Risk factors influencing periprosthetic fracture and mortality in elderly patients following hemiarthroplasty with a cemented collarless polished taper stem for an intracapsular hip fracture

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Aims

The aims of this study were to evaluate the incidence of reoperation (all cause and specifically for periprosthetic femoral fracture (PFF)) and mortality, and associated risk factors, following a hemiarthroplasty incorporating a cemented collarless polished taper slip stem (PTS) for management of an intracapsular hip fracture.

Methods

This retrospective study included hip fracture patients aged 50 years and older treated with Exeter (PTS) bipolar hemiarthroplasty between 2019 and 2022. Patient demographics, place of domicile, fracture type, delirium status, American Society of Anesthesiologists (ASA) grade, length of stay, and mortality were collected. Reoperation and mortality were recorded up to a median follow-up of 29.5 months (interquartile range 12 to 51.4). Cox regression was performed to evaluate independent risk factors associated with reoperation and mortality.

Results

The cohort consisted of 1,619 patients with a mean age of 82.2 years (50 to 104), of whom 1,100 (67.9%) were female. In total, 29 patients (1.8%) underwent a reoperation; 12 patients (0.7%) sustained a PFF during the observation period (United Classification System (UCS)-A n = 2; UCS-B n = 5; UCS-C n = 5), of whom ten underwent surgical management. Perioperative delirium was independently associated with the occurrence of PFF (hazard ratio (HR) 5.92; p = 0.013) and surgery for UCS-B PFF (HR 21.7; p = 0.022). Neither all-cause reoperation nor PFF-related surgery was independently associated with mortality (HR 0.66; p = 0.217 and HR 0.38; p = 0.170, respectively). Perioperative delirium, male sex, older age, higher ASA grade, and pre-fracture residential status were independently associated with increased mortality risk following hemiarthroplasty (p < 0.001).

Conclusion

The cumulative incidence of PFF at four years was 1.1% in elderly patients following cemented PTS hemiarthroplasty for a hip fracture. Perioperative delirium was independently associated with a PFF. However, reoperation for PPF was not independently associated with patient mortality after adjusting for patient-specific factors.

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Take home message

- The cumulative incidence of periprosthetic femoral fracture (PFF) at four years was 1.1% in elderly patients following cemented polished taper stem hemiarthroplasty for a hip fracture.
- Perioperative delirium was independently associated with a PFF.
- Reoperation for PPF was not independently associated with patient mortality after adjusting for patient-specific factors.

Introduction

Hip arthroplasty is a widely accepted method for treating displaced intracapsular hip fractures in the elderly population. Although uncommon, periprosthetic femoral fracture (PFF) is a devastating complication that can occur following hip arthroplasty, and is associated with a one-year mortality of 11% following surgical treatment.[1] The surgical treatment of PFF is challenging regardless of whether fixation or revision arthroplasty is employed, as multiple aspects, including the fracture, aseptic loosening, bone defects, poor bone quality, and hip instability, must be managed within a single procedure.[2]

It is well established that cementless stems have a higher rate of PPF than cemented stems.[3] Cemented stems are often preferred over cementless in older patients with osteoporotic bone.[4,5] For hip fracture patients specifically, a recent multicentre randomized controlled trial of cemented versus cementless hemiarthroplasty demonstrated that cemented hemiarthroplasty resulted in a modestly but significantly better quality of life and a lower risk of periprosthetic fracture than uncemented stemmed hemiarthroplasty.[6] Among cemented stems there are two broad stem types that follow different biomechanical principles for achieving mechanical stability: 'taper-slip' or by 'composite beam' fixation.[7] The collarless polished tapered stems (PTS), employing 'taper-slip' fixation, are designed to allow the subsidence of stems inside the cement mantle to achieve even loading of the cement mantle and surrounding bone. In contrast, composite beam stems are designed to bond to the cement mantle with a rough surface.[8] After primary total hip arthroplasty incorporating a cemented stem, the risk of PPF has been shown to be consistently significantly higher in PTS stems than in composite beam stems.[9,10] This has led some surgeons to discourage the use of PTS stems in hip fracture patients due to concerns of PPF in patients who potentially have poor bone stock, and who have already sustained a fragility fracture. However, to the authors' knowledge, there is limited literature available regarding PFF risk following hemiarthroplasty with a cemented PTS stem for hip fracture.

