



Is pubic ramus fracture a benign injury?

Hill et al.² performed an epidemiological study on 286 patients with a pubic rami fracture. This study included all age groups and mechanisms with a mean age of 74.7 years; a quarter of the patients suffered from dementia. Incidence was less than neck of femur fractures (25.6/100,000; 164.6/100,000)¹². Mortality was high in the first 3 months. Survival at 1 year (86.7%) was greater than patients suffering from neck of femur fractures; however, 5-year mortality (45.6%) was similar. They highlighted that dementia increased the mortality rate.

Koval et al.¹³ reviewed 63 patients aged over 55 years with pubic rami fractures. This paper is commonly cited by other sources, suggesting that rami fractures are relatively benign, as it concluded that 95% patients returned to their pre-fracture level of dependency and daily living activities. It highlighted that comorbid patients or those requiring aids for ambulation were likely to stay over the average duration of stay of 14 days. About 95% were discharged home with half requiring home care and physiotherapy. One-year mortality was 9.5%.

All 63 patients were community dwelling pre-operatively, suggesting a higher functioning cohort than other series. They included 11 undisplaced fractures, incidentally found on further imaging due to undiagnosed pain. The last patient was included in the study in December 1990, 6 years prior to publication in 1997. Recall bias maybe a factor, particularly in an elderly population alongside a low follow-up rate of only 60%. Their results are in contrast to a number of recent papers discussed below.

In a similar series, in which all patients were living in their home and 84% were fully independent pre-fall, a pubic ramus fracture resulted in greater short- and long-term morbidity¹⁴. Inpatient complications were 52.5% including urine infections, chest

infections and pressure sores. About 31% returned to their home on discharge and at a follow-up of 29 months, three quarter of the patients had returned to their home, whilst 60% required additional assistance with daily living activities. Mortality was 22%.

Taillandier et al.¹⁵ performed a retrospective case note review on 60 patients with pelvic insufficiency fractures. Mean duration of stay was reported to be 45 days, with an inpatient complication rate of 40%. About 25% became institutionalised as a result of the fracture, and 1-year mortality was 14.3%.

There is great variation in terms of which medical specialty manages low energy pelvic fractures in the elderly. As conservative management predominates, many recommend management under physicians once the orthopaedic decision for conservative management has been made because of the predominantly medical complication profile. The availability of rehabilitation units and community care will affect the duration of stay, inpatient complication rates and mortality. Morris et al.⁵ investigated 148 closed pelvic fracture inpatients aged >65 years admitted to medical or geriatric wards (mean age = 83 years). The series was almost exclusively following low energy mechanisms, with 123 confirmed falling from standing height and 24 did not remember. Only one was high energy following a road traffic accident. Mean duration of stay was 21.3 days. The fractures were not classified in detail, with 47.2% single rami fractures and 47.9% in combination with other pelvic fractures. Inpatient and 1-year mortality was 7.6% and 27%, respectively. Excluding the 10 patients who died and 10 already in a nursing home, 80% (26/128) dropped their level of care on discharge. At a mean follow up of 52.3 months, 41.5% of the 53 surviving patients required residential or nursing home care.

Rapp et al.¹⁶, in a retrospective cohort study, calculated mortality in

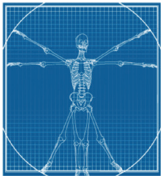
1154 pelvic fractures in nursing home residents exclusively and compared it to a matched non-fracture group of 5770. This study demonstrated that the mortality was high when compared with controls. The hazard risk ratio (HRR) was high in the first and second months when compared with the matched controls (1st month: HRR 1.83 in females and 2.95 in males, 2nd month: HRR 1.52 in females and 2.22 in males).

Similar findings were shown by Hill et al.² where there was no significant HRR compared with controls after 2 months. The mortality risk of pelvic fractures was approximately half the risk of proximal femur fractures in the matched populations. The authors attributed the higher risk of hip fractures to the physiological impact of surgery. The duration of inpatient stay was not included, but the authors noted that 26% died as inpatients. They suggested that mortality in this group, which included a high proportion of patients with multiple medical, physical and mental comorbidities, should focus on ensuring that they are receiving appropriate analgesia, physiotherapy and thromboprophylaxis within the nursing home environment.

