Lateral compression fractures of the superior pubic ramus with intra-articular extension

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A total of 30 patients with lateral compression fractures of the pelvis with intra-articular extension into the anterior column were followed for a mean of 4.2 years (2 to 6), using the validated functional outcome tools of the musculoskeletal function assessment and the short-form health survey (SF-36). The functional outcome was compared with that of a series of patients who had sustained type-B1 and type-C pelvic fractures. The lateral-compression group included 20 men and ten women with a mean age of 42.7 years (13 to 84) at the time of injury.

Functional deficits were noted for the mental component summary score ($p = 0.008$) and in the social function domain ($p < 0.05$) of the SF-36. There was no evidence of degenerative arthritis in the lateral-compression group. However, they had high functional morbidity including greater emotional and psychological distress.

The most common injury to the pelvic ring is the type-B2 lateral compression fracture.¹ According to Tile,² the prognosis is excellent with minimal long-term effects. Open reduction and internal fixation (ORIF) is rarely indicated and the recommended treatment is bed rest with delayed weight-bearing.²⁻⁵ With the advent of validated measurement instruments, post-traumatic deficits in physical, social and emotional function can be quantified.⁶ However, when describing the prognosis of lateral compression injuries, few studies have used such tools.

Steinitz et al⁷ observed that many factors influenced the prognosis, including the type of fracture of the ramus with high superior fractures having a poorer outcome than those of the inferior ramus. The former often enter the hip and, although they are regarded as fractures of the pelvic ring rather than of the acetabulum⁸ this low extension into the anterior-column is commonly overlooked as an acetabular fracture. According to Tile,⁸ the articular involvement is rarely sufficiently displaced to require open reduction and is unlikely to affect the function of the hip. Apart from clinical impression of outcome, there have been no previous studies documenting the functional outcome of these injuries.

Our aim therefore was to evaluate the outcome of lateral compression injuries of the pelvis with intra-articular extension.

Patients and Methods

We identified 30 lateral compression fractures with intra-articular extension into the ipsilateral acetabulum (lateral compression/anterior column group) which had been treated between 1996 and 2000 at our level-one trauma centre. Ethical approval had been obtained from our institutional review board. There were 20 males and ten females with a mean age of 42.7 years (13 to 84; Table I) at the time of injury.

Anteroposterior plain pelvic radiographs and Judet views had been taken in all patients at the initial presentation and CT scans obtained after they had been resuscitated and closed reduction of any dislocation of the hip carried out. Any stabilisation of the pelvic ring depended on the anterior and posterior pelvic fractures as well as on the nature of any associated injuries, especially urological and neurological. Of the 30 patients, 27 had been treated conservatively and allowed to mobilise with toe-touch weight-bearing on the injured side for six weeks. Their weight-bearing status was then re-evaluated and allowed to increase based on the clinical and radiological findings. Patients who had undergone operation had been given peri-operative antibiotics for 24 to 48 hours after surgery and Coumadin or low-molecular-weight heparin was used as thromboembolic prophylaxis until discharge home from either hospital or in-patient rehabilitation. All the

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Table I. The clinical details and injury characteristics of the 30 patients with lateral compression/anterior column (LC/AC) fractures

	Type LC/AC
Number of cases	30
Mean (range) age in years	42.7 (13 to 84)
Male gender (%)	20 (66.7)
Number of comorbidities (%)	18 (60)
0	3
1	3
≥ 2	12
Mean ISS* (SD)	28.9 (10.0)
Mean GCS† (SD)	13.2 (3.6)
Mean time to treatment in days (SD)	4.7 (6.4)
Number who have conservative treatment (%)	27 (90)
Numbers with associated injuries (%)	
Head	14 (46.7)
Spine	6 (20.0)
Chest	15 (50.0)
Abdomen	10 (33.3)
Upper limb	10 (33.3)
Lower limb	7 (23.3)
Hip dislocation	2 (6.7)
Initial nerve deficit	0

* ISS, injury severity score

† GCS, Glasgow coma scale

patients were assessed clinically at six and 12 weeks, at six months and then yearly thereafter.

