



# A 3-year retrospective analysis of patients admitted with clinical vertebral fragility fractures across hospitals in England, UK

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## Abstract

**Summary** Our database aimed to assess the impact of vertebral fragility fractures (VFFs) on hospitalisation in England. The results showed that admissions secondary to VFF are increasing annually, more significantly in patients aged 75 years and over. Vertebral augmentation has been showed to reduce length of stay in hospital.

**Introduction** Vertebral fragility fractures (VFFs) are the most common osteoporotic fracture. VFF can result in significant pain requiring hospitalisation. However, there are little data on patient numbers, hospital bed days, and costs, contributed to by these patients.

**Methodology** We report a retrospective analysis of patients aged 55 years and over admitted to hospitals across England from 2017 to 2019. ICD-10 classifications for VFF and OPCS codes were used to identify admissions and patients who had undergone vertebral augmentation (VA).

**Results** There were 99,370 patients (61% female) admitted during this period, with 64,370 (65%) patients aged over 75 years. There was a 14.3% average increase in admissions annually. Patients aged over 75 years accounted for 1.5 million bed days, costing £465 million (median length of stay (MLOS) 14.4 days). In comparison, those aged 55–74 years, accounted for 659,000 bed days, costing £239 million (MLOS 10.7 days). The majority of patients (84%) were admitted under a non-surgical speciality and were primarily older (median age 76.8 vs 67.6 years, MLOS 8.2 vs 6.0 days), compared to those admitted to surgical wards 1755 patients underwent vertebral augmentation (VA) (1.8% of the total cohort). The median age of patients undergoing VA was 73.3 years, with 775 (44.2%) of these were aged 75 years and over. In comparison, the median age of patients managed conservatively (non-surgically) was 75.7 years, with 63,595 patients (65.1%) aged 75 years and over. The MLOS and cost per patient admission were lower in the VA group compared to those managed non-surgically.

**Conclusion** Hospitalised VFF patients represented a significant number, cost, and use of bed days. Those undergoing VA had a significantly shorter length of stay. Further studies are necessary to define those who may benefit from early VA.

**Keywords** Hospitalisation · Osteoporosis · Vertebral augmentation · Vertebral fragility fractures

## Introduction

Osteoporosis is a common chronic condition, affecting 200 million people worldwide [1], with one fragility fracture occurring every 3 s [2]. In the United Kingdom (UK), it is estimated that 3.5 million people have osteoporosis and its prevalence is increasing with an aging population [3]. Vertebral fragility fractures (VFFs) are the most common osteoporotic fracture, with an estimated 66,000 presenting clinically each year in the UK. This is projected to increase by a further 18,000 annually by 2025 [4]. VFF can develop by performing our daily tasks such as getting up from a chair, twisting, bending, coughing, or sneezing [5].

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The majority of VFF result in minimal to moderate pain; however, in a significant proportion, the pain may be so severe that they require emergency hospital admission. Studies have shown that 10–35% of those patients who develop an acute VFF will require emergency medical attention. The incidence ranges from 10 to 20 per 10,000 per year, and this rises to 50 per 10,000 per year in those aged 80 years and over [6]. In one UK study, it was reported that 34% of patients with VFF required acute hospital admission [7]. Patients who require hospitalisation tend to be older, be multi-morbid, have complex care needs with associated longer hospital stay, and have higher mortality rates [8]. The reported average length of stay for these patients is 15 days [9]. Additionally, 1 in 5 patients is readmitted within 30 days [10].

Currently, there are insufficient data to provide an accurate demographic representation of patients hospitalised with VFF across England. From our local audit data, 81 patients had vertebroplasty (VP) in Nottingham in 2020. This amounted to a cost of £650,000, with a single level VP costing £4500. This provided us with a small snapshot into what we anticipate will be an increasing demand for VP in hospitalised patients not only locally, but nationally given our ageing population. With the increasing numbers of VFF and more patients expected to require acute hospitalisation, the healthcare resource burden within this group of patients is alarming.

