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What interventions add value in lateral compression type 1 fragility pelvis fractures? A retrospective cohort study

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Abstract

Introduction: Fragility fractures are a large source of morbidity and mortality in the elderly. Orthopaedic surgeons are regularly the main point of contact in patients with lateral compression type 1 pelvis fractures, despite many of these being treated non-operatively. This study aims to identify risk factors for mortality and elucidate which follow-up visits have the potential to improve care for these patients.

Methods and materials: In all, 211 patients have been identified with fragility lateral compression type 1 fractures at a level 1 trauma centre over a 5-year period. For all patients, we recorded patient demographics, imaging data, hospital readmissions, medical complications and death dates if applicable.

Results: Of the 211 patients identified, 56.4% had at least one orthopaedic follow-up, of which no patient had a clinically meaningful medical intervention initiated. 30-day readmission rate was 19%, and 1-year mortality was 24%. Male sex, need for an assist device, higher Charlson Comorbidity Index and increased age were found to be statistically associated with increased risk of mortality. Patients who followed up with their primary care physician were found to have a statistically lower risk of mortality. Computed tomography scans were obtained in 70% of patients and never limited patient weight-bearing status or found any additional injury not already identified on the radiograph.

Discussion/Conclusions: For patients with lateral compression type 1 type fragility fractures, orthopaedic surgeons did not offer additional clinically meaningful intervention after the time of initial diagnosis in this patient cohort. The rate of clinical follow-up with a primary care physician is relatively low despite high rates of medical comorbidity. Computed tomography scans were utilised frequently but did not change recommendations. The high rate of medical complications and lack of orthopaedic intervention suggest that we should re-evaluate the role of the orthopaedic surgeon versus the primary care physician as the primary point of medical contact for patients with these injuries.

Keywords

Orthopaedics, rehabilitation, occupational therapy, lateral compression type 1, fragility fracture, trauma

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Introduction

Fragility fractures are common, with an estimated 2 million osteoporotic fractures occurring each year.[1] Patients over the age of 85 are at the highest risk of fragility fracture and it is estimated that the population will increase from 5.5 million to over 19 million by the year 2050.[2,3] While hip fractures are the most well-known fragility fracture and have been extensively studied regarding risk factors, mortality, and treatment options,[2–5] management pathways for fragility fractures of the pelvic ring are less well described.

The most common pattern in elderly patients is the lateral compression type 1 (LC-1) impaction fracture of the sacral ala, which typically results from a low-energy fall from

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standing height.[6–8] The standard of care for LC-1 pelvic fractures is typically non-surgical with emphasis on early mobilisation as allowed by pain unless they are felt to be mechanically unstable.[7,9,10] Despite the emphasis on early ambulation, the pain of these injuries can significantly impact a patient's mobility,[11] and many patients report never returning to the same level of pre-injury independence.[6,7,12] Mortality rates for LC-1 fractures have been reported anywhere from 5.1% to as high as 24%.[7,11,13–17]

Given the growing elderly population, the incidence of these injuries is likely to increase. Therefore, there is a need to understand the mortality, associated risk factors, and follow-up logistics in patients with LC-1 fragility fractures to identify which interventions add the most value to patients. The primary aim of this study is to identify risk factors for readmission and mortality in patients with fragility LC-1 fractures and evaluate which follow-up visits are likely to result in changes to patient care. We hypothesise that many of these patients will be medically complex and at high risk for morbidity and mortality and that post-injury medical management may benefit these patients.