In terms of considering the impact of intervention, outcome measures included the duration of stay in hospital, inpatient complications, social care level, use of mobility aids and mortality. In a low functioning cohort, the duration of acute hospital stay and mortality rate were the main outcome measures to be assessed, as morbidity and social care level are maximal.

Does fracture severity affect the outcome? Is the presence of posterior ring involvement worth identifying?

Mears et al.¹⁷ investigated 181 low energy elderly pelvic and sacral fractures with the aim of identifying whether fracture type affected the outcome. Outcomes were analysed relative to four groups: undisplaced



sacral insufficiency and undisplaced, displaced and bilateral displaced pubic rami fractures. The authors concluded that morbidity and mortality were similar regardless of displacement or fracture type and this has, in accordance with Koval et al.¹³, served to limit interest in considering aggressive management in certain fracture types and patients. However, detailed analysis of their results revealed higher odds ratios in the displaced fractures for likelihood of hospitalisation, complications and 1- and 2-year mortality. More support in living situation and ambulatory aids was required for all fracture types. The duration of stay in hospital (5.9 days) was shorter than that in other studies, and no information was available on whether the patients returned home or were discharged to rehabilitation facilities. About 26% patients had complications of immobility, and mortality at 30 days, 1 year and 2 years was 7%, 23% and 47%, respectively. The main weakness of the paper was that their primary aim was to compare mortality and morbidity with fracture classification, and no radiographic images were available for review but were classified using written radiology reports alone. The presence and extent of sacral involvement radiologically or by examination in either the undisplaced or displaced fractures was unknown.

Alnaib et al.⁶ prospectively investigated the association and outcomes between pubic rami fractures, sacral osteoporotic fractures and combination of both in 67 patients with low energy pelvic fractures (nine isolated sacral fractures and 58 pubic rami or in combination; 54.1% of pubic rami fractures included a sacral fracture). The likelihood of a sacral fracture was greater (60.6%) than an isolated rami fracture (39.4%) if two or more rami fractures were present. Magnetic resonance imaging (MRI) and bone scan were used to confirm sacral involvement, but they demonstrated that on clinical diagnosis alone, the presence

of low back pain showed a significant relationship. Mean duration of stay was 45 days, inpatient mortality was 10.4% and the proportion of patients returning to their home dropped from 89.6% to 53.7%. Only 9% were fully independent on discharge. Subgroup analysis revealed that the duration of stay was greater in combined (52.8 days) than in isolated (36.3 days) pubic rami fractures. The destination on discharge and mobility were not significantly different.

Van Dijk et al.¹⁸ highlighted that even when excluding pubic rami fractures with an associated sacral fracture, there was a high level of morbidity. About 20% of 99 patients had complications including urinary tract infections, pneumonia, cardiac failure and side effects of analgesia. Mean duration of stay was 10 days (range 2–57), with 33% requiring increased level of care after discharge. Mortality at 1, 5 and 10 years was 24.7%, 64.4% and 93.8%, respectively.

Scheyerer et al.¹⁹ highlighted that in a retrospective series of 233 pubic rami fractures, at least 73% had evidence of a posterior pelvic ring injury. Although this series was not exclusive to the elderly or low energy trauma patients, it included a greater proportion of female patients (56.5%; median age = 74 years). Unfortunately, there was no subgroup analysis of the elderly low energy group.

In a study by Cosker et al.²⁰, non-selective MRI scans of 50 consecutive elderly patients with pubic rami fractures demonstrated that 90% patients had an associated sacral fracture. Posterior pain remained in 93% patients at 5-month follow-up and 77% patients rated their pain as severe enough to limit their daily living activities.

Bruce et al.²¹ reviewed 117 lateral compression 1 (LC1) fractures, reporting that some subtypes of these typically stable fractures were unstable with displacement at follow-up, with 33% and 68% of complete sacral fractures with unilateral and bilateral rami displaced fractures, respectively.

