanter.¹ Ferguson *et al* found a similar larger proportion of fractures involving the anterior column in those aged >60 years although they did not clearly define the term 'fall' as a mechanism of injury or the height of the fall (a more significant height would otherwise be considered a HE mechanism).⁶

The proportion of anterior column fractures with posterior hemitransverse fractures was significantly higher ($p<0.001$) in our LE study population than in three of the largest studies detailing acetabular fractures sustained from any type of mechanism of injury (Table 1).^{1,6,7} This was also the case for anterior column fractures (Giannoudis *et al*'s ($p<0.001$), Letournel *et al*'s ($p<0.001$) and Ferguson *et al*'s ($p=0.047$) total study populations), with the exception of Ferguson *et al*'s population aged >60 years ($p=0.7$).^{1,6,7} The vast majority of fractures in these studies are likely to be a result of HE injuries (involving different mechanisms and points of impact on the acetabulum), which explains the higher proportion of fractures involving the posterior acetabulum (Table 1).

As 84.5% of patients with LE fractures in our study were aged ≥ 50 years, with an average age of 67.0 years, there is a distinct risk of osteoporosis or low bone density in this group and therefore a possible underlying cause of many of these LE acetabular fractures.^{19,20} With the predicted continued rise in life expectancy, osteoporosis and an

aging population, a similar rising trend may be seen with LE acetabular fractures.^{4,5,21} At least two other studies have also reported an apparent increase in lower energy acetabular fractures or acetabular fractures occurring in older patients.^{6,8}

Osteoporotic fractures generally occur more frequently in female patients.^{19,22} However, we found a higher proportion of males sustaining LE fractures. This may be due to a relatively small LE fracture patient group and specific referral patterns to our unit from other hospitals. Nevertheless, not all of the LE fractures can be attributed to osteoporosis and acetabular fractures are generally more common in men.⁷

With the potential rise of LE fractures, optimal management will need to be considered, particularly with the relatively large proportion of fractures involving the anterior acetabulum. Conventional treatment with ORIF of displaced acetabular fractures has been considered to be technically more difficult or to result in a poorer outcome in osteoporotic bone or older patients.^{1,23–26} As many of these patients often have medical co-morbidities or increased perioperative morbidity, conservative management, closed reduction or delayed THA has been advocated.^{1,27,28} Some authors recommend the use of a variety of acute surgical techniques. These include ORIF, ORIF using modified operative techniques, acute THA and ORIF with primary THA.^{27–30}

A fifth (21.1%) of our LE fracture group were aged 50–59 years, and at risk of having low bone density and sustaining an osteoporotic fracture.^{19,20} ORIF may fail or prove to be difficult in the presence of poorer bone quality and a THA may be a suboptimal choice in a younger active age group (Fig 1). Owing to such cases and the relatively high number of LE fractures, we have introduced a management algorithm to optimise treatment (Fig 2), working closely with the revision hip surgeons in the decision making process. The algorithm is currently in the process of being assessed prospectively.

The main limitation of this study is the reliance of data collected retrospectively from a database. Additionally, the imaging assessment and fracture classification were conducted by a single reader, with no inter and intraobserver evaluation.

Figure 1 Preoperative plain radiography and computed tomography (A and B) and postoperative plain radiography (C) of an anterior column fracture variant with roof impaction (black arrow). Optimal fixation proved difficult, thereby highlighting the complexities of operating in bone with low density or osteoporosis.

Figure 2 The treatment algorithm used in our unit for LE acetabular fractures

Conclusions

Our study details one of the largest case series of acetabular fractures to date with 12.4% of these found to be secondary to a LE mechanism of injury. The majority of fractures involved the anterior column and occurred in older patients. As the population continues to age, the incidence of this fracture type is likely to increase, and surgeons will have to make progressively more difficult management decisions and undertake operations that are more technically challenging.

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