Methods and materials

This retrospective, observational cohort study was conducted using patient data from a single level 1 trauma centre over a 5-year period (January 2015–December 2019). Institutional review board approval was obtained from our home institution (University of Massachusetts, Worcester) prior to the initiation of this study (H00020991). Patient consent was waived by IRB approval due to the retrospective nature of this study. Patients were identified from an internally maintained trauma database using OTA/AO type 61-B2 as defined by the OTA/AO Fracture and Dislocation Compendium.[18] From this cohort, inclusion criteria included all patients at least 50 years of age, with available radiographic imaging, and low-energy mechanisms of injury (defined as fall from standing or fall from less than 5 feet). Due to the normal strength of pelvic and long bones, fractures of the pelvis from this low-energy mechanism are commonly accepted as a fragility fracture in practice and used with this definition in our study. Fractures were classified by review of the plain radiographs (AP pelvis, inlet and outlet views), and CT scans, when available. Fractures that had SI widening, a crescent/iliac wing component (LC-2), or included anterior–posterior compression or vertical sheer components were excluded. Patients with pelvis fractures from high energy mechanisms (i.e. motor vehicle crashes, pedestrian strikes, falls from 5 feet or more) were also excluded. Power analysis for this study and expected differences had us requiring 200 patients for this study.

Information was extracted from the chart regarding patient demographics (age, sex, medical comorbidities, ambulatory status), injury factors, treatment, follow-up, and mortality. Medical comorbidities were measured using the Charlson Comorbidity Index (CCI) as defined by the National Cancer Institute.[19] Any admissions to the hospital system after the injury were identified, and the reasons for admissions were recorded.

The impact of orthopaedic follow-up was assessed via a review of the outpatient documentation. In the outpatient clinic, decisions were assessed to affect patient management if they involved a change in weight-bearing status to anything other than weight bearing as tolerated, prescription of any medication or recommendation of any activity modification beyond 'as tolerated without restrictions'. All patients were scheduled for orthopaedic follow-up prior to discharge and received written documentation on their injuries and precautions. All patients were verbally instructed to set up an appointment with their primary care provider, which was also placed in written instructions on discharge from the emergency department. If admitted, patients would have both orthopaedic and primary care follow-ups established on discharge. Any follow-up with their primary care provider was also recorded. Our electronic medical record allowed the identification of primary care visits both within our system and through neighbouring health networks, minimising the chances of under-recording primary care visits.

Survival following the fracture was recorded at 30 days, 3 months and 1 year. Patient mortality was first assessed using the electronic medical record. If the patient was listed as not deceased in the electronic medical record and had recent documented contact that occurred beyond 1 year from injury, they were recorded as alive. If the patient was recorded as deceased in the electronic medical record and a date of death was documented, the patient was marked as deceased, and their date of death was recorded. If a patient was not listed as deceased in the electronic medical record and there was no recent follow-up, an internet search for their obituary was attempted. If the appropriate obituary was found, the date of death was recorded, and the patient was marked as deceased.

Imaging

Injury and follow-up Anterior-Posterior (AP), inlet, and outlet radiographs were assessed for stability using previously reported measurements of pelvic symmetry.[20] Iliac wing height difference, sacral height difference, ischial height difference and symphyseal width were measured on the AP radiograph. Sacral width difference and pelvic ring width difference were measured from inlet radiographs. The iliac wing height difference and ischial height difference were also measured on outlet radiographs. Changes in sacral height difference, sacral width difference and pelvic ring difference were calculated from the initial injury to the last follow-up images. Image measurements were performed by two orthopaedic trauma surgeons and the average of the two values was taken and performed on the same image software for equal calibration. No values were more than 5 mm different for each measurement.

Statistical analysis

Odds ratios were calculated for each of the documented factors to calculate whether there was a statistical impact on mortality. CCI was calculated both with and without age.

Two-tailed t-tests were performed on radiograph measurements immediately post-imaging and at the final follow-up to evaluate for changes in alignment. A p-value less than 0.05 was deemed to be significant.

