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Received 19 July 2016; editorial decision 24 October 2016

Age and Ageing 2017; **46**: 465–470
doi: 10.1093/ageing/afw232
Published electronically 14 December 2016

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Improving hip fracture outcomes with integrated orthogeriatric care: a comparison between two accepted orthogeriatric models

MARK MIDDLETON¹, BETTINA WAN², RUY DA ASSUNÇÃO³

¹Trauma and Orthopaedics, Epsom and St Helier University Hospital NHS Trust, Carshalton, Surrey SM5 1AA, UK

²Department of Medicine for Elderly, University College London Hospital, London, UK

³Department of Orthopaedic and Trauma Surgery, Western Sussex Hospitals NHS Trust, Worthing, West Sussex, UK

Address correspondence to: M. C. F. Middleton. Tel: 020 8296 2000. Email: m.c.f.middleton@doctors.org.uk

Abstract

Background: our orthopaedic trauma unit serves a large elderly population, admitting 400–500 hip fractures annually. A higher than expected mortality was detected amongst these patients, prompting a change in the hip fracture pathway. The aim of this study was to assess the impact of a change in orthogeriatric provision on hip fracture outcomes and care quality indicators.

Patients and Methods: the hip fracture pathway was changed from a geriatric consultation service to a completely integrated service on a dedicated orthogeriatric ward. A total of 1,894 consecutive patients with hip fractures treated in the 2 years before and after this intervention were analysed.

Results: despite an increase in case complexity, the intervention resulted in a significant reduction in mean length of stay from 27.5 to 21 days ($P < 0.001$), a significant reduction in mean time to surgery from 41.8 to 27.2 h ($P < 0.001$) and a significant 22% reduction in 30-day mortality (13.2–10.3%, $P = 0.04$). After controlling for the effects of age, gender, American Society of Anesthesiology (ASA) Grade and abbreviated mental test score (AMTS), the effect of integrating orthogeriatric services into the hip fracture pathway significantly reduced the risk of mortality (odds ratio 0.68, $P = 0.03$).

Conclusions: changing our hip fracture service from a geriatric consultation model of care to an integrated orthogeriatric model significantly improved mortality and performance indicators. This is the first study to directly compare two accepted models of orthogeriatric care in the same hospital.

Keywords: older people, hip fracture, orthogeriatric care, multidisciplinary treatment, integrated care, National Hip Fracture Database

Introduction

The increasing clinical and financial impact of hip fractures [1] on the United Kingdom (UK) National Health Service (NHS) has led to the publication of national guidelines recommending co-operation between orthopaedic surgeons and geriatricians [2, 3]. Early orthogeriatric involvement in patients' care is an expected standard [4] and, when achieved, results in increased hospital reimbursement through the best practice tariff [5]. Models of combined care [2, 6] range from orthopaedic care with geriatric consultation and *vice versa* to an integrated model combining medical and surgical care [7, 8]. The efficacy of orthogeriatric care has been mixed, possibly due to the variety of clinical models of care employed [9–15]. Kammerlander *et al's* [16] review and a recent meta-analysis [17] give strong evidence to support orthogeriatric collaboration but are unable to determine which model is best. As the majority of previous studies do not directly compare different models of orthogeriatric care, they recommend further study to determine this, but note the trend towards more recent studies using a more integrated approach [16].

The UK National Hip Fracture Database (NHFD) was launched in 2007 to provide an audit tool to improve hip fracture care and has since been used to benchmark quality indicators and guide best practice funding in the NHS [18]. The NHFD allows hip fracture care providers to compare outcomes and quality indicators with other units as well as use the data for purposes of audit. Outcome data collated from UK hospital episode statistics (HES) are also available from Dr Foster, a UK healthcare information provider set up in 2000 [19]. Our unit treats between 400 and 500 hip fractures annually from an elderly population with levels of comorbidity higher than the national average recorded in the NHFD [18]. In early 2011, data from the NHFD and Dr Foster demonstrated higher than expected mortality in patients with hip fracture treated in our unit. A review of the service led to a fundamental change in practice. The orthopaedic-led practice with regular orthogeriatric consultation, review and rehabilitation service was changed to create a fully integrated multidisciplinary hip fracture care pathway on a dedicated orthogeriatric ward. The primary purpose of this study was to compare the two orthogeriatric models by quantifying the effect of this intervention on outcome and quality indicators such as mortality, length of stay (LOS) and time to surgery (TTS) after hip fracture. In addition, we tried to identify important factors affecting outcomes in our clinically complex local population.