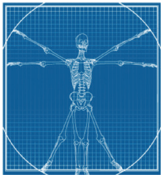
However, they did not show whether patients with displaced fractures had a worse clinical outcome than those with undisplaced fractures. However, in this case (unlike acetabular fractures), the outcomes of pelvic ring injuries were not shown to correlate with fracture displacement. This series comprised younger patients following high-energy mechanisms, and there were no comparable studies in elderly low energy fractures. However, it potentially highlights the spectrum within LC1 fractures and it maybe relevant to the elderly, particularly those who are mentally or physically unable to protect weight bearing.

Lefavre et al.²² similarly concluded that LC1 fractures represent a spectrum of injury, with 98% of rami fractures having an associated sacral fracture.

Operative versus non-operative

Two papers retrospectively analysed the outcomes of operative and conservatively managed patients.

Lau et al.²³ retrospectively compared 37 osteoporotic pubic rami fractures in an elderly population with a mean age 85 years. They noted that 57% of pubic rami fractures had additional posterior ring fractures. Three groups were classified: pubic rami alone (15), LC1 (13) and LC2 (9). They reported morbidity and mortality with an average follow-up of 1 year in both groups. Seven of the nine LC2 fractures were operatively managed; the remaining 30 were conservatively managed. Non-operative management included bed rest and those operatively managed underwent internal fixation with plates and/or screws. Specific surgical approach was not discussed. There was no difference in walking status at 3 months based on fracture classification (pubic rami 53%, LC1 62% and LC2 56%). The walking status deteriorated in all operatively managed and all but six conservatively managed patients at 1 year. Mortality at 1 year was less for operative than non-operative



management (operative 1/7, 14%; non-operative 8/30, 26.7%); however, sample sizes were too small to be significant. All mortalities were between 3 months and 1 year. Overall, they concluded that functional outcome was not affected by the involvement of the posterior pelvic ring but that it should be managed operatively if they are unstable or reduce pain.

Dechert et al.²⁴ retrospectively reported on 157 pelvic fractures admitted to a Level 1 trauma centre in patients with a minimum age of 65 years (mean = 75.7 years). Outcomes were compared against their series of pelvic fractures aged under 65 years and a matched control of over 65 years with blunt trauma without fracture. The mechanism was low energy falls in 30% patients; the remainder were high energy. One hundred and thirty-seven patients were non-operatively managed, with bed rest alone. No further details on duration of bed rest or other movement restrictions, such as traction, were included. The authors demonstrated that 75% patients required increased levels of care as a result of their injury. They did not clarify whether this pertained to purely non-operatively managed patients or their operatively managed cohort too. Overall mortality was 22.3% (31/139) and 5.5% (1/18) in the non-operative versus operative group, respectively. Eighteen patients were operatively managed, but no details on surgical procedure or the approach used were described. The authors did not describe the indication for operative management, patient fitness for surgery, specific patient comorbidities, fracture classification or fracture stability. The authors concluded that elderly patients, irrespective of treatment, have worse outcomes and poorer functional outcomes following pelvic fractures than younger patients and elderly patients without pelvic fractures. Unfortunately, outcomes were not analysed by mechanism or fracture type; therefore, it is difficult to make any specific

conclusions regarding the fragility fractures in a series with a relatively high proportion of high energy injuries than other series.

Operative management

The evidence on surgical stabilization is predominantly limited to small retrospective case series with no controls. There is some controversy, but most authors regard pubic rami fractures even in the presence of sacral impaction following low energy falls in the elderly to be classified as stable type A or LC1 fractures.

Tosounidis et al.²⁵ investigated 183 pelvic fractures in the elderly and identified seven rotationally unstable fractures on computed tomography (CT) scanning initially treated as stable type A fractures. An anterior external fixator was advocated on these seven patients for an average of 3 weeks with an associated improvement in the outcome score.