Therefore, the aim of this retrospective analysis was to provide numeric and descriptive data on patient numbers, occupied hospital bed days, and costs contributed to by these patients across England, as well as national numbers of patients receiving vertebral augmentation (VA).

## Methodology

We conducted a retrospective analysis of data obtained by the English of Hospital Episode Statistics (HES) database produced by National Health Service (NHS) digital. We obtained data of all patients admitted as an emergency admission to hospitals across England with clinical vertebral fractures over a 3-year period (2017–2019). Analysis was performed on the available data for patients aged 55 years and above, whose admissions were coded according to the International Classification of Diseases (ICD)-10 classifications for VFF; *M484*, *M485*, *S220*, and *S320*. The Office of Population Censuses and Surveys (OPCS) classification of Interventions and Procedures codes *V44.4* and *V44.5* were used to identify patients who had undergone VP and balloon kyphoplasty (BKP), respectively. The total numbers for VP and BKP have been collated as one and will be expressed as “vertebral augmentation”. Data obtained included patient age, gender, speciality admitted under, length of hospital

stay expressed as the median (MLOS), total inpatient bed days, and costs associated with admission. In the data analysis, we have used an age cut-off to provide a comparison and more in depth analysis into two separate subgroups; patients in the age group of 55–74 and patients aged 75 years and over.

Results were expressed as a whole number where possible, or rounded off to the first decimal point. Statistical analysis was conducted using JASP software.

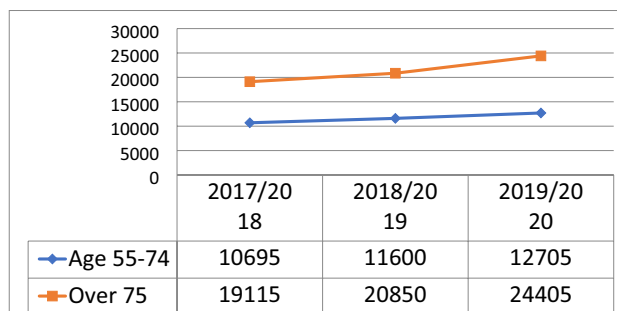
Data suppression was applied to the raw data for the following variables; for patients, spells and bed days for values between 1 and 7 inclusive have been suppressed and are represented by \*. Following suppression of data for each field, cost, MLOS, and pre-operative and post-operative median LOS were also suppressed.

## Results

For the purpose of this study, we grouped our analysis based on the age: patients aged from 55 to 74 years (group A) and patients aged 75 and over (group B).

There were a total of 99,370 patients admitted to hospitals across England over the 3 years coded with a VFF. Group B accounted for 64,370 (64.8%) of the admissions. There was an average increase in incidence of 14.3% in admissions with VFF annually. This is shown in Fig. 1. The increase was more notable in group B where there was an increase of 3555 patients (17.1%) in 2019/2020 compared to 2018/2019. In contrast, there was an increase of 1105 (9.5%) increase in group A.

Further analysis showed a combined total of 119,225 inpatient spells between the two groups over the 3 years, with an increasing trend over the 3 years in both groups. Group A accumulated 659,000 occupied bed days and group B almost double, accounting for 1.5 million occupied bed days. Increasing trends were noted in occupied bed days across both groups; however, this was more evident in group B, most notably in the year of 2019/2020, where there was



**Fig. 1** Total number of patients admitted with VFF over the 3-year period

a 17.3% increase in admissions compared to 2018/2019. The overall median length of stay (MLOS) in group B was higher (14.4 days) compared to group A (10.7 days). The total number of occupied bed days for both groups over the 3 year was 2.2 million bed days, costing approximately £704 million (group A £239 million vs £465 million for group B).

Analysis of patients undergoing VA throughout the 3-year period showed that 1755 patients underwent VA representing only 1.8% of the total cohort, with a median age of 73.3 years. In comparison, the median age of patients managed conservatively (non-surgically) was 75.7 years, with 63,595 patients (65.1%) aged 75 years and over.

