Does a dedicated hip fracture unit improve clinical outcomes? A five-year case series

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ABSTRACT

INTRODUCTION The aim of the study was to establish whether a dedicated hip fracture unit, geographically separate from the local major trauma centre, could improve clinical outcomes for patients sustaining proximal femoral fragility fractures.

MATERIALS AND METHODS This study was a retrospective case series, using data collected from Brighton and Sussex University Hospitals NHS Trust's submissions to the National Hip Fracture Database between 1 April 2011 and 16 September 2016. The outcomes measured were mortality, length of hospital stay, time from admission to surgical intervention and return to pre-morbid residence. Patients were compared before and after reconfiguration of services into a separate dedicated hip fracture unit geographically distinct from the major trauma centre.

RESULTS A total of 2117 patients (2178 injuries) were managed before the existence of the hip fracture unit, while 660 patients (673 injuries) were treated within the hip fracture unit. During the five-year study period, the 30-day mortality rate (pre-hip fracture unit 5.47% vs hip fracture unit 3.13%, $P = 0.014$), variance in the length of hospital stay ($P < 0.001$), mean time to surgical intervention ($P = 0.044$) and return to pre-morbid residence were significantly improved. An immediate 12-month comparison demonstrated significantly improved variance in length of hospital stay ($P = 0.020$) and return to pre-morbid residence ($P = 0.015$).

DISCUSSION The reconfiguration of services significantly reduced variance in length of stay, enabling accurate resource planning in future. Multiple incremental improvements in service provision, in addition to the hip fracture unit, may explain the lower mortality observed.

CONCLUSION While further research is required, replication of the hip fracture unit service model may potentially afford significant clinical and financial gains.

KEYWORDS

Hip fracture – Femoral neck fracture – Osteoporosis – Frail elderly – Quality improvement – Orthopaedic surgery

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Introduction

Proximal femoral fractures affect over 65,000 patients every year in the UK,¹ predicted to increase to 100,000 by 2025.^{2,3} The 30-day mortality for these patients is now 6.7%,¹ with 365-day mortality varying between 20% and 40%.^{4–7} In survivors, 37% of patients return to their previous level of activity,⁸ but a significant proportion develop a new-onset dependency in their activities of daily living,⁹ representing a loss of nearly 20,000 quality adjusted life years/year.²

The delivery of major trauma care in the UK has evolved into a hub-and-spoke model with 22 adult major trauma centres.¹⁰ There is evidence to demonstrate an ongoing improvement in clinical outcomes for patients with multiple injuries within this new centralised service model.^{11,12} However, elderly patients sustaining proximal femoral

fractures represent a discrete injury group with multiple comorbidities. They have different clinical requirements compared with major trauma patients.^{13,14} While the care of these patients has not been adversely effected by the introduction of major trauma centres,¹⁵ it remains unclear whether outcomes for hip fractures can be improved by the separation of their care into dedicated units away from the regionalised trauma centres.

A hip fracture unit is a proposed service provision model, applying the principle of centralisation demonstrated by the UK major trauma network. This model incorporates comprehensive multidisciplinary care on a specific orthopaedic rehabilitation ward with orthogeriatric input and dedicated hip fracture theatre lists within the same hospital site.^{16,17} There is evidence that a hip fracture unit reduces both hospital stay and time from admission to operation.^{16–19}

To date, no direct comparison of clinical outcomes has been reported for proximal femoral fractures managed within a major trauma centre, compared with a centralised hip fracture unit at a geographically distinct site. The aim of this study was to establish whether the reconfiguration of services for elderly patients with proximal femoral fractures into a dedicated hip fracture unit geographically separate from the major trauma centre could improve clinical outcomes.

Materials and methods

Study design

This study was a retrospective database analysis, using data collected as part of standard clinical practice from Brighton and Sussex University Hospitals NHS Trust's submissions to the National Hip Fracture Database. Incomplete data points were retrieved securely and anonymously from electronic patient records software. Approval from the local research ethics committee was not required and the study was registered with the local audit department. Data were collected between 1 April 2011 and 16 September 2016 (National Hip Fracture Database dataset versions 7–9).

