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Dynamic hip screws versus proximal femoral nails for intertrochanteric fractures

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Abstract

Background: It is essential to determine the optimal treatment of intertrochanteric fractures due to their high incidence and related public health burden. Debate remains as to whether dynamic hip screws (DHS) or proximal femoral nails (PFNs) are best practice, and this pilot study seeks to collect information relevant to this query.

Methods: We undertook a retrospective audit of 144 patients who received a dynamic hip screw or a proximal femoral nail in order to compare age, sex, duration of surgery, duration of hospitalization, time of first mobilization, and rate anaemia, sepsis, avascular necrosis, prosthesis failure, revision, deep vein thrombosis, pulmonary embolus, non-ST elevation myocardial infarction, common peroneal nerve palsy and death between implantation of a DHS and a PFN.

Results: No differences were found between groups in age, duration of surgery, duration of hospitalization, time of first mobilization and rate of complications. Statistically significant differences were found in sex distributions, operation time and length of stay. However, analysis of median operation time and length of stay when adjusted for sex revealed no significant differences.

Conclusion: This study demonstrated no statistically significant differences in peri- and post-operative measures between patients undergoing intertrochanteric fracture fixation via PFN or DHS. This is the only data from Australian hospitals, and further national research is needed.

Introduction

Inter- (per-) trochanteric femoral fractures occur in over 80 per 100 000 patients annually (US data), with mortality rates of 15–30%.[1] Such fractures pose a serious public health burden, due to hospitalisation, and increased dependence, co-morbidity and mortality. Due to the aging population, a global epidemic of hip fractures (intertrochanteric plus femoral neck fractures) is predicted – from 1.26 million in 1990, doubling by 2025, then 4.5–21 million by 2050,[2] with a comparable increase in public health demand.

Most systems of fracture classification divide intertrochanteric fractures into stable and unstable,[3] the most commonly used of which is the AO system. This divides intertrochanteric fractures into four types: stable trochanteric (Type A1), unstable trochanteric (Type A2), fractures at the lesser trochanter (Type A3) and sub-trochanteric fractures. Optimal treatment of intertrochanteric and high sub-trochanteric fractures is internal fixation[3,4] via either intra-medullary or extra-medullary implants, namely the proximal femoral nail (PFN) or dynamic hip screw (DHS), respectively.[1,3–5] The DHS is an extra-medullary device, which consists of a lag screw inserted into the femoral head via the femoral neck, and attached to a plate on the side of the femur. The PFN is an intra-medullary device inserted from proximal to distal (cephalocondylic), through the greater trochanter, and secured via a cross pin or screw, which is passed up femoral neck into the femoral head. The PFN is biomechanically advantaged, as it lies closer to the line of weight bearing, resulting in a shorter distance between implant and hip joint, which reduces torsional strain across the implant.

Currently, literature demonstrating the PFN having an advantage over the DHS is conflicted. Several studies have suggested that the DHS achieves greater compression of the fracture,[6] is less technically demanding[1] and less expensive.[1,7] In addition, Pajarinen *et al.*[6] found no difference in peri- and post-operative measures, as well as consolidation of fracture. Saudan *et al.*[7] also found no difference in time of operation and fluoroscopy, difficulty of operation, blood loss, fracture healing, fixation failure, post-operative pain, social

functioning, and mobility. Likewise, a recent Cochrane review found that there were no differences between the PFN and DHS regarding fracture fixation complications, reoperation, wound infection and length of hospital stay.[8] However, this same review found that the PFN achieved better intra-operative results than extra-medullary implants.[8] Numerous other studies recommend use of the PFN as they demonstrate decreased operation time,[9–11] decreased length of incision[11] producing minimal soft tissue trauma,[12] decreased blood loss,[1,10,11] an advantage in unstable fractures,[1,9,10] less post-operative instability and risk of dislocation[12] resulting in fewer reoperations,[10] decreased hospitalization time,[9,10] faster recovery of mobility,[6,9] and less post-operative pain.[12] To the authors' knowledge, there is currently no data comparing the DHS to PFN from Australian hospitals.

Overall, the literature suggests that the DHS has little advantage over the PFN except cost, while the PFN achieves better intra- and post-operative results, with fewer complications, dislocations and less pain, while increasing speed of mobilization. This suggests that the PFN is the optimal treatment for intertrochanteric and high sub-trochanteric fractures, but due to the continuing controversy and the lack of Australian data, further comparison is required.