Patients and Methods

A sample of 1,894 consecutive hip fracture patients admitted during the 2 years before (880 patients from 1 July 2009 to

30 June 2011) and after (1,014 patients from 1 July 2011 to 30 June 2013) the intervention was reviewed. Prospectively entered data were retrospectively retrieved from the NHFD and mortality data were cross-referenced locally to ensure accuracy. During the years examined, data had been prospectively collected and entered into the NHFD by a dedicated orthopaedic trauma nurse and clerk. Variables of interest included patient demographics, abbreviated mental test score (AMTS), American Society of Anesthesiology (ASA) Grade, fracture type, TTS, LOS, mobility status, time spent in the emergency department (ED) prior to admission and time to orthogeriatric assessment.

The intervention consisted of several major changes to logistical and clinical elements of the hip fracture pathway. Prior to the intervention, patients were admitted to an orthopaedic trauma ward under the care of an orthopaedic surgical team, who remained primarily responsible for their care. A consultant ortho-geriatrician attended trauma meetings three times a week, and attendance of anaesthetists was not routine. There was an afternoon trauma list each day of the week, and patients with hip fractures were not necessarily prioritised. There were three consultant ortho-geriatrician ward rounds a week (three programmed activities), supported by a specialty registrar in geriatrics. This meant not all patients were seen pre-operatively, though all patients with fractured neck of femur were reviewed on ward rounds. Following surgery, some patients were discharged directly from the orthopaedic trauma ward, whilst those requiring longer rehabilitation were transferred to a geriatric ward in a subacute hospital when they were deemed medically fit to do so. This extended rehabilitation facility was staffed by a senior house officer, and there were two consultant ward rounds a week (two programmed activities). If patients became unwell in the subacute hospital, then they would be transferred back to the acute hospital under the care of geriatricians. There were 27 beds in the orthopaedic trauma ward and 25 beds in the geriatric rehabilitation ward.

After the system change, patients were acutely assessed by the orthopaedic trauma on-call team and admitted to a 22-bedded Acute Frailty Unit under joint care with an orthogeriatrician. The Acute Frailty Unit functions as the Acute Medical Unit for older people with frailty. Patients were seen pre-operatively by the ortho-geriatrician or as part of the Department of Medicine for Elderly post-take ward round. Nursing care was provided by Department of Medicine for Elderly, who received support and training from the Department of Orthopaedics and Intensive Care Unit Outreach Team. Trauma meetings were attended by a consultant ortho-geriatrician and anaesthetists, where patients were proactively identified for post-operative High Dependency Unit care where indicated. The number of

trauma lists was increased to full day lists Monday to Friday, and morning lists at weekends. Patients with fractured neck of femur were prioritised. The weekly sessional commitments of the Consultant Ortho-geriatrician remained at three, supported by a Trust grade doctor, until Deanery approval for a Foundation Year 2 doctor to be transferred from Department of Orthopaedics to Department of Medicine for Elderly. There were three consultant orthogeriatric ward rounds a week, and patients were also seen on Orthopaedic Consultant ward rounds regularly until no further surgical input was needed. Physiotherapy provisions remained unchanged. However, patients were included in the daily multidisciplinary team discussions on the Acute Frailty Unit. Patients who required longer rehabilitation were transferred to a 22-bedded orthogeriatric rehabilitation ward on site. This ward was staffed by a Consultant Geriatrician, who conducted ward rounds twice a week (2 programmed activities), and was supported by a Foundation Year 2 doctor. The recorded LOS included time spent in the off-site extended rehabilitation facility (pre-intervention) and the on-site orthogeriatric rehabilitation ward (post-intervention).