Results

There were 598 patients over the age of 50 with pelvic ring injuries identified, of which 398 (65.1%) were LC-type patterns. Of those, 211 were low energy, LC-1 type pattern injuries based on radiographs and injury mechanisms. Patient demographics are shown in Table 1. The average age was 81.5 years at the time of injury. In all, 24 patients (11.4%) had a concomitant injury (Table 2), with proximal humerus being the most common. In total, 39 (18.5%) patients were re-hospitalised within 30 days and all of those readmissions were for chronic medical conditions, repeat falls or pain control (Table 3). No readmissions involved any orthopaedic intervention (i.e. surgery, procedures).

Of the 211 patients with low-energy LC-1 type pattern injuries, 147 (70.0%) underwent CT scans as part of the initial work-up in the emergency department. All of these were obtained by the emergency room physicians prior to orthopaedic consultation and not as part of the requested work-up by the orthopaedic consultant. Indications for obtaining a CT are provided in Appendix A. Of the 147 patients who received CTs, none had their weight-bearing status limited or had any additional injuries identified. 70.1% underwent CT without a clearly documented reason, and 22.4% had 'dementia' as the indication.

56.4% of patients had at least one orthopaedic follow-up appointment, with 55.6% having a follow-up of at least 3 months. Of the 119 patients who followed up at least once in our system (for a total of 212 visits to the orthopaedic clinic), there were no changes in management that occurred at any of these visits. Of the patients who had a documented primary care doctor within our medical system, 29.4% followed up with their primary doctor within 3 months of injury.

Of the 211 patients included in the study, we were able to obtain definitive proof of life (a documented encounter in our medical system) or of death (in a death date in our medical system or a published obituary) for 208 (98.6%) patients, leaving only three patients who were assumed to be alive without proof of continued follow-up or documented death. Mortality at 30 days, 3 months and 1 year was 7.1%, 10.9% and 24.2%, respectively. All patients recorded as dead were done so using death dates from the electronic medical record. Factors analysed between patients alive or deceased at 1 year are shown in Table 4. Patient demographic factors that were significantly associated with an increased risk of 1-year mortality were male sex, need for a pre-injury assist device for ambulation and CCI (both with and without age). Follow-up with primary care physicians within 3 months of injury was associated with a decreased risk of 1-year mortality (OR: 0.25, $p = 0.0027$). Living in a nursing facility pre-injury, having a concomitant injury, and 30-day

Table 1. Patient demographics and mortality rate.

Patient Demographics	Patient #	Percent (%)
Total	211	100
Gender		
Male	30	14
Female	181	86
Pre-injury assist device?		
Yes	130	62
No	81	38
Nursing home/assisted living?		
Yes	157	74
No	54	26
Cumulative mortality		
30 days	15	7
3 months	23	11
1 year	51	24

Table 2. Concomitant injuries.

Injury	Patients
Proximal humerus fracture	5
Distal radius fracture	4
Vertebral compression fracture	4
Greater trochanter fracture	3
Femoral neck fracture	2
Clavicle fracture	2
Olecranon fracture	1
Triquetral fracture	1
Coracoid fracture	1
Distal humerus fracture	1
Total	24

Table 3. Causes of re-hospitalisation within 30 days.

Reason	Patients
Repeat fall or syncope	10
Pain control/unable to perform activities of daily living	7
Chronic obstructive pulmonary disease exacerbation	4
Gastrointestinal bleed	5
Urinary tract infection	3
Heart failure exacerbation	2
Chest pain work-up	1
Acute kidney injury	1
Hyperglycaemia	1
Hyponatremia	1
IV drug use	1
Stroke	1
Cancer treatment	1
Conjunctival haemorrhage	1
Total	39

Table 4. Patient risk factors for 1-year mortality.