In group A, 980 patients had VA, with a median age of 65.5 years. In comparison, 34,020 patients admitted with VFF were managed conservatively and had a median age of 66.3 years. The MLOS was 1.6 days in those who had VA compared to 5.8 days in those managed conservatively. The average cost per patient admission was £4542 in the VA group compared to £6846 in those who managed conservatively.

In group B, 775 (44.2%) patients who had VA were aged over 75 years. The median age of those undergoing VA was 80.1 years and 84.0 years for those who were managed conservatively. The MLOS was 2.4 days in those who underwent VA compared to 10.8 days in those who were managed conservatively ( $p \leq 0.01$ ). The average cost per patient admission was £4737 in the VA group compared to £7250 in those who were managed conservatively ( $p \leq 0.01$ ).

Figure 2 illustrates the proportion of patients undergoing VA in each of the fiscal years. It is evident that although the number of patients admitted annually with VFF increases, the proportion of patients undergoing VA remained static.

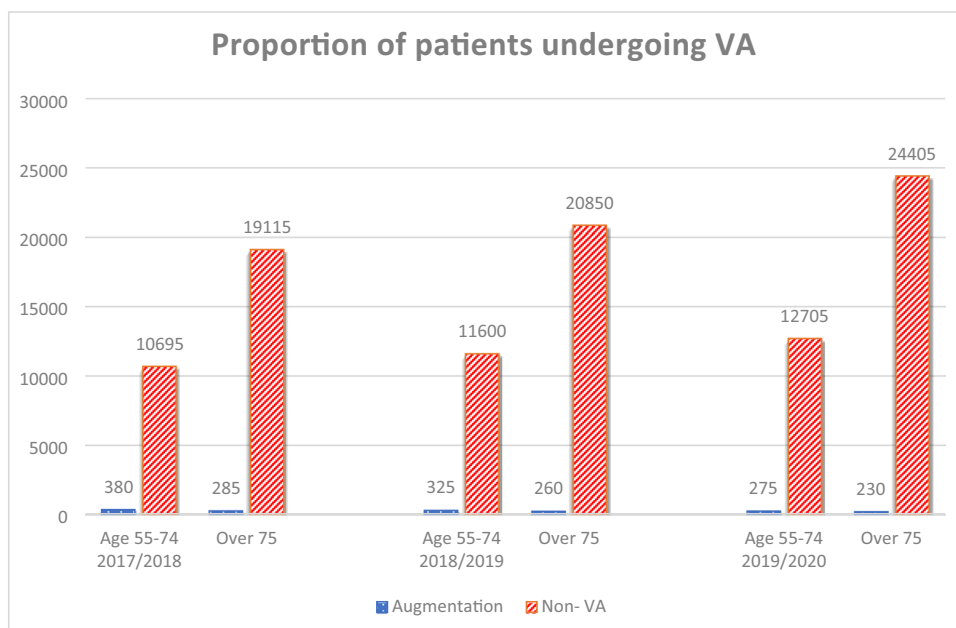
We also analysed which specialities patients with VFF were being admitted under during admission. The majority of patients (84%) were admitted under non-surgical specialities. These patients were primarily older (median age of 76.8 vs 67.6 years) and had a longer length of stay (8.2 vs 6.0 days).

### Discussion

In the UK, around 3.5 million people have osteoporosis, with an annual incidence of 500,000 of new fragility fractures [11]. With regard to VFF, worldwide data report that it is more prevalent in an ageing population. Prevalence studies suggest 20% of women aged over 80 years have sustained a VFF [12]. The reported known lifetime risk of a VFF is at 32%, much higher than those of hip fracture (15.6%) [13]. Our data have conformed with these estimates and have shown that hospitalisations attributed to VFFs have increased annually, with people aged 75 and over representing approximately two-thirds of the total number of admissions to hospitals across England over the 3-year period.