Statistical analyses

Twenty-five patients were excluded, leaving 1,869 for analysis. Twelve were excluded due to missing age data and thirteen whose ages were greater than 3.29 standard deviations from the mean (all of whom were younger, *i.e.* the youngest 0.1%, mean age 52.4 ± 4.5 years vs 84.5 ± 8 years for the remaining sample). Comparisons between groups were made using Pearson Chi-squared (χ^2) tests and independent sample *t*-tests with bias-corrected accelerated bootstrapping to account for non-normal distributions. When one or more variables other than the variable of interest differed between groups, analysis of covariance (ANCOVA) was used for comparison with the potentially confounding variable entered as a covariate. Associations between continuous variables or between one continuous and one dichotomous (binary) variable were investigated using Pearson's product-moment correlation coefficient or point-biserial correlation respectively. A multivariate logistic regression model was used to investigate the effect of the

intervention on mortality while controlling for confounding variables, as well as assessing the impact of predictor variables on mortality. Predictor variables were chosen based on previous research [20–22] and included age, gender, AMTS, ASA, TTS, mobility, fracture type and LOS. AMTS, ASA and TTS were dichotomised for the analysis (AMTS ≤ 7 , ASA ≤ 3 , TTS ≤ 36 h). LOS was found to be strongly associated with TTS ($P < 0.001$) and therefore omitted from the final model to prevent multicollinearity. The final iteration omitted variables that were not significant predictors of mortality and included the intervention as a predictor, allowing assessment of the effect of the intervention while controlling for the effects of the other variables. Model diagnostics were carefully assessed for factors governing regression. Significance was assumed at $P \leq 0.05$ for all analyses. Analyses were performed using SPSS 20 (IBM, Armonk, USA).

Results

There was no difference between the pre- and post-intervention groups with respect to age (*t*-test, $P = 0.8$), gender distribution (χ^2 test, $P = 0.26$) and AMTS (*t*-test, $P = 0.75$) (Table 1). However, the proportion of patients with an ASA score of 4 or higher was significantly larger in the post-intervention group (18.1% vs 11.5%, χ^2 test, $P = 0.001$). The proportion of patients with poor mobility (using two sticks, crutches or a frame) also increased in the post-intervention group (55.9% vs 49.8%, χ^2 test, $P = 0.008$). Since there was a strong association between ASA and mobility ($P < 0.001$), ASA scores only were chosen as a general indicator of patient comorbidity for subsequent multivariate analysis. Time spent by patients in the ED prior to admission did not change significantly, with a mean stay of 3.7 h (range 0–52) before and 3.6 h (range 0–15) after (*t*-test, $P = 0.5$). However, time taken until orthogeriatric review was significantly reduced from a mean of 53 h (range 2–337) to 23 h (range 0–164, *t*-test, $P = 0.001$).

ANCOVA with ASA as a covariate showed that TTS and LOS dropped significantly after the intervention, despite the potential effect of an increased ASA in the post-intervention group on both these factors. TTS dropped significantly from

Table 1. Group comparison results

	Group 1 (pre-intervention)	Group 2 (post-intervention)	Test	<i>P</i>
Mean age (range)	84.54 (57–102)	84.46 (57–104)	<i>t</i>	0.85
Male/Female	217/645	231/776	χ^2	0.82
Mean AMTS	7 (0–10)	7.1 (0–10)	<i>t</i>	0.75
ASA ≥ 4 (%)	11.5	18.1	χ^2	0.001
Reduced mobility (%)	49.8	55.9	χ^2	0.008
Intracapsular fracture (%)	62.8	60.4	χ^2	0.27
TTR (hours)	53	23	<i>t</i>	<0.001
TTS (hours)	42	27	ANCOVA	<0.001
LOS (days)	27.5	21	ANCOVA	<0.001
30-day mortality (%)	13.2	10.3	ANCOVA	0.04

TTR, time to orthogeriatric review.

41.8 to 27.2 h ($P < 0.001$) and LOS dropped significantly from a mean 27.5–21 days ($P < 0.001$). Despite the overall increase in comorbidity, 30-day mortality dropped significantly from 13.2% to 10.3% (χ^2 test, $P = 0.04$).

Multivariate logistic regression modelling demonstrated that lower ASA, female gender, lower age and higher AMTS were significant predictors of lower 30-day mortality (Table 2). These predictors remained significant after orthogeriatric intervention was added as a predictor in the final model. TTS and fracture type failed to reach significance and were omitted from the final iteration. The final model confirmed that the orthogeriatric intervention was an independent predictor of lower 30-day mortality even when all other significant predictors were taken into account. Given the increase in ASA post-intervention, the models were repeated with an ASA dichotomised at ≥ 3 (rather than ≥ 4) with similar results and a consistent reduction in the odds ratio (OR) for 30-day mortality (Table 3).