Risk factor	Died < 1 year from injury (%)	Survived > 1 year (%)	Odds ratio (95% CI)	*p*-Value
Male sex	**23.5%**	**11.3%**	**2.4 (1.1–5.5)**	**0.030**
Used assist device pre-injury	**84.3%**	**54.4%**	**4.5 (2.0–10.2)**	**<0.001**
Assisted living pre-injury	31.4%	23.8%	1.5 (0.7–2.9)	0.280
Re-hospitalised within 30 days	25.5%	15.6%	1.9 (0.9–4.2)	0.090
Concomitant injury	11.8%	10.6%	1.1 (0.4–3.0)	0.820
Had 3-month primary care follow-up	**11.8%**	**35.0%**	**0.3 (0.1–0.6)**	**0.003**
CCI comparison	Deceased at 1 year (avg score)	Alive at 1 year (avg score)		
CCI (no age)	**3.1**	**2.1**		**0.011**
CCI (age)	**6.8**	**5.5**		**0.001**

Statistical significant *p*-Values (<0.5) are bolded.

Table 5. Initial and final radiographic measurements.

Radiographic measurement	Injury measurement (Avg mm ± SD)	Final measurement (Avg mm ± SD)	*p*-Value
Iliac wing height difference (AP)	1.93 (±2.82)	1.90 (±2.62)	0.930
Sacral height difference (AP)	2.30 (±1.86)	1.63 (±1.39)	0.003
Ischial height difference (AP)	1.82 (±2.54)	2.00 (±2.38)	0.600
Symphyseal width (AP)	4.18 (±1.48)	3.99 (±1.42)	0.330
Sacral width difference (Inlet)	2.60 (±2.09)	2.27 (±2.14)	0.260
Pelvic ring width difference (Inlet)	3.23 (±3.04)	3.53 (±3.57)	0.510
Iliac wing height difference (Outlet)	1.91 (±2.80)	1.61 (±2.68)	0.430
Ischial height difference (Outlet)	2.71 (±3.15)	2.90 (±3.21)	0.670

re-hospitalisation were not found to be associated with an increased risk of 1-year mortality.

Radiographic parameters are shown in Table 5. Other than a slight improvement in sacral height asymmetry, there were no statistically significant changes between initial and final radiographic measurements.

Discussion

From a strictly orthopaedic standpoint, all the patients in our cohort were treated with closed management for their LC-1 fracture. No patients required surgery, and there was no loss of reduction or instability seen in follow-up radiographs.

However, from a medical perspective, readmission and mortality for these patients were still quite high (18% readmission at 30 days, 24% 1-year mortality). In our cohort, this increased medical complication rate appears to largely be related to patients' medical comorbidities and impaired ambulation. This is best illustrated by the increased risk of 1-year mortality with increased CCI, and correlation with the need for an assist device for ambulation pre-injury. Of note, the degree to which patients were aware of their pre-existing diminished life expectancy is unclear due to the retrospective nature of this study and would merit investigation in future research. It is important to highlight that we found this as a correlation, not necessarily a cause of their mortality. We feel that similarly to studies that have found similar risk factors for fragility hip fracture patients, it is not necessarily the limited mobility or medical complexity itself that is causing the increased mortality but it is acting as an overall marker of frailty in this population.

Despite the medical complexity of some of these patients, many do not follow up with their primary care physicians after this injury, which was the only modifiable factor found to be associated with improved 1-year mortality. While the exact reason is not able to be concluded from our retrospective study, we feel the fact that an LC-1 injury is perceived as a bony injury, and therefore an orthopaedic issue probably plays a large role.

By contrast, fragility hip fractures have undergone a perspective shift recently such that the injury is not seen as just a simple fracture but rather as a global metabolic insult and an indicator of medical frailty. In that context, many major centres have converged on a model of medical co-management teams for these patients for inpatient needs and for establishing osteoporotic management in the inpatient and outpatient settings. In our system, osteoporosis management after hip fractures is managed cooperatively with the endocrine team, with screening laboratories and vitamin D/calcium supplementation being administered while inpatient and osteoporotic treatment being administered as an outpatient after stabilisation and treatment of their hip fracture.

There are multiple ways of osteoporosis management of patients with fragility fractures in different healthcare systems but it is now standard of care that this is addressed in this population in conjunction with the orthopaedist specialist, if not solely by them.