The aims of this study were to evaluate the incidence of reoperation (for all causes and specifically for PFF) and mortality, and the associated risk factors thereof, when an Exeter (Stryker, USA) PTS stem was used as part of a hemiarthroplasty for a hip fracture.

Methods

This retrospective study included a consecutive series of patients aged 50 years or older who were admitted with a hip fracture to the study centre (Royal Infirmary of Edinburgh) over a 42-month period (1 January 2019 to 30 June 2022). The study centre is the only trauma unit serving a catchment population of approximately 900,000 and manages more than 1,000 hip fractures annually. The inclusion criteria were hip fracture patients treated with hemiarthroplasty. The hemiarthroplasty implant exclusively used in this study centre was a cemented Exeter stem with a bipolar head. The Exeter stem is a double-tapered shape combined with a highly polished surface, and collarless design facilitates the 'taper-slip' principle. Patients with concomitant fractures of the acetabulum, pubic ramus, and greater trochanter were excluded.

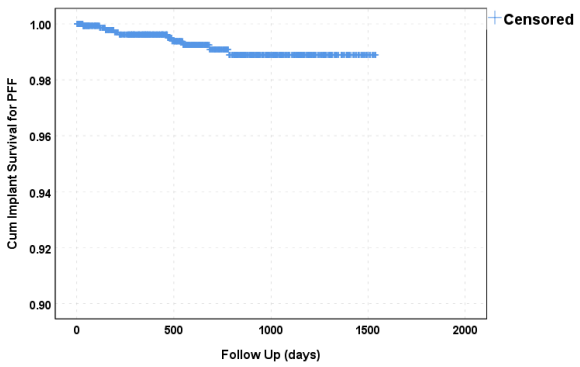

Fig. 1
Kaplan-Meier curve for implant survival for periprosthetic femoral fracture. There were ten revisions during the four years' observation period.

Patients were retrospectively identified from the local hip fracture database; their data were collected prospectively on a continuous basis for submission to the Scottish Hip Fracture Audit (SHFA) and was inclusive of all patients. Patient demographic details, place of domicile, fracture type, delirium status, American Society of Anesthesiologists (ASA) grade,[11] length of stay, and mortality was collected from the patients' e-health records and service documentation. The ASA grade was obtained from the anaesthetic notes, recorded at the time of surgery. These data were compiled by specialist local audit coordinators familiar with the clinical condition and the trauma unit. The data were collected and assessed for completeness by a senior researcher (NDC) as part of the routine activity of the SHFA. All data were handled in accordance with the UK Caldicott principles.[12]

The Scottish Index of Multiple Deprivation (SIMD) was used to assign the socioeconomic status of each patient with assessment of seven domains: current income, employment, health, education, skills and training, housing, geographical access, and crime.[13] The current study used the updated SIMD rankings published in 2020 to assign a patient to a quintile of local data zone deprivations (1 = most deprived to 5 = least deprived) according to their postcode at time of injury.

The four "A's" test (4AT) is used internationally as a validated clinical tool for detecting delirium.[14] A score of 4 or more is suggestive of delirium but is not diagnostic. The 4AT is assessed and recorded as part of the 'standard' of care for the SHFA in the emergency department (ED) and on the ward as a screening tool for perioperative delirium. Data submitted to the SHFA were used to assess the effect of ED waiting time on risk of delirium.

Table I. Patient characteristics undergoing hemiarthroplasty with cemented polished taper slip stem comparing those who sustained a postoperative periprosthetic femoral fracture and those who did not.