Table 2. Predictors of 30-day mortality (in descending order of OR magnitude); ASA cutoff point at 4

	<i>P</i>	OR	95% CI for OR	
			Lower limit	Upper limit
Model 1				
ASA score ≤4	<0.001	0.44	0.30	0.65
Female gender	<0.001	0.46	0.31	0.66
AMTS ≥7	0.001	0.53	0.37	0.76
Age	<0.001	1.07	1.05	1.10
Time to surgery <36 h	0.568	1.12	0.77	1.62
Extracapsular fracture	0.597	0.91	0.63	1.30
Model 2				
ASA score ≤4	<0.001	0.37	0.25	0.54
Female gender	<0.001	0.46	0.32	0.67
Post-intervention	0.036	0.69	0.49	0.98
AMTS ≥7	0.001	0.55	0.38	0.78
Age	<0.001	1.07	1.04	1.10

CI, confidence interval.

Table 3. Predictors of 30-day mortality (in descending order of OR magnitude); ASA cutoff point at 3

	<i>P</i>	OR	95% CI for OR	
			Lower limit	Upper limit
Model 1				
ASA score ≤3	<0.001	0.33	0.20	0.55
Female gender	<0.001	0.46	0.32	0.67
AMTS >7	0.003	0.58	0.40	0.83
Age	<0.001	1.07	1.04	1.10
Time to surgery <36 h	0.651	1.09	0.75	1.58
Extracapsular fracture	0.492	0.88	0.62	1.26
Model 2				
ASA score ≤3	<0.001	0.28	0.17	0.47
Female gender	<0.001	0.47	0.32	0.68
Post-intervention	0.026	0.68	0.48	0.96
AMTS ≥7	0.003	0.59	0.41	0.84
Age	<0.001	1.07	1.04	1.09

CI, confidence interval.

Discussion

The change in our hip fracture service to an integrated orthogeriatric model of care resulted in an improvement in quality of care indicators and a significant reduction in mortality. Previous meta-analyses have agreed that orthogeriatric input improves the results of hip fracture surgery and is now a recommended standard of care. However, the best model of care remains uncertain [16]. Gupta demonstrated a significant reduction in TTS and LOS by changing from a minimal, weekly liaison model to fully integrated care, although a weekly model can now be considered historical and is no longer recommended [2, 23]. This study, to the best of our knowledge, is the first to directly compare two currently accepted models of orthogeriatric care in the same hospital. The improvements demonstrated support the implementation of a comprehensive integrated orthogeriatric care model in preference to an orthogeriatric consultation model of care [6]. The substantial effect of the intervention is emphasised by the improvement in mortality and other indicators despite a significant increase in comorbidity in the post-intervention group. Multivariate analysis defined the importance of age, gender, AMTS and comorbidity in predicting mortality. These findings are consistent with meta-analyses [22], prognostic studies [20, 21] and studies based on NHFD data [24]. This knowledge can be used to identify those most at risk and thus allocate local clinical resources appropriately. The improvement in quality indicators such as mortality, LOS and TTS have obvious clinical, financial and service benefits, and have been defined as the first 3 of 12 objective and subjective parameters useful in evaluating hip fracture care [25].

The main weakness of this study is that the intervention is compared with a historical control group. Also, the nature of any significant system change, especially where attitudes and behaviours are important, is that it occurs over a period of time. The date of intervention coincided with the majority of the changes, but it is likely that the hip fracture patients admitted from this date would have initially experienced a differential effect as the system was restructured. The improvements achieved have come despite an increase in the case-mix complexity. This was demonstrated crudely in the form of ASA grade, but the data required to perform detailed analysis of comorbidity and specific risk factors are not available from the NHFD.

We were unable to demonstrate a significant effect of TTS on mortality when other predictors were taken into account, and thus this variable was removed from our final model. Current evidence is far from clear, though suggests that early surgery is associated with a reduction in mortality and reduced LOS [26, 27]. The commonly cited time limit of 48 h for early surgery appears somewhat arbitrary [28]. We chose 36 h as the preferred maximum TTS since this is the current recommendation for best practice [5]. As our mean TTS dropped from 41.8 to 27.2 h with no effect on mortality, it is not clear whether reduction of the maximum TTS from 48 h to the currently recommended 36 h would

be clinically effective (in terms of mortality) in our population. The benefits may be seen in the incidence of post-operative medical complications, but these could not be investigated with our data set and warrant further study.