Although our cohort of LC-1 injuries did not frequently require prolonged hospitalisation and none underwent surgical management, viewing fragility LC-1 injuries through this lens may help us refocus our perspective on how these patients might be better managed in the outpatient setting. In that context, a visit to an orthopaedic surgeon rarely changes operative management, as no orthopaedic surgical interventions were performed in this cohort. However, there may be an opportunity for a patient's primary care team in conjunction with orthopaedics to meaningfully intervene by addressing decompensated medical problems, helping to improve safety at home and managing the long-term consequences to the patient of their change in health, all of which have potential to be high-value interventions from a patient perspective. A crucial component of these efforts must be to educate patients on the underlying metabolic processes at play and to ensure they understand that they are at risk for additional insufficiency fractures. It is important to note that we still think that orthopaedic follow-up is appropriate and necessary but that the focus of the visit may need to be more on fall prevention and osteoporotic optimisation instead of solely fracture healing and the need for surgery.

Due to the varied nature of the disposition for these LC1 injuries, it was not possible to utilise the established osteoporotic management pathway for hip fractures in all LC1 patients. For those who were discharged from the emergency department, counselling was given to patients/families in the emergency room setting but work-up and treatment were relegated to the outpatient setting. For those who were admitted, the pathway was utilised for some patients but others were discharged too quickly for them to be seen by endocrine due to the unpredictable discharge timing of LC1 injuries compared to the more standard post-operative protocols around hip fractures. Our system is now making changes to better capture fragility fractures with less predictable dispositions to ensure capture for osteoporotic management but this is still a continued area of improvement. Our system can also be better optimised by standardising patient education and establishing opportunities for long-term follow-up care either internally or with outside providers.

Due to the retrospective nature of this study, it was difficult to ascertain what role primary care physicians had on a granular level for the patients in our cohort. For many, their follow-up was less for this specific injury but appeared to be for their underlying medical complexities as seen by their high CCI, as well as fall-risk modifications. This would be of importance to look at in our patients prospectively and is currently under investigation at our institution to better identify the benefit that was seen statistically in our study.

It is worth noting that with a predominantly nonoperative management strategy, some patients were represented with issues related to pain management following their injury (7/211 patients). This may be an indicator that some patients continued to have issues with mobilisation and symptom management, which is sometimes given as an indication for surgical intervention in this population, although it is controversial. However, even in these cases, the patients ultimately went on to heal their fractures with acceptable alignment without operative intervention. Future research will need to continue to focus on generating evidence to identify which patients (if any) might benefit from early fixation for purposes of pain control and mobilisation and would benefit from a thorough assessment of how many patients possessed a complaint of pain prior to the traumatic event. Due to the retrospective nature of this study, we were unable to quantify how many patients had pain and the quality/type of pain they had.

CT scans were found to be highly utilised in the emergency room setting as part of the initial work-up by emergency room physicians. While some CT scans were obtained with clear indications, many were obtained as part of pan-scans or to further classify the LC-1 injury already identified on the radiograph. In this case series, no CT scan changed orthopaedic management, weight-bearing status or identified any additional bony injuries. In that light, pathways critically evaluating the use of CT scans in this patient population may add value by reducing healthcare costs, radiation exposure, and time in the emergency department associated with unnecessary scans.

