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ORIGINAL STUDY

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Hip fracture specialists facilitate low-dose spinal anaesthesia in fractured neck of femur surgery

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Fractured neck of femur is a common but potentially devastating complication of frailty. In other surgical specialities, there is an inverse relationship between surgical experience and duration of surgery; however, this has not been quantified in hip trauma. In perioperative hip fracture care, prolonged surgery may be associated with increased morbidity and significantly impacts on the conduct of anaesthesia. Specifically, low-dose spinal anaesthesia, which is associated with improved haemodynamic stability, cannot be used if surgery is likely to be prolonged. We studied the duration of hip fracture surgery undertaken in our institution and compared this to surgical expertise. We retrospectively explored our theatre database to identify patients who underwent hip fracture surgery in our hospital over a 62-month period, recording duration of surgery and primary operating surgeon. Surgeons were classified into one of 3 groups: Consultant hip surgeon (specialist interest in hip surgery), Consultant orthopaedic surgeon but non-hip specialist, or Non-consultant (trainee or non-training grade). We identified 1426 hip fracture procedures. Consultant hip surgeons performed all types of hip fracture surgery faster, and with reduced variation in surgical duration, than did either non-hip specialist consultants or non-consultant grades. Consultant hip surgeons consistently performed hip fracture surgery in under 60 minutes. Specialist consultant hip surgeons make low-dose spinal anaesthesia (with shorter block duration but increased haemodynamic stability) feasible. Our data supports the development of dedicated hip fracture trauma lists where patients should be operated on by specialist hip surgeons or trainees directly under their supervision.

Declaration of conflicting interests: Richard Griffiths is a member of the group developing NICE guidelines for arthroplasty, and is a founder member of the NHS Hip Fracture Perioperative Network. Richard Griffiths chaired Association of Anaesthetists of Great Britain & Ireland guidelines on surgery in the elderly and proximal femoral fracture.

Martyn Parker has received expenses and honorarium from several commercial companies and organisations for giving lectures on different aspects of hip fracture treatment, and has received royalties from BBrawn Ltd related to design and development of an implant used for internal fixation of intracapsular hip fractures.

The Authors declare that there is no other conflict of interest.

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INTRODUCTION

Fractured neck of femur is a common but potentially devastating complication of frailty, with a 30-day mortality of 8.3% reported in the National Hip Fracture Database in 2020 *(1)*. Recently, increased focus on the process of perioperative care and outcomes have helped to reduce this figure *(1,2)*. Intra-operative events that have previously been considered 'normal', such as brief episodes of hypotension, should no longer be deemed to be acceptable as they have recently been shown to be associated with increased mortality *(3,4)*. Longer surgical time, as well as post-operative problems, such as delirium or pain that limit early mobilisation after surgery, also contribute to morbidity and mortality *(5-7)*.

Hip fracture surgery is usually performed under general or spinal anaesthesia *(2)*. Large studies have not demonstrated a difference in outcome between these two anaesthetic techniques *(8-10)*, suggesting it is quality of care (for example, meticulous control of haemodynamics) rather than the type of anaesthetic which is most important *(3)*. The low-dose spinal technique has been shown to be associated with reduced intra-operative hypotension and blood pressure variability than 'standard dose' spinal anaesthesia *(3,11)*, and thus may be a simple means of improving quality of anaesthetic care by improving haemodynamic stability during surgery. However, low-dose spinal has a shorter block duration, which means its use is limited to procedures that will reliably be complete within approximately 60 minutes *(11)*.

Individual surgeons have an intrinsic 'work rate' that is independent of their grade or experience *(12)*, but in general, surgeons with less experience perform procedures more slowly than do more experienced surgeons *(13)*. Previous work has demonstrated an inverse relationship between the number of cases performed and duration of surgery in orthopaedic trainees when just starting to learn hip fracture surgery *(14)*. How surgical experience and duration of surgery is related once surgeons reach consultant level has not, to our knowledge, been studied in hip trauma surgery. This information is essential and relevant since the expected duration of surgery may impact on the conduct of anaesthesia, particularly concerning the feasibility of low-dose spinal anaesthesia.

We studied the duration of emergency hip fracture surgery undertaken in our hospital to assess whether increased use of the low-dose spinal technique would be possible in the future. We postulated that a surgeon's experience in hip fracture surgery was associated with surgical duration and variability of procedure length.

Approval for the study was sought from our local research and governance department but, as a retrospective audit, ethical approval was not considered necessary.

MATERIALS AND METHODS

We used our theatre database to retrospectively identify all patients that underwent surgery for fractured neck of femur in our institution from 29 October 2013 to 31 December 2018 inclusive using OPCS-4.9 codes W19.1, W19.2, W24.1, W46.1, and W47.1, corresponding to sliding hip screw, intramedullary nail, hip screws, cemented hemiarthroplasty and uncemented hemiarthroplasty respectively *(15)*.