Tsiridis et al.²⁶ published a case series of three patients with sacral insufficiency fractures treated with percutaneous sacroiliac screws, resulting in immediate pain relief, uncomplicated rehabilitation and uneventful healing.

Vanderschot et al.²⁷ published a significant reduction in pain and early discharge in 17 patients who had trans-sacral iliac screws for chronic sacral insufficiency fractures, of which 12 patients had osteoporosis.

Starr et al.²⁸ highlighted from a series of 108 surgically-repaired rami fractures that loss of reduction was common in the elderly and female patients intrinsically linked to the osteoporotic bone. They found that anterior column screws were most likely to fail in medial fractures closer to the pubic symphysis.

Analogous to stable vertebral body fractures in the elderly, there are limited studies on percutaneous sacroplasty for sacral insufficiency fractures. A prospective observational cohort study of 52 patients with a mean age of 75.9 years underwent sacroplasty²⁹. A significant reduction

in pain was immediately reported along with 80% reduction in visual analogue pain score at 2 weeks and 90% in 1 year from pre-procedure score. Reduced opiate requirements were also noted.

There have been a number of similar retrospective case series using fluoroscopy or CT guidance to perform sacroplasty in sacral insufficiency fractures³⁰⁻³⁴. They all report improved pain score, improved mobility and early discharge. All patients had attempted conservative management, but due to persisting pain, the procedure was performed.

Both percutaneous sacroplasty and insertion of sacroiliac screws carry the risk of neurovascular injury. In the severely osteoporotic bone, tactile feedback and poor hold may limit their effectiveness. In contrast to inserting bone cement, screw fixation facilitates primary bone healing, where as injecting cement can impair fracture healing. There is a risk of cement extrusion into the foramina and injury to nerve roots from either heat or space occupation. Ideal cement viscosity is currently based on vertebroplasty results. The role in acute fractures is not fully known, and potentially, the risk of cement extrusion is greater.

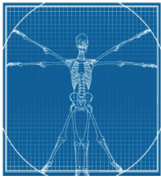
To date, there are no randomised comparative studies comparing operative to conservative management in fragility fractures of the pelvis.

Discussion

Differences in healthcare systems, rehabilitative provision, social support and among hospitals make comparisons between retrospective studies difficult, particularly in the absence of controls.

By excluding high energy and younger patients, this review highlights that there is great heterogeneity in low energy pelvic fractures in the elderly.

Historically, surgery has only been advocated in unstable pelvic ring injuries throughout all age groups. By comparison, proximal femoral



fractures in the elderly carry very strong evidence that early operative management is extremely beneficial¹².

Stability and pain are intrinsically linked. Mental function and pre-operative morbidity are key indicators of greater morbidity and mortality. In younger patients, LC1 fractures can be conservatively managed because they routinely possess the mental and physical ability to follow commands and non-weight bearing on the unaffected side with or without aids. Typically, patients lacking the cognitive function to understand the cause of pain will not mobilise, and thereby, they risk the consequences of immobility. Early mortality in most studies appears to occur during the initial period when fractures are painful.

Before considering a randomised trial for internally stabilising low energy pelvic fractures in the elderly, it is appreciated that there is a spectrum of disease and that these may need to be separately classified. One suggestion is sub-classification of LC1 fractures with increasing severity into the following categories:

- I Undisplaced rami only (no posterior fracture)
- II Displaced rami only
- III Rami fractures with anterior sacral impaction or posterior avulsion
- IV Rami fractures with an associated sacral fracture that exits posteriorly

In order to identify those with sacral involvement, considering surgical management would routinely require a CT scan. NICE guidelines recommend the role of limited MRIs to rule out hip fracture, but continued pain and inability to mobilise with negative hip imaging is often a result of rami fractures with or without a missed posterior pelvic ring injury.

Surgical intervention would allow full weight bearing, and there is an expectation that pain relief gained by fixation would support early mobilisation versus the anaesthetic risk and complications of surgery itself.