There are several limitations to this study which should be considered when interpreting the findings. This is a retrospective study and bears the typical biases associated with that form of study, particularly limiting the ability to make causal associations (e.g. between primary care follow-up and mortality). Additionally, our method for estimating both mortality and primary care involvement is imperfect and may potentially underestimate both factors. In terms of mortality, the 1-year mortality rate of 24% is consistent with prior studies on this population and is comparable to that seen in fragility hip fractures.[21–24] As the average age of our cohort exceeds the average US life expectancy by 2 years, future research would benefit from the case–control study of a comparable cohort of individuals without pelvic fractures to better characterise the degree to which fracture compromises life expectancy and post-traumatic morbidity. This would assist in further characterising the limits of therapeutic intervention on clinical outcomes but still may be limited due to the advanced age and CCI of this population. Our study may also underestimate primary care involvement, although our observed rate of 30% 3-month primary care follow-up is roughly consistent with the involvement of primary care for other osteoporotic fragility fractures at our institution. Additionally, the lack of orthopaedic intervention in these patients may be a function of the care philosophy at our specific institution (though there are no specific policies to this effect) and other centres may be more aggressive in this population. However, we feel that this predominantly nonoperative pathway is in line with national norms and achieves acceptable radiographic results.

Additionally, this retrospective evaluation was performed at a Level-1 trauma centre for a clinical problem typically managed in a non-trauma setting, which may have affected results via lack of pre-existing familiarity with non-orthopaedic providers. This may have led to the high utilisation of unnecessary CTs that were obtained, as well as potentially altered discussions had around this injury with the patient and their families. Finally, our rate of long-term orthopaedic follow-up is relatively low (56% at 3 months). We feel this is more consistent with the notion that patients and families find little value in their orthopaedic follow-up rather than the concern that there may be significant musculoskeletal pathology that we are missing in our patients who do not follow up. Future research surveying patient perspectives is needed to better characterise this dynamic.

Conclusions

This study confirms findings from prior studies that LC-1 fragility injuries are a major source of morbidity and mortality. Orthopaedic surgeons who manage patients with fragility fractures bear the responsibility of educating patients about the underlying problem and their risk for further fractures, as well as ensuring that they are connected with appropriate follow-up for further therapeutic guidance. At the same time, when viewed through the lens of patient value, our data suggest that orthopaedic follow-up rarely offers meaningful operative intervention; instead, there may be greater opportunities for primary care physicians to manage the medical changes that inevitably accompany the loss of mobility and independence associated with these injuries, as well as treat the underlying comorbidities that predispose one to fracture. In that context, as a medical community, we may need to consider shifting our perspective on these injuries by focusing less on the fracture, and more on the loss of mobility and medical frailty that these common injuries represent.

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Author contributions

PBC was responsible for conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing of original draft, review, and editing of drafts and visualisation. VGM was responsible for investigation, resources, data curation, writing of original draft, and review and editing of drafts. AEC was responsible for investigation, resources, data curation, writing of original draft, and review and editing of drafts. EFS was responsible for conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing of original draft, review and editing of drafts, visualisation, and supervision.

Declaration of conflicting interests

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Ethics approval

Ethical approval for this study was obtained from the University of Massachusetts IRB (approved, # H00020991). This study was IRB approved and did not require patient consent given its purely retrospective nature.

Informed consent

Informed consent was not sought for the present study because *REASON* retrospective chart review and waived by home IRB.

Trial registration

Not applicable.

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Supplemental material

Supplemental material for this article is available online.

References

1. Singer A, Exuzides A, Spangler L, et al. Burden of illness for osteoporotic fractures compared with other serious diseases among postmenopausal women in the United States. *Mayo Clin Proc* 2015; 90: 53–62.
2. Friedman SM and Mendelson DA. Epidemiology of fragility fractures. *Clin Geriatr Med* 2014; 30: 175–181.
3. Holt G, Smith R, Duncan K, et al. Changes in population demographics and the future incidence of hip fracture. *Injury* 2009; 40: 722–726.
4. Center JR, Nguyen TV, Schneider D, et al. Mortality after all major types of osteoporotic fracture in men and women: an observational study. *Lancet* 1999; 353: 878–882.
5. Shortt NL and Robinson CM. Mortality after low-energy fractures in patients aged at least 45 years old. *J Orthop Trauma* 2005; 19: 396–400.
6. Andrich S, Haastert B, Neuhaus E, et al. Epidemiology of pelvic fractures in Germany: considerably high incidence rates among older people. *PLoS One* 2015; 10: e0139078.
7. Booth A, Ingoe HMA, Northgraves M, et al. Effectiveness of surgical fixation for lateral compression type one (LC-1) fragility fractures of the pelvis: a systematic review. *BMJ Open* 2019; 9: e024737.