We identified the primary operating surgeon's grade for each procedure, classified the grade of the primary operating surgeon as 'Consultant with specialist expertise in hip surgery', 'Consultant without specialist expertise in hip surgery' and 'Non-consultant' grade i.e. specialist registrar in training or non-consultant middle grade or Senior House Officer. A 'Consultant with specialist expertise in hip surgery' was defined by one who regularly undertakes major elective hip procedures such as total hip arthroplasty. We used data collected routinely in Trisoft TheatreMan *(16)*, our operating theatre database, to determine the surgical start and finish times, and used this to calculate operative time.

Table I. — Patient characteristics

		Number of patients	% of patients	Mean Age (years)	Age range (years)	Median Age (years)	Standard Deviation (years)
Gender	Female	977	68.5%	83.26	21–103	85	9.24
	Male	449	31.5%	78.21	21–102	81	13.26
All patients		1426	100.0%	81.67	21–103	84	10.92

Table II. — Number of procedures by type and surgical grade

Procedure and OPCS-4.9 Code		Total number of procedures	Grade of primary operating surgeon		
			Consultant Hip Specialist	Consultant Non-hip specialist	Non-consultant
W19.1	Sliding hip screw	174	96	7	71
W19.2	Intramedullary nail	112	77	3	32
W24.1	Hip screws	334	171	14	149
W46.1	Cemented hemi-arthroplasty	631	333	48	250
W47.1	Uncemented hemi-arthroplasty	175	147	2	26
	Total	1426	824	74	528

Sixty minutes operating time was chosen as a cut-off for suitability for low-dose spinal, allowing adequate time for positioning and draping, and was based on data from a previous study in which time from spinal injection to sensory block regression to T12 was 78.6 ± 23.6 minutes *(11)*.

We used GraphPad Prism version 8.1.2 to analyse our data, using one-way ANOVA to calculate differences between groups *(17)*.

RESULTS

A total of 1426 procedures for hip fracture repair with OPCS-4.9 codes W19.1, W19.2, W24.1, W46.1, and W47.1 (sliding hip screw, intramedullary nail, hip screws, cemented hemi-arthroplasty and uncemented hemi-arthroplasty) *(15)* were performed during the study period *(18)*. Patient characteristics from the procedures identified are presented in Table I. Specialist hip consultants performed the majority (57.8%) of these procedures. The number of procedures performed for each of these codes, and by each grade of surgeon, is presented in Table II.

Overall, specialist consultant hip surgeons performed surgery for fractured neck of femur faster than both non-hip specialist consultants and non-consultant grades, taking a median of 45.0 minutes (95% confidence interval 45.0-47.0 minutes), compared to 78.5 minutes (95% confidence interval 68.0-82.0 minutes) and 65.0 minutes (95% confidence interval 64-68 minutes) respectively (see Figure 1).

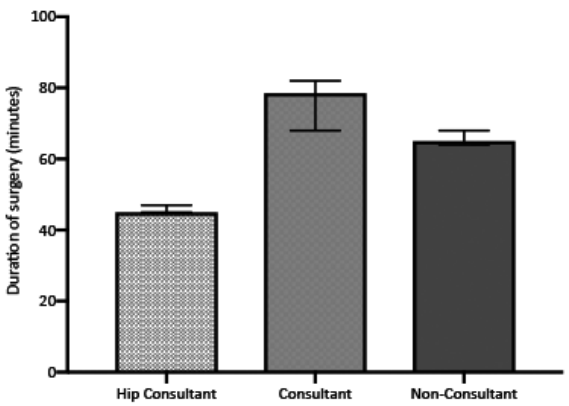

Figure 1. — Median and 95% confidence intervals for duration of all hip fracture surgery by surgical grade.

Across all procedures, specialist hip consultants performed procedures faster than did non-specialist hip consultants, with differences being both clinically and statistically significant ($p < 0.001$). Specialist hip consultants were statistically faster