The simple acquisition of a large enough sample to permit robust data analysis in this study was possible because of the NHFD. Initially, the benchmarking data from these national data sets identified the need to improve local outcomes and gave the leverage required for resources to change our practice. The improved outcomes demonstrate elegantly how national data collection improved local practice. Compliance with the NHFD forms part of the best practice financial incentives in the NHS [5] and therefore leads to incremental improvement in standards and keeps hip fractures high on the agenda [18]. Monitoring itself can lead to improved productivity [29] and specifically, implementation of the NHFD has been shown to be beneficial [30]. Compliance with the NHFD collects the detailed data about the case-mix of patients, process of care and outcomes that are required to participate in the essential audit process when a change in practice is implemented [6].

This study suggests that implementation of an integrated orthogeriatric hip fracture pathway instead of a consultation-based service resulted in a significant improvement in mortality and quality of care indicators. The improvements occurred despite an increase in the complexity of an already challenging case-mix. National benchmarking data were instrumental in facilitating and monitoring the changes in our practice.

Key points

- Comparison of orthogeriatric care models.
- Reduced mortality with integrated orthogeriatric care.
- Reduced length of stay with integrated orthogeriatric care.
- Reduced time to surgery with integrated orthogeriatric care.

Acknowledgements

The authors wish to thank Tamas Borbely for assistance with data analysis.

Conflicts of interest

None declared.

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Received 21 July 2016; editorial decision 31 October 2016

Age and Ageing 2017; 46: 470–476

doi: 10.1093/ageing/afw216

Published electronically 8 December 2016

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Association between lower limb osteoarthritis and incidence of depressive symptoms: data from the osteoarthritis initiative

NICOLA VERONESE^{1,2†}, BRENDON STUBBS^{3,4,5†}, MARCO SOLMI^{2,6,7}, TOBY O. SMITH⁸, MARIANNA NOALE⁹, CYRUS COOPER^{10,11,12}, STEFANIA MAGGI⁹

¹Department of Medicine (DIMED), Geriatrics Division, University of Padova, Padova, Italy

²Institute of Clinical Research and Education in Medicine (IREM), Padova, Italy

³Physiotherapy Department, South London and Maudsley NHS Foundation Trust, Denmark Hill, London SE5 8AZ, UK

⁴Health Service and Population Research Department, Institute of Psychiatry, King's College London, De Crespigny Park, London SE5 8 AF, UK

⁵Faculty of Health, Social Care and Education, Anglia Ruskin University, Bishop Hall Lane, Chelmsford CM1 1SQ, UK

⁶Department of Neurosciences, University of Padova, Padova, Italy

⁷National Health Care System, Padua Local Unit ULSS 17, Italy

⁸Faculty of Medicine and Health Sciences, University of East Anglia, Norwich Research Park, Norwich NR4 7TJ, UK

⁹National Research Council, Neuroscience Institute, Aging Branch, Padova, Italy

¹⁰Oxford NIHR Musculoskeletal Biomedical Research Unit, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, Nuffield Orthopaedic Centre, University of Oxford, Windmill Road, Oxford OX3 7LD, UK

¹¹MRC Lifecourse Epidemiology Unit, Southampton General Hospital, University of Southampton, Southampton SO16 6YD, UK

¹²National Institute for Health Research Nutrition Biomedical Research Centre, University of Southampton and University Hospital Southampton NHS Foundation Trust, Southampton General Hospital, Southampton SO16 6YD, UK

[†]Veronese and Stubbs are joint first authors.

Address correspondence to: N. Veronese, Department of Medicine—DIMED, Geriatrics Division, University of Padova, Via Giustiniani, 2-35128, Padova, Italy. Tel: (+39) 049 8218492; Fax: (+39) 049 8211218. Email: ilmannato@gmail.com

Abstract

Background: osteoarthritis (OA) is associated with a number of medical morbidities. Although the prevalence of depression and depressive symptoms is presumed to be high in people with OA, no prospective comparative study has analyzed its incidence.