8. Hill RM, Robinson CM and Keating JF. Fractures of the pubic rami. Epidemiology and five-year survival. *J Bone Joint Surg Br* 2001; 83: 1141–1144.
9. Krappinger D, Struve P, Schmid R, et al. Fractures of the pubic rami: a retrospective review of 534 cases. *Arch Orthop Trauma Surg* 2009; 129: 1685–1690.
10. Scheyerer MJ, Osterhoff G, Wehrle S, et al. Detection of posterior pelvic injuries in fractures of the pubic rami. *Injury* 2012; 43: 1326–1329.
11. Loggers SAI, Joosse P and Jan Ponsen K. Outcome of pubic rami fractures with or without concomitant involvement of the posterior ring in elderly patients. *Eur J Trauma Emerg Surg* 2019; 45: 1021–1029.
12. Taillandier J, Langue F, Alemanni M, et al. Mortality and functional outcomes of pelvic insufficiency fractures in older patients. *Joint Bone Spine* 2003; 70: 287–289.
13. Burgess AR, Eastridge BJ, Young JW, et al. Pelvic ring disruptions: effective classification system and treatment protocols. *J Trauma* 1990; 30: 848–856.
14. Höch A, Özkurtul O, Pieroh P, et al. Outcome and 2-year survival rate in elderly patients with lateral compression fractures of the pelvis. *Geriatr Orthop Surg Rehabil* 2017; 8: 3–9.
15. Manson T, O'Toole RV, Whitney A, et al. Young-Burgess classification of pelvic ring fractures: does it predict mortality, transfusion requirements, and non-orthopaedic injuries? *J Orthop Trauma* 2010; 24: 603–609.
16. Studer P, Suhm N, Zappe B, et al. Pubic rami fractures in the elderly – a neglected injury? *Swiss Med Wkly* 2013; 143: w13859.
17. Ting B, Zurakowski D, Herder L, et al. Preinjury ambulatory status is associated with 1-year mortality following lateral compression Type I fractures in the geriatric population older than 80 years. *J Trauma Acute Care Surg* 2014; 76: 1306–1309.
18. Meinberg E, Agel J, Roberts C, et al. Fracture and dislocation classification compendium–2018. *J Orthop Trauma* 2018; 32(1): S1–S170.
19. NCI Comorbidity Index Overview. National Cancer Institute Division of Cancer Control and Population Sciences, https://healthcaredelivery.cancer.gov/seermedicare/considerations/comorbidity.html (2023, 11 January 2023).
20. Gibbs S, Colcord M, Curtin P, et al. Nonoperative treatment of select LC-II pelvic ring injuries (OTA/AO 61B2.2) results in a low rate of radiographic displacement. *J Orthop Trauma* 2021; 36(1): 30–35.
21. Guzon-Illescas O, Perez Fernandez E, Crespí Villarias N, et al. Mortality after osteoporotic hip fracture: incidence, trends, and associated factors. *J Orthop Surg Res* 2019; 14: 203.
22. Huette P, Abou-Arab O, Djebara A-E, et al. Risk factors and mortality of patients undergoing hip fracture surgery: a one-year follow-up study. *Sci Rep* 2020; 10: 9607.
23. Kang H-Y, Yang K, Kim YN, et al. Incidence and mortality of hip fracture among the elderly population in South Korea: a population-based study using the national health insurance claims data. *BMC Public Health* 2010; 10: 230.
24. Morri M, Ambrosi E, Chiari P, et al. One-year mortality after hip fracture surgery and prognostic factors: a prospective cohort study. *Sci Rep* 2019; 9: 18718.