	Group			
Variable	**Non-operation without PFF (n = 1,588)**	**PFF (n = 12)**	**Difference/OR (95% CI)**	**p-value**
Sex, n (% of group)				
Male	513 (32.3)	5 (41.7)	Reference	
Female	1,075 (67.7)	7 (58.3)	0.67 (0.21 to 2.12)	0.540*
Mean age, yrs (SD)	82.3 (8.8)	81.3 (10.9)	-1.0 (-7.9 to 5.9)	0.756†
SIMD, n (% of group)				
1 (most)	166 (10.5)	1 (8.3)	1.05 (0.11 to 10.2)	1.000*
2	401 (25.3)	1 (8.3)	0.43 (0.05 to 4.2)	0.638*
3	243 (15.3)	2 (16.7)	1.43 (0.24 to 8.62)	0.655*
4	255 (16.1)	5 (41.7)	3.41 (0.81 to 14.5)	0.124*
5 (least)	523 (32.9)	3 (25)	Reference	
ASA grade, n (% of group)				
1	13 (0.8)	0	N/A	1.000*
2	298 (18.8)	5 (41.7)	2.57 (0.78 to 8.47)	0.152*
3	920 (57.9)	6 (50)	Reference	
4	157 (9.9)	0	N/A	0.601*
Missing	200 (12.6)	1 (8.3)	0.77 (0.09 to 6.40)	1.000*
Pre-fracture residence, n (% of group)				
Home	1,144 (72)	10 (83.3)	Reference	
Care home	299 (18.8)	0	N/A	0.230*
Hospital	83 (5.2)	1 (8.3)	1.37 (0.17 to 10.9)	0.540*
Rehab	30 (1.9)	1 (8.3)	3.81 (0.47 to 30.7)	0.254*
Other	32 (2)	0	N/A	1.000*
4AT, n (% of group)				
0 to 3	923 (58.1)	6 (50)	Reference	
4+	344 (21.7)	4 (33.3)	1.79 (0.50 to 6.38)	0.474*
Missing	321 (20.2)	2 (16.7)	0.96 (0.19 to 4.77)	1.000*
Mean LOS, days (SD)	12.2 (10.4)	12.6 (7.8)	0.36 (-4.61 to 5.33)	0.877†

*Chi-squared test.
†Independent-samples *t*-test.
ASA, American Society of Anesthesiologists; CI, confidence interval; LOS, length of stay; N/A, not applicable; OR, odds ratio; PFF, periprosthetic femoral fracture; SD, standard deviation; SIMD, Scottish Index of Multiple Deprivation.

Outcomes

Length of stay (LoS) was defined as the number of days spent as an inpatient on any service (including rehabilitation facilities) at our centre from the day of admission until eventual discharge or death. Patient mortality status was obtained from the local (study centre) hospital electronic records, which is the sole provider for national healthcare for the catchment population. All patient radiographs were assessed on the National (Scotland) Picture Archiving system (Kodak (USA) picture archiving and communication system on a liquid crystal display) for PFF and all-cause reoperation, in order that patients undergoing surgery or radiological investigations for any issues with hemiarthroplasty, both within and outside of the catchment area of the hospital, would be identified.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software v. 25 (IBM, USA). Descriptive statistics were used to describe the data. Parametric tests were used to assess continuous variables for significant differences between groups using an independent-samples *t*-test (age and LoS) to assess for differences. Dichotomous variables were assessed using a chi-squared test for between-group comparisons (sex, SIMD, ASA grade, pre-fracture residence, and delirium). Kaplan-Meier time-to-event methodology was used to assess reoperation for PFF and mortality rate in hip fracture patients following hemiarthroplasty. Log rank (Mantel-Cox) test was used to assess differences in reoperation for PFF and mortality rate between groups. Cox regression

Table II. Cox regression model for variables associated with periprosthetic femoral fracture following a hemiarthroplasty at four years.

Variable	HR	95% CI	p-value
Sex			
Male	Reference		
Female	0.53	0.16 to 1.73	0.289
Age	0.995	0.93 to 1.07	0.900
SIMD			
1 (most)	0.82	0.08 to 8.62	0.868
2	0.42	0.04 to 4.17	0.459
3	1.45	0.24 to 8.82	0.687
4	3.05	0.70 to 13.29	0.137
5 (least)	Reference		
ASA grade			
1	N/A		
2	1.89	0.52 to 6.82	0.332
3	Reference		
4	N/A		
Missing	0.43	0.02 to 8.41	0.579
Pre-fracture residence			
Home	Reference		
Care home	N/A		
Hospital	1.54	0.16 to 14.99	0.712
Rehab	3.33	0.36 to 30.44	0.287
Other	N/A		
4AT			
0 to 3	Reference		
4+	5.92	1.47 to 23.86	0.013
Missing	2.26	0.21 to 24.13	0.499
LOS	0.99	0.93 to 1.05	0.757

ASA, American Society of Anesthesiologists; CI, confidence interval; LOS, length of stay; N/A, not available; SIMD, Scottish Index of Multiple Deprivation.

analysis was used to assess the independent association of factors influencing reoperation for PFF and mortality when adjusting for confounding variables. A p-value ≤ 0.05 was defined as statistically significant.