Methods

This was a retrospective study carried out in an acute care Sydney hospital. Medical records of 144 patients (149 procedures) who had undergone operative treatment of an intertrochanteric fracture between 2006 and 2010 were de-identified and analysed. Various demographic, surgical and clinical data were collected from these records, including age, sex, type of implant, duration of surgery, duration of hospitalization and time of first mobilization, as well as complications directly related to surgery, including anaemia, sepsis, avascular necrosis (AVN), prosthesis failure, revision, deep vein thrombosis (DVT), pulmonary embolus (PE), non-ST elevation myocardial infarction (NSTEMI), common peroneal nerve palsy and death. Due to the retrospective nature of this study, duration of surgery was calculated from when the patient entered the operating theatre to when he/she left. The assumption was made that 'time-to-first-incision' and 'time for retrieval of patient' were equal in all cases. In reality, this is probably not the case, but the differences were estimated to be in the magnitude of only a few minutes, hence the authors felt that this would have a minimal impact on the final result. As our study centres around finding a difference between groups rather than an absolute value for 'duration of surgery', the results are still valid.

To determine whether there were any differences between the two surgical procedures, comparisons were conducted on all study variables. Data were analysed using the Stata V10.0 statistical software program (StataCorp, College Station, TX, USA). Study variables were analysed and described with means, standard deviations, medians and percentages. Bivariate analysis comparing outcome variables between the two surgical procedures were conducted using *t*-tests for continuous variables with normal distributions, and Mann–Whitney tests for variables with skewed distributions. Categorical variables were compared using chi-squared test. Non-parametric regression was used to compare outcome variables between surgical procedures after adjusting for potential confounders found in the bivariate analyses. A *P*-value of less than 0.05 was considered to be statistically significant.

Results

A total of 149 cases were included in this study. Patients' characteristics and outcomes are summarized in Table 1. The results obtained from the comparisons between the two surgical procedures were summarized in Table 2. As shown, there were no significant differences between groups in age, duration of surgery, duration of hospitalization, time of first mobilization and rate of complications. Although statistically significant differences were found in sex distributions, operation time and length of stay, adjusting for sex caused length of operation and hospitalization to lose their significance (Table 3). A total of 25 complications were suffered, with the majority of complications encountered by patients who had a PFN inserted, although this was not statistically significant. Twice as

Table 1 Mean (SD), median, or frequencies [%] of patients' characteristics and outcomes by procedure ($n = 149$)

Variables	Dynamic hip screw ($n = 98$)	Proximal femoral nail ($n = 51$)
Age	84.6 (8.2), 85.5	82.8 (9.8), 85.0
Sex		
Male	16 [16]	16 [31]
Female	82 [84]	35 [69]
Side		
Left	50 [51]	30 [59]
Right	48 (49)	21 [41]
Outcomes		
Operation time (min)	80.5 (21.2), 79.0	98.3 (39.3), 90.0
Length of stay (days)	10.4 (5.4), 9.0	14.8 (13.0), 12.0
1st mobilization (days)	3.1 (3.0), 2.0	2.4 (1.2), 2.0
Complications		
Yes	6 [6]	19 [37]
No	92 [94]	32 [63]

Table 2 Unadjusted comparisons on patients' characteristics and outcomes between the two conventional surgical procedures

Variables	Results
Age	$t_{147} = 1.31, P = 0.260$
Sex	$\chi^2_1 = 4.50, P = 0.034$
Side	$\chi^2_1 = 0.82, P = 0.365$
Outcomes	
Operation time (min)	$Z = -2.89, P = 0.004$
Length of stay (days)	$Z = -2.51, P = 0.012$
1st mobilization (days)	$Z = 0.67, P = 0.506$
Complications	$\chi^2_1 = 3.28, P = 0.07$

Table 3 Comparisons of operation time and length of stay after adjustment for sex

Outcomes	Results
Operation time (min)	$t_{137} = 1.67,\ P = 0.096$
Length of stay (days)	$t_{137} = 1.71,\ P = 0.090$

many PFN patients required a transfusion post-operatively (nine versus four). In the PFN group, one patient had a DVT and another had a PE. Two patients had an NSTEMI in the PFN group and one of these patients died as a result. Two patients in the PFN group required a revision to improve outcomes, while one patient in the DHS group had complete failure of their prosthesis. Two patients in the PFN group developed sepsis post operatively. One patient in the DHS group suffered from common peroneal nerve palsy, and one patient in the PFN group suffered from AVN.