The clinical details, the characteristics of the injury, associated injuries, details of treatment, complications and the length of hospital stay were collected from the records by two independent observers (JD, DR). The functional outcome was measured using the musculoskeletal function assessment (MFA)⁹⁻¹² and the 36-item short-form health survey (SF-36)¹³ questionnaires. The MFA is a validated 101-item self-administered health status instrument designed to detect differences in function after traumatic musculoskeletal injuries⁹⁻¹² and has been shown to perform well in patients with acetabular fractures.^{13,14} The score is calculated using the recommended algorithm and ranges from 0 to 100, with a lower score suggesting a better outcome.^{11,12} The SF-36 is a well-established and validated general-health status measurement^{15,16} used to elicit perception of disability, pain and emotional state and for which there are now Canadian normative values.¹⁷ If these were not returned within two weeks, at least two attempts were made to contact each patient by telephone. If any patients had moved, we attempted to locate them by contacting the last-known family physician and any relatives listed in the hospital records.

Two orthopaedic fellows, not involved in patient management and blinded to the outcome, reviewed the immediate post-operative radiographs and those at the final

follow-up. If there was uncertainty about a parameter, the reviewers sought the opinion of the senior co-author (GYL), who was also blinded to the identity of the patients. Pre-operative assessment of the fracture was made from anteroposterior, inlet/outlet, and Judet views along with CT scans if available. The pelvic fractures were classified according to Tile,¹⁸ the sacral fractures according to Denis, Davis and Comfort,¹⁹ and the acetabular fractures according to Letournel.²⁰ Post-operative films were reviewed for residual displacement of the fracture according to the classification of Matta and Merritt²¹ within two weeks of surgery, at one year and at the final follow-up. All articular displacement was considered, including step deformity. The final follow-up radiographs were used to assess the grade of osteoarthritis (OA), if present, using the method of Kellgren and Lawrence,²² the grade of heterotopic ossification according to Brooker et al²³ and the presence or absence of avascular necrosis (AVN).²⁰

Statistical analysis. This was performed using SPSS version 14.0 (SPSS Inc., Chicago, Illinois). Routine descriptive statistics were used to describe the clinical characteristics and the functional and radiological outcome. Bivariate comparisons were made using the Pearson chi-squared test for dichotomic data and continuous data means were analysed using Student's *t*-test. The MFA scores were compared with published population reference values.¹²⁻¹⁴ The mean standardised z-scores of the SF-36 were also compared with published reference values for the normal Canadian population.¹⁷ A *p*-value ≤ 0.05 was considered to be statistically significant. We also compared the functional outcome of the study group with that of other patients with pelvic injuries in our database, including those with type-B and type-C fractures (other group).

Results

The mean duration of follow-up was 4.2 years (2 to 6). Most patients had two or more pre-existing comorbidities. A motorised vehicle has been involved in 21 of the 30 cases (70%). The mean injury severity score²⁴ (ISS) was 28.9 (6 to 75) and 14 patients (46.7%) had an associated head injury, which was generally mild with a mean Glasgow coma scale²⁵ (GCS) of 13.2 (2 to 15). A total of 28 patients (93.3%) had considerable associated injuries, of whom seven (23.3%) had a musculoskeletal injury of a lower limb (Table I).

Most patients were treated conservatively with progressive weight-bearing after six weeks. Seven had mild discomfort in the affected groin. Posterior pain was a concern in 11 patients (36.7%), but only six considered this severe enough to need occasional analgesia.