Results

The study cohort consisted of 1,619 patients sustaining a hip fracture treated with hemiarthroplasty, of whom 519 (32.1%) were male and 1,100 (67.9%) female with an overall mean age of 82.2 years (standard deviation (SD) 8.8; 50 to 104). The median follow-up was 29.5 months (interquartile range (IQR) 12 to 51.4). During follow-up, 758 patients (46.8%) died: 30-day mortality of 90 (5.6%), and one-year mortality of 476 (29.4%).

A total of 12 patients (0.7%) sustained a PFF: two were Unified Classification System (UCS)-A; five UCS-B; and five UCS-C.

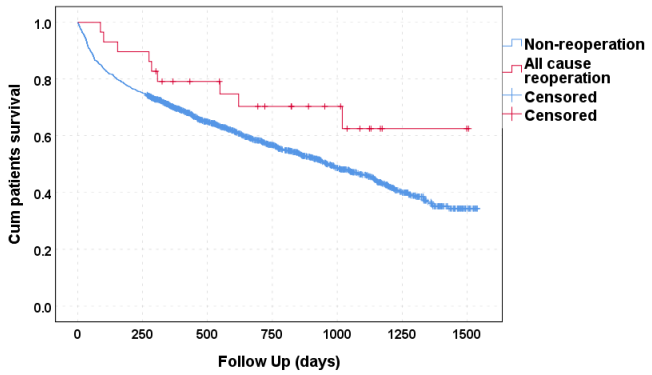

Fig. 2
Kaplan-Meier curve for patient survival between non-reoperation group and all-cause reoperation group (Mantel-Cox log-rank test 2.64, p = 0.104). Cum, cumulative.

Only UCS-B and C fractures underwent surgical treatment, which accounted for 0.6% of the cohort, with a median time to reoperation of 12 months (IQR 4.9 to 18.5). There were 29 patients (1.8%) who underwent reoperation: 25 for aseptic reasons (15 dislocations and ten PFFs); and four (0.25%) for septic reasons.

The cumulative PFF-related implant survival was 98.9% (95% confidence interval (CI) 98.1 to 99.7) at four years (Figure 1). There was no significant difference identified between patients with or without a PFF (Table I). However, after adjusting for confounding factors, the Cox regression model demonstrated that perioperative delirium was independently associated with the occurrence of PFF (hazard ratio (HR) 5.92; p = 0.013, Table II).

Subgroup analyses according to UCS were performed; all UCS-B fractures were in males (p = 0.004) whereas all UCS-C fractures were in females (p = 0.183). The Kaplan-Meier patient survival at four years between those who underwent reoperation after hemiarthoplasty for all causes compared to those who did not were 59.9% (95% CI 38.9 to 80.9) and 34.4% (95% CI 30.1 to 38.7), respectively (p = 0.104, log-rank; Figure 2). Neither all-cause reoperation nor PFF-related reoperation were independently associated with mortality (HR 0.66, p = 0.217 and HR 0.38, p = 0.170, respectively) when adjusting for confounding (Table III and Table IV). Male sex (HR 1.52; p < 0.001), older age (HR 1.04; p < 0.001), ASA grade 4 (HR 1.59; p < 0.001), residence in care home (HR 1.83; p < 0.001), hospital (HR 2.00; p < 0.001), and rehabilitation hospital (HR 1.78; p = 0.015), and perioperative delirium (HR 1.29; p = 0.020) were independently associated with an increased mortality risk.

Discussion

In this retrospective study of elderly patients, the cumulative incidence of PFF following cemented hemiarthroplasty using a PTS stem for a hip fracture was 1.1% at four years. The rate of PFF-related reoperation and all-cause reoperation was 0.6% and 1.8%, respectively. Perioperative delirium was independently associated with an increased risk of a UCS-B and C PFF. All patients with UCS- B fractures around the stem were male, whereas all patients with UCS-C fractures distal to the stem were female. Both all-cause reoperation and

Table III. Patient demographics, American Society of Anesthesiologists grade, place of residence, fracture type, delirium status according the 4AT, and length of stay according to survival and deceased group.