Conclusion

As shown by the national hip fracture database, improved morbidity and mortality is multifactorial, and appropriate surgery is a small part of patient management. These patients should ideally be managed by a combined ortho-geriatrician service. Patient selection may not be solely based on initial diagnosis but the ability to mobilise relative to pain control over the first few days. Review by the orthopaedic team may warrant further imaging and reassess any decision for conservative management in patients with severe pain and immobility.

Performing randomised controlled trials to develop evidence-based protocols can reduce the morbidity and mortality in the elderly with fragility fractures of the pelvis.

References

1. Krappinger D, Struve P, Schmid R, Kroesslhuber J, Blauth M. Fractures of the pubic rami: a retrospective review of 534 cases. *Arch Orthop Trauma Surg.* 2009 Dec;129(12):1685–90.
2. Hill RM, Robinson CM, Keating JF. Fractures of the pubic rami. *Epidemiology and five-year survival.* *J Bone Joint Surg Br.* 2001 Nov;83(8):1141–4.
3. Kannus P, Palvanen M, Niemi S, Parkkari J, Jarvinen M. Epidemiology of osteoporotic pelvic fractures in elderly people in Finland: sharp increase in 1970–1997 and alarming projections for the new millennium. *Osteoporos Int.* 2000;11(5):443–8.
4. Boufous S, Finch C, Lord S, Close J. The increasing burden of pelvic fractures in older people, New South Wales, Australia. *Injury.* 2005 Nov;36(11):1323–9.
5. Morris RO, Sonibare A, Green DJ, Masud T. Closed pelvic fractures: characteristics and outcomes in older patients admitted to medical and geriatric wards. *Postgrad Med J.* 2000 Oct;76(900):646–50.
6. Alnaib M, Waters S, Shanshal Y, Caplan N, Jones S, St Clair Gibson A, et al. Combined pubic rami and sacral osteoporotic fractures: a prospective study. *J Orthop Traumatol.* 2012 Jun;13(2):97–103.

J fractures: a prospective study. *J Orthop Traumatol.* 2012 Jun;13(2):97–103.

7. Ooi LH, Wong TH, Toh CL, Wong HP. Hip fractures in nonagenarians – a study on operative and non-operative management. *Injury.* 2005 Jan;36(1):142–7.
8. Sherk HH, Snape WJ, Loprete FL. Internal fixation versus nontreatment of hip fractures in senile patients. *Clin Orthop Relat Res.* 1979 Jun(141):196–8.
9. The care of patients with fragility fracture. The British Orthopaedic Association; 2007.
10. Falls and Fractures. Effective interventions in health and social care. Department of Health; 2009.
11. The National Hip Fracture Database. [cited 2013 Jan 5]. Available from: www.nhfd.co.uk/.
12. Hip Fracture. CG124. National Institute for Health and Clinical Excellence; 2011.
13. Koval KJ, Aharonoff GB, Schwartz MC, Alpert S, Cohen G, McShinaw A, et al. Pubic rami fracture: a benign pelvic injury? *J Orthop Trauma.* 1997 Jan;11(1):7–9.
14. Breuil V, Roux CH, Testa J, Albert C, Chassang M, Brocq O, et al. Outcome of osteoporotic pelvic fractures: an underestimated severity. Survey of 60 cases. *Joint Bone Spine.* 2008 Oct;75(5):585–8.
15. Taillandier J, Langue F, Alemanni M, Taillandier-Heriche E. Mortality and functional outcomes of pelvic insufficiency fractures in older patients. *Joint Bone Spine.* 2003 Aug;70(4):287–9.
16. Rapp K, Cameron ID, Kurrle S, Klenk J, Kleiner A, Heinrich S, et al. Excess mortality after pelvic fractures in institutionalized older people. *Osteoporos Int.* 2010 Nov;21(11):1835–9.
17. Mears SC, Berry DJ. Outcomes of displaced and nondisplaced pelvic and sacral fractures in elderly adults. *J Am Geriatr Soc.* 2011 Jul;59(7):1309–12.
18. van Dijk WA, Poeze M, van Helden SH, Brink PR, Verbruggen JP. Ten-year mortality among hospitalised patients with fractures of the pubic rami. *Injury.* 2010 Apr;41(4):411–4.
19. Scheyerer MJ, Osterhoff G, Wehrle S, Wanner GA, Simmen HP, Werner CM. Detection of posterior pelvic injuries in fractures of the pubic rami. *Injury.* 2012 Aug;43(8):1326–9.
20. Cosker TD, Ghandour A, Gupta SK, Tayton KJ. Pelvic ramus fractures in the elderly: 50 patients studied with MRI. *Acta Orthop.* 2005 Aug 76(4):513–6.