Only three patients (10%) required surgery. Of these, two underwent ORIF of the pelvis and one an ilio-inguinal approach to address a grossly displaced fracture of the superior ramus with comminution of the anterior column. Fixation was achieved using pelvic reconstruction plates. No post-operative complications were observed. No

Table II. Details of the functional outcome in 18 patients with lateral compression/anterior column (LC/AC) fractures

Number of patients*	LC/AC	Other group	p-value
Number of patients	18	74	NA [†]
SF-36 [‡]			
Physical component summary	-1.89 (-5.03, 1.52)	-2.47 (-6.44, 0.89)	0.185
Mental component summary	-1.50 (-4.21, 0.12)	-0.56 (-5.28, 1.97)	0.008 [§]
Physical function	-2.12 (-5.16, 1.58)	-2.27 (-6.62, 0.61)	0.789
Role physical	-0.76 (-3.42, 0.95)	-1.16 (-3.42, 0.69)	0.312
Bodily pain	-1.16 (-2.58, 1.17)	-1.23 (-3.65, 1.16)	0.836
General health	-1.01 (-4.14, 0.93)	-1.01 (-4.70, 1.43)	0.885
Vitality	-1.34 (-3.83, 1.81)	-1.01 (-4.45, 1.66)	0.374
Social function	-1.46 (-4.39, 0.73)	-0.69 (-4.49, 0.85)	0.043 [§]
Role emotional	-1.24 (-4.01, 0.59)	-1.07 (-3.15, 0.63)	0.885
Mental health	-1.07 (-3.84, 1.50)	-0.63 (-5.20, 1.35)	0.345
MFA [¶]			
Overall	40.50 (1.00, 76.00)	35.77 (1.00, 82.00)	0.422
Mobility	51.40 (0.00, 90.00)	45.74 (0.00, 95.00)	0.446
Fine motor skills	23.80 (0.00, 71.43)	7.72 (0.00, 100.00)	0.003 [§]
Home	50.60 (0.00, 100.00)	42.00 (0.00, 100.00)	0.296
Activities of daily living	20.10 (0.00, 72.22)	18.10 (0.00, 94.44)	0.749
Sleep	49.10 (0.00, 100.00)	49.10 (0.00, 100.00)	0.998
Leisure	69.40 (0.00, 100.00)	59.10 (0.00, 100.00)	0.251
Relationships	32.80 (0.00, 100.00)	29.60 (0.00, 100.00)	0.662
Cognition	37.50 (0.00, 100.00)	29.10 (0.00, 100.00)	0.394
Emotional adjustment	42.93 (0.00, 88.89)	42.40 (0.00, 83.33)	0.941
Employment/work	54.20 (0.00, 100.00)	49.30 (0.00, 100.00)	0.692

* SF-36, short form 36; MFA, musculoskeletal function assessment

† NA, not available

‡ SF-36: normalized Z-scores are reported for the 8 domains and 2 summary scores; the Z-score value represents the number of SD above (positive values) or below (negative values) the age- and gender-matched normal population

§ statistically significant ($p < 0.05$)

¶ MFA, means with maximum and minimum values are reported

patient required delayed ORIF for loss of reduction of the fracture. No secondary procedures were needed.

Radiography of the pelvis showed that 93.3% (28 of 30) of the pelvic fractures had a maximum residual displacement within 10 mm. For the acetabular extension, the residual step-off was within 2 mm in all patients, with no loss of reduction or late displacement. The anterior column fracture was below the anteroinferior iliac spine, seen typically with high fractures of the superior pubic ramus. The roof arc was more than 45° in all fractures. Comminution was seen in six fractures (20%). There was no radiological evidence of OA, HO or AVN in any patient at the latest follow-up.

Of the 30 patients, 18 (60%) completed the SF-36 and MFA questionnaires at a minimum period of two years after injury. The mean overall MFA score (Table II) was not statistically different between the lateral compression/anterior column group and the other group. The former had a particularly good score for fine motor skills (mean 23.80; 0.0 to 71.4) which was statistically different from that of the other group (mean 7.72 (0.00 to 100.00, $p = 0.003$)). Functional deficits were noted for the mental

component summary score ($p = 0.008$) and in the social function domain ($p = 0.043$) of the SF-36 (Table II).