	Group			
Variable	**Survival** (n = 861)	**Deceased** (n = 758)	**Difference/OR** (95% CI)	p-value
Sex, n (% of group)				
Male	237 (27.5)	282 (37.2)	Reference	
Female	624 (72.5)	476 (62.8)	0.64 (0.52 to 0.79)	< 0.001*
Mean age, yrs (SD)	80.5 (8.9)	84.1 (8.3)	3.6 (2.8 to 4.5)	< 0.001†
All-cause reoperation, n (% of group)	20 (2.3)	9 (1.2)	0.51 (0.23 to 1.12)	0.086*
Reoperation for PFF, n (% of group)	8 (0.9)	2 (0.3)	0.28 (0.06 to 1.33)	0.115*
SIMD, n (% of group)				
1 (most)	93 (10.8)	76 (10)	0.81 (0.58 to 1.15)	0.229*
2	226 (26.2)	179 (23.6)	0.78 (0.6 to 1.02)	0.065*
3	143 (16.6)	105 (13.9)	0.73 (0.54 to 0.98)	0.039*
4	134 (15.6)	130 (17.2)	0.96 (0.71 to 1.29)	0.782*
5 (least)	265 (30.8)	268 (35.4)	Reference	
ASA grade, n (% of group)				
1	10 (1.2)	3 (0.4)	0.32 (0.09 to 1.18)	0.094*
2	240 (27.9)	67 (8.8)	0.30 (0.22 to 0.41)	< 0.001*
3	486 (56.4)	451 (59.5)	Reference	
4	53 (6.2)	105 (13.9)	2.14 (1.50 to 3.04)	< 0.001*
Missing	72 (8.4)	132 (17.4)	1.98 (1.44 to 2.71)	< 0.001*
Pre-fracture residence, n (% of group)				
Home	713 (82.8)	456 (60.2)	Reference	
Care home	94 (10.9)	207 (27.3)	3.44 (2.63 to 4.51)	< 0.001*
Hospital	28 (3.3)	58 (7.7)	3.24 (2.03 to 5.16)	< 0.001*
Rehab	12 (1.4)	19 (2.5)	2.48 (1.19 to 5.15)	0.012*
Other	14 (1.6)	18 (2.4)	2.01 (0.99 to 4.08)	0.049*
4AT, n (% of group)				
0 to 3	603 (70)	337 (44.5)	Reference	
4+	127 (14.8)	224 (29.6)	3.16 (2.45 to 4.07)	< 0.001*
Missing	131 (15.2)	197 (26)	2.69 (2.08 to 3.48)	< 0.001*
Mean LOS, days (SD)	12.2 (10.6)	12.4 (10.3)	0.18 (-0.84 to 1.21)	0.730†

*Chi-squared test.
†Independent-samples *t*-test.
ASA, American Society of Anesthesiologists; CI, confidence interval; LOS, length of stay; OR, odds ratio; PFF, periprosthetic femoral fracture; SD, standard deviation; SD, standard deviation; SIMD, Scottish Index of Multiple Deprivation.

PFF-related reoperation were not independently associated with an increased mortality rate.

There have been multiple studies assessing the incidence of PFF following THA using a PTS type stems. They have, however, reported considerable variability in the rate ranging from 0.12% to 9%, which may be due to differences in follow-up duration or differences between PTS stem types.[10,15,16] Regarding the Exeter stem specifically, the incidence of PPF after THA is variable across registry and cohort study data. Registry data have demonstrated a low absolute risk of fracture for the Exeter stem used in THA (0.66% of 22,271 Exeter stems),[9] though this is ten times the risk of a PPF observed with the Lubinus composite beam stem in a Swedish registry study of 65,910 primary THAs;[9] and twice that of the Charnley in a linked NJR study of 257,202 primary THAs.[10] Similarly, Thien et al[17] identified a five-times greater risk of PPF following THA with the Exeter stem compared to a Lubinus anatomical composite beam stem using data from the Nordic Arthroplasty register, but again the incidence remained low at 0.14% within two years. In contrast, cohort studies and case series have demonstrated higher incidences of PPF around Exeter stems in THA. Among a consecutive series of patients who underwent Exeter stem THA, there were no intraoperative femur fractures, but the cumulative incidence

Table IV. Cox regression model for variables associated with patients survival following Exeter stemmed hemiarthroplasty during observation period.