Although our study was not able to capture data on frailty itself, given the age of the cohort, it is expected that frailty syndrome will be highly prevalent. Frailty is characterised by an age-associated decline in physiological and functional reserve across multi-organ systems leading to increased vulnerability for adverse health outcomes [14] and is well recognised as an independent risk factor for falls, fractures, and mortality. The management of frail, older persons in hospital is complex and often present a challenge to admitting teams.

**Fig. 2** Proportion of patients undergoing VA in each of the 3 fiscal years



This is illustrated by the long MLOS (14.4 days) of those patients who were managed conservatively.

Frail, older people undergoing surgical interventions are at an increased risk of perioperative complications, mortality, and prolonged hospitalization and require a multi-faceted approach pre- and post-surgical care to improve patient outcomes. Therefore, the involvement of ortho-geriatricians in the management of patients with VFFs should be the standard of care within clinical practice, as seen in hip fracture care, which has shown to significantly reduced inpatient length of stay and mortality rates [15]. In addition, secondary prevention and commencement of osteoporosis treatment can be planned whilst as in-patient to minimise the risk of future fractures.

Our figures indicate that many patients hospitalised with VFF were managed conservatively and account for longer MLOS, compared to those undergoing VA. In the current climate in the healthcare system where hospitals are focusing on reducing length of stay, we wish to highlight that only a small proportion (1755 patients (1.8% of the total population) over 3 years) of patients underwent VA. The MLOS and cost per patient admission was lower in the VA group compared to those managed non-surgically (MLOS 2.4 vs 10.8 days,  $p \leq 0.01$ , cost £4737 vs £7250).

VA comprises both VP and BKP. VP, a minimally invasive, fluoroscopic-guided procedure, has now been recommended as the first-line treatment for symptomatic VFF unresponsive to conservative treatment, given its cost-effectiveness and minimally invasive nature compared to BKP, which is normally reserved for traumatic fractures in younger people [16]. The VAPOUR trial [17], the only trial to include hospitalised patients with VFF in their patient recruitment, demonstrated that VP has shown benefit in terms reduction in length of stay in hospital. However, more research is currently required to define precisely the characteristics of patients who may benefit from VP.

From the results, it appears that VA was able to reduce MLOS by 8.4 days compared to conservative management in those aged 75 years and over. This equates to an estimated cost saving of £2940 (£351 per excess bed day) [18] per patient saved on excess hospital bed days. By performing a cost analysis of VP versus conservative management based on our data, considering the cost of VA procedure (factoring into account the number of vertebral fractures, cost of equipment and type of cement used), the average cost is estimated at £1546 per patient [19]. Therefore, the potential estimated cost saving of identifying a suitable patient with an acute VFF for VA is about £1394.

The main limitation of the study is the retrospective nature of the data collected. We were unable to determine if the fracture was the main reason for admission, nor were we able to quantify the number and exact location of the vertebral fractures. In addition, data to draw further correlations

were not available, for example, frailty scores and how this impacted on decision-making for VA and subsequently its effects on the lengths of stay. We were able to record chronic co-morbid conditions such as hypertension, diabetes, chronic kidney disease, and medical complications during admission such as hospital acquired infections but were unable to draw meaningful conclusions from this.

In conclusion, our data demonstrated the increasing incidence of older patients hospitalised across England with acute VFF. In our opinion, the data mandates a national framework to standardise care for these patients. This should include comprehensive geriatric assessments and evidence-based guidance for clinicians to identify appropriate patients who may benefit from VA, most likely in the form of VP in efforts to reduce pain related disability, deconditioning and ultimately reducing inpatient hospital stay and improving patient outcomes.

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**Author contribution** CWT and OSS were involved in the conception, design, analysis, and interpretation of the data, drafting the article, revising it, and final approval of the version for submission. CWT accepts responsibility for the integrity of the data analysis.

**Data availability** The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Declarations

**Consent for publication** Not required.

**Competing interests** None.

**Disclaimer** The views expressed are those of the authors and not necessarily those of the NHS. The authors would like to declare that the interpretation of the data and opinions shared are solely those of the authors.

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