Intervention

Brighton and Sussex University Hospitals NHS Trust provides care across two main hospital sites: a regional major

trauma centre and a large district general hospital. Prior to July 2015, hip fracture care was primarily delivered within the major trauma centre. From 1 July 2015, a dedicated hip fracture unit was established within the district general hospital, at a site geographically distinct from the major trauma centre. The changes made to the pathway of hip fracture patient care are detailed in Figure 1. The key features of this hip fracture unit are:

- > an agreement with the local ambulance service to triage any patient with a suspected hip fracture directly to the hip fracture unit rather than the nearest hospital
- > the coordinated transfer of patients to the hip fracture unit hospital by the local ambulance service when patients erroneously present to the major trauma centre
- > the reconfiguration of the scheduled working hours among specialist staff to facilitate delivery of care at the hip fracture unit (this includes orthopaedic surgeons, orthogeriatric physicians, anaesthetists, physiotherapists, occupational therapists and specialist nurses)
- > the introduction of a specialised rehabilitation ward with the aforementioned specialists present, with the primary aim of providing care for this group of patients
- > the implementation of daily consultant-led theatre lists, dedicated to the operative management of proximal femoral fractures.

Outcomes

The outcomes measured were mortality (recorded at 30, 120 and 365 days post-injury), length of hospital stay, time from admission to surgical intervention and return to pre-morbid residence.

Comparison

Comparisons were made between two separate subgroups:

1. Total patient comparison group: all patients from 1 April 2011 to 30 June 2015 (pre-hip fracture unit) and all patients from 1 July 2015 to 16 September 2016 (hip fracture unit).
2. Immediate 12-month comparison group: patients presenting from 1 July 2014 to 30 June 2015 (pre-hip fracture unit) and from 1 July 2015 to 30 June 2016 (hip fracture unit).

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences software (IBM SPSS 24.0). Categorical variables were analysed using Fisher's exact test (two-sided), continuous variables not following a normal distribution were analysed using a Mann-Whitney test, and equality of variances was determined using Levene's test. Statistical significance was set at $P < 0.05$.

Results

Study population

A total of 2777 patients sustaining 2851 fragility-related proximal femoral fractures were included in this study. Of these, 2117 patients (2178 injuries) were managed pre-hip fracture unit, while 660 patients (673 injuries) presented after the introduction of the hip fracture unit. For the immediate 12 months before and after service reconfiguration, 548 patients (597 injuries) pre-hip fracture unit and 557 patients (567 injuries) within the hip fracture unit were included. Mortality and reoperation data were unobtainable for two patients (two injuries) in the pre-hip fracture unit group and two patients (2 injuries) with the hip fracture unit group; all were foreign nationals who left the UK after discharge. In-hospital outcome measures were still recorded and no further patients were lost to follow-up. There were no significant demographic differences between these groups (Table 1) for either of the two comparisons performed (Table 2).

Mortality rate

In total, comparing all included patients before and after the initiation of the hip fracture unit, the observed mortality rates were lower after implementation of the hip fracture unit at each follow-up interval. The 30-day mortality rate was significantly reduced (pre-hip fracture unit 5.47% vs hip fracture unit 3.13%, $P = 0.014$). The overall 120-day and 365-day mortality rates were reduced, but not to statistical significance ($P = 0.078$ and $P = 0.769$, respectively).

Table 1 Demographics of the study population and intraoperative characteristics.

Study population	Pre-HFU	HFU
Total patients (<i>n</i>)	2117	660
Total injuries (<i>n</i>)	2178	673
Mean age, years (SD)	82.6 ($\pm$ 9.72)	83.8 ($\pm$ 8.43)
Sex (male : female)	591 : 1526	191 : 469
Fracture type (<i>n</i>):		
Intracapsular	1218	381
Intertrochanteric	866	268
Subtrochanteric	83	24
ASA grade:		
1	91	12
2	575	202
3	1179	379
4	302	76
5	3	1

ASA, American Society of Anesthesiologists; HFU, hip fracture unit; SD, standard deviation from the mean.