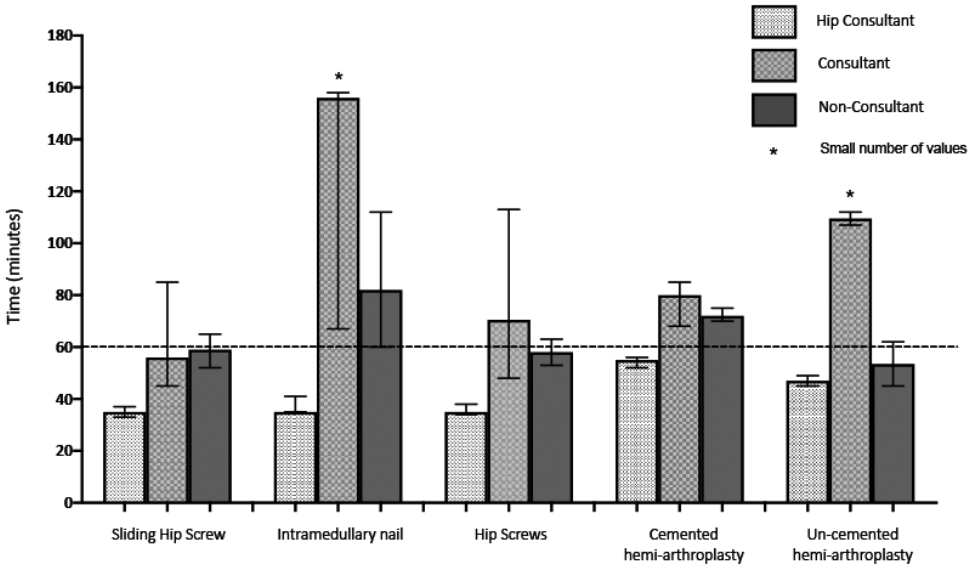

Figure 2. — Median time with 95% confidence intervals for surgical time (minutes) for the five different neck of femur fixation procedures, divided by surgical grade. The horizontal line marks 60 minutes, the maximum recommended duration for surgery.

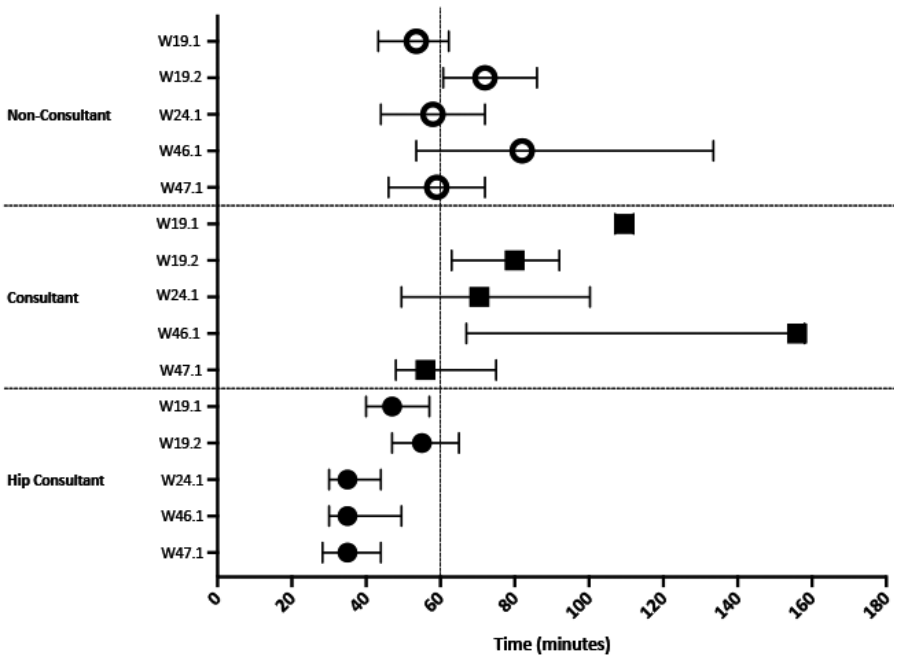

Figure 3. — Median and interquartile range of surgical duration (minutes) by procedure, and grouped by operating surgeon.

than were non-consultants for all procedures other than uncemented hemiarthroplasty procedures (see Figure 2).

The 95% confidence intervals (see Figure 2) and interquartile ranges (see Figure 3) for the specialist hip surgeons are narrower than for both

non-hip consultants and non-consultants, and few procedures performed by specialist hip surgeons lasted longer than the 60 minutes.

DISCUSSION

Hip fracture surgery is common, but there are substantial and significant differences in procedural duration which makes it challenging to standardise anaesthetic techniques for hip fracture surgery *(19)*. The most obvious reason for this is the variation in the surgical expertise available. Services need to ensure that those with 'appropriate expertise' are always available to perform and supervise this type of surgery. We suggest that 'appropriate expertise' equates to undertaking regular elective major hip procedures, and regularly undertaking fractured neck of femur surgery on trauma lists.

Data from our institution suggests that specialist hip surgeons perform hip fracture surgery faster than do non-specialist hip consultant surgeons and non-consultant grades. The range of surgical times for specialist hip surgeons is narrower; thus, the duration of surgery is more predictable pre-operatively than for non-specialist consultants or non-consultant grades. This is an essential finding for anaesthetists involved in the care of these patients: low-dose spinal anaesthesia may be performed for patients undergoing all but intramedullary nail repair if the surgeon is a consultant hip specialist without fear of surgery exceeding block duration since almost all procedures were completed in under 60 minutes. However, the duration of surgery will almost certainly exceed 60 minutes if performed by a non-specialist consultant. Total hip arthroplasty procedures are also likely to exceed 60 minutes; however, the type of arthroplasty performed has recently been shown to have no significant influence on the incidence of unexpected secondary hip procedures over a 24 month period *(20)*.