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21. Bruce B, Reilly M, Sims S. OTA highlight paper predicting future displacement of nonoperatively managed lateral compression sacral fractures: can it be done? *J Orthop Trauma*. 2011 Sep;25(9):523–7.
22. Lefavre KA, Padalecki JR, Starr AJ. What constitutes a Young and Burgess lateral compression-I (OTA 61-B2) pelvic ring disruption? A description of computed tomography-based fracture anatomy and associated injuries. *J Orthop Trauma*. 2009 Jan;23(1):16–21.
23. Lau TW, Leung F. Occult posterior pelvic ring fractures in elderly patients with osteoporotic pubic rami fractures. *J Orthop Surg (Hong Kong)*. 2010 Aug;18(2):153–7.
24. Dechert TA, Duane TM, Frykberg BP, Aboutanos MB, Malhotra AK, Ivatury RR. Elderly patients with pelvic fracture: interventions and outcomes. *Am Surg*. 2009 Apr;75(4):291–5.
25. Tosounidis G, Wirbel R, Culemann U, Pohlemann T. Misinterpretation of anterior pelvic ring fractures in the elderly. *Unfallchirurg*. 2006 Aug;109(8):678–80.
26. Tsiridis E, Upadhyay N, Gamie Z, Giannoudis PV. Percutaneous screw fixation for sacral insufficiency fractures: a review of three cases. *J Bone Joint Surg Br*. 2007 Dec;89(12):1650–3.
27. Vanderschot P, Koppers M, Sermon A, Lateur L. Trans-iliac-sacral-iliac-bar procedure to treat insufficiency fractures of the sacrum. *Indian J Orthop*. 2009 Jul;43(3):245–52.
28. Starr AJ, Nakatani T, Reinert CM, Cederberg K. Superior pubic ramus fractures fixed with percutaneous screws: what predicts fixation failure? *J Orthop Trauma*. 2008 Feb;22(2):81–7.
29. Frey ME, Depalma MJ, Cifu DX, Bhagia SM, Carne W, Daitch JS. Percutaneous sacroplasty for osteoporotic sacral insufficiency fractures: a prospective, multicenter, observational pilot study. *Spine J*. 2008 Mar–Apr;8(2):367–73.
30. Sciubba DM, Wolinsky JP, Than KD, Gokaslan ZL, Witham TF, Murphy KP. CT fluoroscopically guided percutaneous placement of transiliosacral rod for sacral insufficiency fracture: case report and technique. *AJNR Am J Neuroradiol*. 2007 Sep;28(8):1451–4.
31. Kamel EM, Binaghi S, Guntern D, Mouhsine E, Schnyder P, Theumann N. Outcome of long-axis percutaneous sacroplasty for the treatment of sacral insufficiency fractures. *Eur Radiol*. 2009 Dec;19(12):3002–7.
32. Heron J, Connell DA, James SL. CT-guided sacroplasty for the treatment of sacral insufficiency fractures. *Clin Radiol*. 2007 Nov;62(11):1094–100.
33. Brook AL, Mirsky DM, Bello JA. Computerized tomography guided sacroplasty: a practical treatment for sacral insufficiency fracture: case report. *Spine (Phila Pa 1976)*. 2005 Aug 1;30(15):E450–4.
34. Douis H, James SL. CT-guided sacroplasty for the treatment of zone II sacral insufficiency fractures. *Clin Radiol*. 2009 Oct;64(10):1037–40.