For the 12-month comparison, the 30-day mortality rate was lower after initiation of the hip fracture unit, but not to significance (pre-hip fracture unit 4.74% vs hip fracture unit 3.70%, $P = 0.470$). Similarly, there was no significant difference for 120-day mortality (pre-hip fracture unit 11.13% vs hip fracture unit 11.29%, $P = 1.000$) or 365-day mortality (pre-hip fracture unit 18.25% vs hip fracture unit 20.86%, $P = 0.364$).

Length of stay

In total, the mean length of stay within the acute hospital setting was lower after hip fracture unit implementation by 1.53 days, although this did not reach statistical significance (pre-hip fracture unit 19.09 days, 95% confidence interval, CI, 18.44–19.75 vs hip fracture unit 17.56 days, 95% CI 16.66–18.47, $P = 0.411$). However, the variance in the length of hospital stay reduced significantly after implementation of the hip fracture unit ($P < 0.001$).

For the 12-month comparison group, the mean length of stay after hip fracture unit implementation was 0.42 day lower, but not significantly (pre-hip fracture unit 18.57 days, 95% CI 17.32–19.80 vs hip fracture unit 18.15 days, 95% CI 17.11–19.18, $P = 0.492$). In conjunction with the overall analysis, there was significantly less variance in length of stay associated with the hip fracture unit ($P = 0.020$) for the 12-month comparison.

Time to surgery

In total, the mean time to surgical intervention after admission was reduced following implementation of the hip

Table 2 Results for total patient comparison and 12-month comparison.

Outcome measure	Total patient comparison			12-month comparison		
	Pre-HFU	HFU	P-value	Pre-HFU	12-month HFU	P-value
Mortality rate (%):						
30-day	5.47	3.13	0.014*	4.74	3.70	0.457
120-day	12.68	10.13	0.078	11.13	11.29	1.000
365-day	21.46	20.57	0.769	18.25	20.86	0.364
Length of stay (days):						
Mean (95% CI)	19.09 (18.44–19.75)	17.56 (16.66–18.47)	0.411	18.57 (17.32–19.80)	18.15 (17.11–19.18)	0.492
Variance	243.17	144.46	< 0.001*	219.01	156.70	0.020*
Time to surgery (hours):						
Mean (95% CI)	26.45 (25.44–27.46)	24.74 (23.43–26.05)	0.150	26.38 (23.90–28.85)	24.45 (23.14–25.75)	0.602
Variance	578.93	299.36	0.044*	870.78	250.43	0.083

CI, confidence interval; HFU, hip fracture unit.

fracture unit, but not to statistical significance (pre-hip fracture unit 26.45 hours, 95% CI 25.44–27.46 vs hip fracture unit 24.74 hours, 95% CI 23.43–25.06, $P = 0.150$). There was, however, significantly less variance in mean time to surgical intervention after implementation of the hip fracture unit ($P = 0.044$).

The 12-month comparison also demonstrated a lower mean time to surgical intervention after admission, associated with the hip fracture unit, but not to significance (pre-hip fracture unit 26.38 hours, 95% CI 23.90–28.85 vs hip fracture unit 24.45 hours, 95% CI 23.14–25.75, $P = 0.602$). The variance in mean time to surgical intervention after implementation of the hip fracture unit was also lower, but not to statistical significance ($P = 0.083$).

Discharge destination

For all included patients, the discharge destination differed significantly between groups ($P < 0.001$). At the conclusion of their inpatient stay, 886 patients (40.68%) treated within the major trauma centre group were discharged to their own home or supported accommodation, compared with 334 patients (49.63%) in the hip fracture unit group.