Somewhat surprisingly, non-consultants performed hip fracture surgery faster than did non-specialist consultants. This may be explained by the fact that this group is the most heterogeneous in terms of experience, comprising junior registrars near the beginning of their specialist orthopaedic training, to non-consultant specialists with many years of experience in hip fracture surgery. Some individuals in this group may be considered to be almost on a par with consultant hip surgeons in terms of experience. In contrast, others may have been very inexperienced and still working under close supervision and being trained. Junior surgeons may also perform hip fracture surgery more frequently than do non-hip specialist consultant surgeons.

The ASAP-2 study failed to demonstrate that grade of operating surgeon affected patient outcomes *(3)*. However, the authors suggest this might have been because consultants with specialist expertise in hip fracture repair were grouped with consultant non-specialists *(3)*. Our study demonstrates that non-specialist consultants take longer to perform hip fracture surgery. It would also not be surprising if non-specialist consultants had higher complication rates following hip fracture repair than specialists, since this has been observed in other surgical specialities *(21-26)*.

Patients operated on by non-specialist hip surgeons are more vulnerable to complications for several different but interrelated reasons. Non-specialists may have higher complication rates than do specialists; morbidity increases as the duration of surgery increases, which is also associated with surgeon experience; and anaesthetic technique may need to be modified to accommodate prolonged surgery by avoiding a low-dose spinal anaesthetic, which similarly may affect morbidity and mortality through increased haemodynamic instability *(3,4)*. The National Institute of Clinical Excellence clinical guidelines for fragility hip fracture [CG124] 1.5.2 states "Consultants or senior staff should supervise trainee and junior members of the anaesthesia, surgical and theatre teams when they carry out hip fracture procedures" *(27)*. We suggest that it is not so much 'seniority' but expertise in hip fracture surgery that is key, and only surgical and anaesthetic consultants that undertake hip fracture repair regularly should undertake these procedures, or supervise juniors.

For elective total hip arthroplasty, surgeons that perform at least 35 procedures annually have a significantly lower complication rate than those performing fewer procedures, and that in orthopaedics (as with other specialities) higher

case volume equates to better outcomes *(28)*. We suspect that anaesthetists require similar annual case numbers to maintain their skills, particularly given the frailty and vulnerability of the hip fracture population. Our local data supports the development of a specialist hip fracture service in our hospital with frequent dedicated theatre sessions, and a move away from providing hip fracture care on generic trauma lists. We suspect that our findings are typical for medium-sized UK district general hospitals. The incidence of hip fracture is such that many hospitals will be performing two to three operations daily, and this trend will likely increase with the ageing population. To ensure the best outcomes for these vulnerable patients, surgeons, anaesthetists and theatre staff need to concentrate their expertise so that a smaller number of individuals perform a greater number of procedures annually and are responsible for training junior doctors in hip fracture surgery. Only by focusing expertise in this way can the 'marginal gains' that are required to improve outcomes and reduce variability across the country be achieved.

Our study has a number of limitations. Data was derived from that routinely recorded in our theatre database but may be subject to inputting errors by theatre staff. Although we removed all procedures that had apparent mistakes, errors and omissions may remain. Similarly, the database simply recorded the operating surgeon's name and grade, but we had no record of whether that surgeon was either teaching others or being taught him/herself, the degree of operative complexity, or whether there were any particular intraoperative complications that may have affected the duration of surgery. Numbers were small for some groups, particularly for non-specialist consultants, thus conclusions drawn may be unreliable. Individual surgeons were classified as 'Consultant, hip specialist', 'Consultant, non-hip specialist', or 'Non-consultant' as per their clinical duties in our institution. However, we were unable to obtain data on prior experience of hip fracture, completion of a hip fellowship, nor of non-NHS responsibilities that may include hip surgery. However, the vast majority of hip fracture operations will take place within the NHS, and therefore non-NHS hip fracture work is likely to be infrequent for most surgeons. A follow-up study should investigate the incidence of post-operative surgical complications between surgeons with varying degrees of expertise in hip fracture surgery.

CONCLUSION

Surgeon experience, operating times, and the impact on the conduct of anaesthesia may interact and have a powerful effect on outcomes. Specialist consultant hip surgeons make low-dose spinal anaesthesia (with shorter block duration but increased haemodynamic stability) feasible as they can consistently perform hip fracture surgery in under 60 minutes. Our data supports the development of dedicated hip fracture trauma lists where patients should be operated on by specialist hip surgeons or by trainees under the direct supervision of a specialist hip surgeon, allowing perioperative hip fracture care to be standardised.

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