Variable	HR	95% CI	p-value
Sex			
Male	1.52	1.32 to 1.79	< 0.001
Female	Reference		
Age	1.04	1.03 to 1.05	< 0.001*
Reoperation for PFF	0.38	0.09 to 1.52	0.170
All-cause reoperation	0.66	0.34 to 1.28	0.217
SIMD			
1 (most)	1.04	0.80 to 1.36	0.747
2	0.90	0.74 to 1.09	0.262
3	0.95	0.76 to 1.20	0.682
4	1.09	0.88 to 1.36	0.419
5 (least)	Reference		
ASA grade			
1	0.26	0.06 to 1.03	0.054
2	0.45	0.35 to 0.59	< 0.001
3	Reference		
4	1.59	1.28 to 1.98	< 0.001
Missing	0.91	0.66 to 1.27	0.596
Pre-fracture residence			
Home	Reference		
Care home	1.83	1.48 to 2.25	< 0.001
Hospital	2.00	1.48 to 2.70	< 0.001
Rehab	1.78	1.12 to 2.84	0.015
Other	1.39	0.86 to 2.25	0.182
4AT			
0 to 3	Reference		
4+	1.29	1.04 to 1.59	0.020
Missing	1.09	0.81 to 1.46	0.576
LOS	1.003	0.997 to 1.01	0.278

Reoperation for PFF and all-cause reoperation were separately included in the Cox regression model along with the remaining risk factors. We presented the reoperation for PFF and all-cause reoperation together in a single table because there was almost no difference in the impact on the remaining risk factors in terms of HR and p-values.
*For each increase in year of age.
ASA, American Society of Anesthesiologists; CI, confidence interval; HR, hazard ratio; LOS, length of stay; PFF, periprosthetic femoral fracture; SIMD, Scottish Index of Multiple Deprivation.

of postoperative PFF 1.0% at two years, 2.1% at five years, and 6% at ten years.[18] Westerman et al[19] showed excellent long-term survivorship of the Exeter stem as part of THA, but a revision rate of 1.1% for PFF at ten years' follow-up. Registry data typically miss PFFs that undergo fixation, and therefore registries may underestimate the true incidence of PFF by only detecting those that are revised. As most UCS-B type fractures involving PTS stemmed can be safely treated with fixation,[20,21] this may be more significant for PTS stems. These figures apply only to THA and, to our knowledge, the incidence of PFF for hemiarthroplasty is not as widely reported.

Two previous studies have investigated PPF risk in different stem types after hemiarthoplasty for hip fracture. Using Norwegian hip fracture registry data, Kristensen et al[22] identified a one-year survival free from reoperation for Exeter stem hemiarthroplasties of 96% (95% CI 95.6 to 96.4) with a 0.4% (n = 40/11,245) incidence of PFF at one year. Using a prospective hip fracture database, Phillips et al[23] similarly identified a rate of PFF of 0.4% following Exeter hemiarthroplasty (three PFFs in 812 cases). The current study has demonstrated a cumulative incidence of PFF following Exeter stemmed hemiarthroplasty of 1.1% at four years.

It should be noted that PFF risk is not equivalent across different designs of PTS stem and is consistently highest in the CPT stem (Zimmer Biomet, USA). Among THAs, Palan et al[10] demonstrated that the CPT stem carried > three times the risk of PFF compared to the Exeter, and Kristensen et al[22] demonstrated that among hip fracture hemiarthroplasty patients, the CPT stem carried three times the risk of PFF compared to the Exeter. This stem has now been withdrawn, but cases will clearly remain in registries and will continue to influence results when grouped with other PTS stems.