For the 12-month comparison, discharge destination also differed significantly between groups ($P = 0.015$). At discharge, 249 patients (45.44%) treated pre-hip fracture unit returned to their own home or supported accommodation, compared with 282 patients (49.74%) treated within the hip fracture unit.

Discussion

To our knowledge, this is the first study to assess whether the reconfiguration of services into a dedicated hip fracture unit geographically distinct from the location of regional

major trauma services could improve clinical outcomes for patients sustaining fragility proximal femoral fractures.

When taking into account the full five-year study period, the results demonstrate an improved 30-day mortality following the introduction of a separate dedicated hip fracture unit. While this effect is not replicated after 120 or 365 days, we consider 30-day mortality a surrogate marker of the acute perioperative care provided. In an elderly population, with significant chronic comorbidities, there is evidence to suggest that short-term and long-term mortality are influenced but with different risk factors.^{20,21} The improvement in acute care interventions and perioperative optimisation associated with the introduction of the hip fracture unit may selectively modify short-term risk factors and this could explain why the improved mortality effect does not persist in the longer term.

For the immediate 12-month comparison, a lower 30-day mortality rate was demonstrated, but not to significance. This may indicate the improvement in mortality seen over the five-year period was not entirely related to the introduction of the hip fracture unit, rather to multiple incremental improvements by orthogeriatricians, the anaesthetic department and compliance with national orthopaedic guidelines, in addition to the development of the hip fracture unit.^{22,23} It remains to be seen whether the establishment of a dedicated hip fracture unit represents the natural end point in this continuum of improving care delivery.

For patients treated within a dedicated hip fracture unit, the results demonstrated a significant decrease in variance for both the length of stay and the time to surgery, which persisted in the 12-month comparison for the length of stay. Decreased variance is beneficial in clinical service provision, as highlighted by the 'Getting it Right First Time' initiative.²⁴ Reduced variation in care enables accurate resource planning, with clinical and fiscal benefits.²⁵

Following introduction of the dedicated hip fracture unit, a significantly increased proportion of patients were discharged to their pre-morbid residence. This is socially and financially beneficial to the patient, family and local health economy,²⁶ and facilitates patients' desire for autonomy.²⁷

Importantly, irrespective of any improvement in outcomes, this study has demonstrated an ability to successfully reconfigure care provision for proximal femoral fragility fractures within an NHS trust providing care as a major trauma centre, without adversely affecting patients. This approach allows the care of these two unique cohorts to be managed independently, avoiding potential conflicts in the provision of best practice care, which may otherwise occur within a single centre model. For other institutions delivering major trauma services, we believe that this study affords evidence that a separate dedicated hip fracture unit is a safe solution to this problem.

There are some limitations to this study. First, multiple variables have changed within Brighton and Sussex University Hospitals NHS Trust relating to the care of patients with fragility proximal femoral fractures, during the study period. To account for the continuing improvement of care delivery over time, a 12-month comparison subgroup was included, although this cannot entirely negate the effect of these variables. Second, we have not accounted for any potential learning curve associated with the reconfiguration of services, which we would expect to observe after hip fracture unit implementation.²⁸ As additional experience of the hip fracture unit model is gained, it would be hoped that clinical outcomes continue to improve. Third, no patient-reported outcome measures have been assessed as part of this study. While our focus on selected clinical outcomes is a common means of assessing improvement in care delivery, we acknowledge that these parameters do not necessarily correlate with patients' perception of high-quality care.²⁹ However, although patient-reported outcomes were not formally assessed, it would be reasonable to assume that the increased frequency of discharge to pre-morbid residence, expedited time to surgery and shorter length of stay should not negatively impact upon patient experience.³⁰

Conclusion

This study has demonstrated that within the context of an adult major trauma centre, a separate dedicated hip fracture unit can reduce the variance in length of stay for patients sustaining proximal femoral fragility fractures. As part of the wider continuum of care improvement, the centralisation of care is associated with a significant reduction in 30-day mortality. While further research is required, replication of this service model may potentially afford significant clinical and financial gains within other institutions.

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