Discussion

None of the parameters investigated revealed a significant difference between patients undergoing DHS and PFN procedures for internal fixation of proximal femoral neck fractures. Statistically significant differences were found in sex distributions, length of operation and length of stay. However, once adjusted for sex distribution, length of operation and hospitalization were no longer significantly different between groups. These results are supported by several other studies,[6,7,13] which suggest that there is no difference between patients undergoing PFN and DHS in terms of peri- and post-operative measures, or complication rate. Previous studies have suggested that the PFN procedure has an advantage over DHS in reducing time to first mobilization.[6,9] There was a slightly reduced time to first mobilization in PFN patients, but this was not found to be statistically significant.

Caution needs to be taken when interpreting these results, as several confounding factors have been identified. Firstly, 14 surgeons are included in this study. Some surgeons interchangeably use either DHS or PFN. Other surgeons appear to give preference to PFN or DHS, very rarely if ever, using the alternative. Further, we found that surgeons who gave preference appear to have a consistent 'duration of surgery' for that prosthesis, and that the 'duration of surgery' when these surgeons attempt the other prosthesis is almost always different. This raises the following point. If a surgeon usually gives preference to one method, but then operates with the alternative method, are the results affected in any way? That is, does the experience of the surgeon have a bearing on the results, and if so, how significant is this? Another possible confounder is whether the choice of prosthesis is based on the complexity of the fracture, with PFNs being the optimal treatment for complex fractures.[1,9] If so, the more complex the fracture, the worse the data will be for that prosthesis.

Although the majority of complications were suffered by patients in the PFN group, this did not reach statistical significance. It is unclear how the DHS patient sustained the injury causing the common peroneal nerve palsy. An interesting finding was the occurrence of AVN in a patient who received a PFN. It is possible that this was due to a complex fracture that disrupted the retinacular arteries, but the patient record did not reveal this information.

Generally, the literature is in favour of the PFN,[1,6,9–11] as it has been shown to consistently outperform both DHS and other intra-medullary devices. However, in meta-analyses, PFN are often grouped with less effective intra-medullary devices, resulting in clinical comparisons of DHS and PFN being unfavourable to the latter,[8,14,15] and current recommendations for treatment of hip fractures in Australia reflects this.[16] Further, while acknowledging its benefits, some argue the PFN is more costly for only a few advantages, which has some proponents recommending the DHS for its cost-effectiveness,[3,7] especially in simple fractures.[1,17] However, these advantages are worth the expense, because 'if we can reduce complications and reoperation rate in unstable fractures, and can allow more reliable, early full-weight bearing, the overall costs in these rare cases will be well spent'.[18] That is, a reduction in length of hospital stay (due to fewer complications and reoperations) and increased mobility benefit the patient, the healthcare team and the hospital budget.

This is the first collection of data directly comparing the DHS and the PFN in Australia, with the majority of the current literature being gathered in Europe.[6,7,9–11,13] It is important to obtain national data so that suggestions regarding best practice are specific to each country. In attempting to collect the data for this study, it was found that several of the variables the investigators originally sought to examine were absent from patient charts. These included fracture classification, incision length, blood loss, time of anaesthesia, post-operative pain, haematoma and return to preoperative mobility. As such, a prospective study in which certain parameters are measured before, during and after surgical intervention would reveal much more information. Also, such a study should be carried out over a longer period of time than the current study, examining numerous patients operated on by a single surgeon to reduce variability. Achieving a large sample size with these parameters will take time, especially due to a large reduction in hip fracture incidence (36% decrease in standardized hip fracture incidence between 2001 and 2006) owing to improved pharmacological prevention of osteopenia in elderly women.[19]

The current study was unable to reveal whether the DHS or the PFN is the optimal treatment for intertrochanteric femoral fractures, and similar to Pajarinen *et al*.,[6] found no difference in peri- and post-operative outcomes between the two procedures. However, small differences were found between some variables, and these may reach significance with a large enough cohort. As such, the authors recommend further prospective Australian studies in order to elucidate which treatment is not only most cost-effective, but also best for the patient and the healthcare team.

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