Risk factors for PFF after THA have previously been investigated by Singh et al,[24] who showed that female sex, higher ASA grade, and uncemented implant were significantly associated with higher risk of PFF. More specifically, in a study of THA patients with cemented Exeter stems, Gausden et al[18] did not detect significant associations between potential risk factors and PFF. For hip fracture patients with Exeter stemmed hemiarthroplasty, the current study demonstrated that perioperative delirium was independently associated with PFF and reoperation for UCS-B and C PFF, which, to the authors' knowledge, is novel. Meyer et al[25] reported that all-cause reoperation rate within 90 days after THA and total knee arthroplasty for patients with postoperative delirium was two to three times higher than for patients without postoperative delirium. Patients with hyperactive delirium are more likely to fall.[26,27] It may therefore be expected that patients with delirium are particularly at risk of postoperative PFF.

Subgroup analyses revealed that all the UCS-B PFFs occurred in male patients, while all the UCS-C PFFs were observed in female patents. Females aged 50 years or older have a four-times higher rate of osteoporosis and a two-times higher rate of osteopenia compared with males,[28] potentially attributed to males having larger skeletal size and bone mass than females.[29] It could be argued that UCS-C PPFs remote from the stem may be more related to severe osteoporosis in elderly female patients than to stem design. An explanation for sex distribution in UCS-B and -C PFF following Exeter PTS hemiarthroplasty is supported by the recent study from Powell-Bowns et al,[30] who reported that UCS-B PFFs for Exeter stem design appear to be independent of osteoporosis. In contrast, UCS-C PFFs display typical fragility fracture characteristics and are associated with female sex and thinner femoral cortices.

Male sex, older age, and high ASA grade were demonstrated to be the independent risk factors associated with mortality following an intracapsular hip fracture, which are supported by many studies of elderly patients undergoing hemiarthroplasty for fracture.[31–33] Johansen et al[34]

demonstrated that for each grade increase in the ASA grade, the risk of death increased by 51%. This is consistent with the current study, where the increased mortality risk was at least 59% for each grade increase. The current study also found patients from care home, hospital, and rehabilitation hospital had approximately twice the mortality rate compared to those who were previously living at home, when adjusting for confounding factors. This is supported by Ireland et al,[35] who demonstrated that pre-fracture residential status was the strongest single determinant of mortality after hip fracture. It has been reported that postoperative delirium following hemiarthroplasty was significant predictor of mortality within one to two years.[36,37] More specifically, the current study found that perioperative delirium was an independent risk factor associated with mortality in patients with a positive screen using the 4AT with an increased risk of death by 29%. A novel aspect of the current study was demonstrating that reoperation, including for PPF, was not independently associated with an increased mortality risk. This is consistent with Bhattacharyya et al,[1] who found that the mortality rate after a reoperation for PFF was similar to the mortality rate after surgery for the index hip fracture.

Limitations of the study include the single-centre retrospective nature of design, and the number of deceased patients at final follow-up. However, the mortality rate was typical of that observed in patients following a hip fracture, and survivorship analysis was used to adjust for mortality when assessing PPF risk. Additionally, the maximum observation period of 4.2 years in the current study may be short for the occurrence of UCS-B-type PFF. Powell-Bowns et al[20] reported that type B PFF occurred at median of 4.2 years (IQR 1.2 to 9.2) after primary Exeter stemmed THA or hemiarthroplasty. Finally, the number of PFF cases were relatively small, although this may be conversely a positive aspect. However, from a statistical perspective, particularly with regard to the UCS-B PFF, which may have a higher correlation with implant design, it may have limited the ability to obtain potentially significant results. Considering the relatively high mortality rate within this elderly cohort, a multicentre randomized controlled study would be an appropriate strategy to address the current issue of insufficient sample size in this research.

In summary, the Exeter PTS type stem provides a lasting solution with a low risk of PPF of 1.1% at four years when used for hemiarthroplasty in elderly patients with hip fracture. Perioperative delirium was independently associated with an increased postoperative risk of a PFF. However, neither all-cause reoperation nor reoperation for PFF were independently associated with an increased mortality.

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Data sharing

The data that support the findings for this study are available to other researchers from the corresponding author upon reasonable request.

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Ethical review statement

Ethical approval was obtained from the regional ethics committee (Research Ethics Committee, South-East Scotland Research Ethics Service, Scotland (20/SS/0125)) for the arthroplasty database used in this study. Data collection was carried out in accordance with the GMC guidelines for good clinical practice and the Declaration of Helsinki.

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