Discussion

The prognosis of lateral compression fractures is excellent with minimum long-term effects.^{2,26} When describing the prognosis of these injuries, few reports have used validated functional outcome tools. Gruen et al²⁷ used the sickness impact profile when describing the functional outcome after type-B and type-C fractures of the pelvic ring. Although their results did not reach statistical significance, type-B2 and type-B3 injuries had the least disability. The MFA and the SF-36 were used by Kreder²⁸ in a series of pelvic injuries with follow-up of two years. Type-B1 fractures had results comparable with those of type-C fractures. Our findings did not compare favourably with these.²⁸ In this study²⁸ the type-B2 subgroup obtained an overall MFA score of 29.9 compared with 40.50 in our lateral compression/anterior column group.

Steinitz et al⁷ undertook a retrospective study of all patients with fractures of the pubic ramus seen in a level-one trauma centre. Patients were grouped according to the site of

the fracture. The Harris hip score and MFA (short form) were used for assessment. Both scores indicated that patients with high fractures of the superior pubic ramus had significantly poorer function compared with those with fractures of the inferior ramus. Theoretically, extension of the high fracture into the acetabulum could lead to arthritis of the hip. However, our study does not support this presumption. Others have suggested a more aggressive approach in order to achieve a better outcome. Bellabarba, Ricci and Bolhofner²⁹ observed the results of the use of an external fixator in the treatment of displaced vertically stable lateral compression fractures and concluded that it was highly effective with the advantage of allowing early mobilisation.

No previous studies have used validated outcome instruments to measure function after lateral compression fractures with anterior column extension. Our study gives reference values for the use of the SF-36 and MFA in the evaluation of such patients. The follow-up MFA scores for our patients indicated that there was profound functional impairment compared with the population reference values reported by Martin et al⁹ ($p < 0.001$), suggesting that return to a pre-injury functional level is uncommon. The mean standardised z-scores of the SF-36 were significantly worse than those for the age- and gender-matched normal Canadian population ($p < 0.0001$).¹⁷

It is unclear why the mean mental component summary score of the SF-36 was worse for those in the lateral compression/anterior column group ($p = 0.008$). Patients with pelvic or acetabular fractures not requiring operative treatment may not see a specialist surgeon, are discharged sooner and typically are not followed as regularly as those who have had surgery. It is possible that they have questions or concerns which are never addressed. Previous research has suggested that patients with greater emotional or psychological distress are less likely to use active coping strategies, which include seeking social support and actively managing their medical condition.^{30,31}

It has been pointed out that 50% of adults with isolated orthopaedic limb injuries meet the diagnostic criteria for post-traumatic stress disorder.³² This incidence may be higher in polytraumatised patients. Other studies have shown an incidence of 45% of mental depression after orthopaedic injury³³ and Harris et al³⁴ demonstrated that chronic pain after a major motor-vehicle accident was predicted more by psychosocial than by physical factors. Similar studies have indicated that the initial psychological reaction is related to increased pain for up to two months after the fracture³⁵ and that psychological support has been shown to be efficient in improving symptoms.³⁶ Patients undergoing conservative treatment who receive less support may show higher psychological distress despite a lower severity of injury.

As in most observational studies, our study was limited by the possibility that the results were due to unmeasured variables. In addition, only 60% of the patients contributed to the assessment of functional outcome. If there was a

systematic loss to follow-up this could have led to an over- or underestimation of the functional deficit.

Extension of lateral compression fractures into the acetabulum did not induce degenerative arthritis at mid-term follow-up. However, this subgroup of patients had a high functional morbidity, including greater emotional and psychological distress. All patients, especially those treated conservatively, may benefit from a programme designed to enhance coping strategies. Future research regarding the type and intensity of the clinical care of all patients with pelvic injuries is needed if functional deficits are to be reduced.

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