



Outcome in 36 elderly patients treated with the Gamma3 Long Nail for unstable proximal femoral fracture

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The results of a series of 36 elderly patients with proximal femoral fracture distal to the intertrochanteric line treated with the third generation long Gamma nail are presented. Outcome was comparable with the second generation nail in terms of 1-year mortality, length of stay, surgical complications and re-operation rate. No patients required re-operation for construct failure. Medical complications and reduction in post-operative function were relatively high in an elderly population with significant pre-existing comorbidities but 3 in 4 were independently mobile on discharge from the acute orthopaedic unit. Charlson Comorbidity Index > 5 on admission is identified as a predictor of increased mortality. The Gamma 3 Long Nail is shown to be a suitable implant for the treatment of these fractures. Little tangible benefit of this nail's new instrumentation is seen, with similar operative time to its predecessor, and more units of blood transfused.

Keywords : proximal femoral fractures ; Gamma Long Nail.

method of fixation. The Gamma nail has been widely used but was associated historically with a high rate of femoral fracture and re-operation (6). Several modifications of design and instrumentation have occurred, resulting in the most recent version, the Gamma3 Long Nail™ (GLN) (Stryker Trauma GmbH, Schonkirchen, Germany). In comparison with the second generation Gamma nail, it is narrower proximally and has a lower mediolateral curvature. Improved instrumentation such as the One Shot Device™ is suggested to facilitate minimally invasive surgery (13). Little published literature exists on the outcome of this new implant, especially when used for fractures distal to the intertrochanteric line.

When used for elderly patients with such fractures, the second generation Gamma nail is associated with in-hospital death of 5-6% (5,12), 30-day mortality of 8-20% (3,8) and 1-year mortality of 25-45% (3,8,9). Mean operative time is 93-

INTRODUCTION

Although relatively uncommon fractures of the proximal femur, those distal to the intertrochanteric line present many challenges, due to their inherent instability and the socially dependent and medically frail population who sustain them.

Cephalomedullary nailing is theoretically the most biomechanically stable and least invasive

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133 mins (3,8,10) and patients require on average 2.2 units of blood post-operatively (5,8). Technical or surgical complications range from 10-17% (3,5,8,9) with re-operation rates of 3-11% (9,12). Medical complications occurred in 10-17% (3,8). Mean length of stay in an orthopaedic unit is 6-19 days (3,5,8,10). A proportion of 89-92% of patients return to their pre-fracture residence (3,8).

The aim of this study was therefore to investigate outcome in a population of elderly patients with traumatic fracture of the proximal femur treated with the GLN, looking primarily at mortality, complications and post-operative function, and to compare it with the results of its predecessor. Furthermore, as it is a procedure performed relatively rarely outside designated trauma centres, we aimed to ensure that this is a safe treatment when performed in a District General Hospital in the United Kingdom.

PATIENTS AND METHODS

A retrospective study was performed of all patients treated with the GLN for traumatic fracture of the proximal femur at Weston General Hospital between August 2005 and February 2009. The study period begins when this nail was introduced at the hospital and ends in order to allow minimum follow-up of 1 year. Only those patients aged over 70 were included, or those over 60 with multiple medical comorbidities (Charlson Comorbidity Index Score (CCI) ≥ 4) (2). Fractures due to neoplastic deposits, high-energy fractures, and cases with multiple injuries were excluded. Patients were identified from the operating department's computer-based records and individual theatre logbooks. Data was then extracted from the patient's medical case notes. Comorbidity status was calculated using the Charlson Comorbidity Index while function was assessed using the Parker Mobility Score (PMS) (7). The nails were inserted using standard technique as recommended by the manufacturers. Configuration of distal locking screws was left to the preference of the operating surgeon. All patients received low-molecular weight heparin as thromboprophylaxis and 24 hours of IV antibiotics peri-operatively. Where possible, patients were mobilised on the first day post-operation. Non-parametric Mann-Whitney U-test and the chi-square test were used in the statistical analysis and significance was attributed to p-value < 0.05 .

Thirty seven patients had 37 fractures treated with the Gamma3 Long Nail during the study period. One patient was excluded because the casenote could not be located. There were 8 male and 28 female. The mean age was 84.5 years (median 85, range 62-95).

RESULTS

There were 30 subtrochanteric fractures, 2 reverse oblique, 1 intertrochanteric with a long spiral extension and 1 in the proximal third of the femoral shaft. Two fractures were periprosthetic, 1 just distal to a DHS plate and 1 intertrochanteric with a subtrochanteric extension around a Künscher nail.

The mean CCI score was 5.47 (median 5, range : 3-9). This translates into a mean predicted 10 year survival of between 2.25% (CCI 6) and 21.36% (CCI 5). The mean pre-operative PMS was 5.25 (median 5, range : 0-9) from a maximum of 9.

Twenty five patients (69%) were operated on within 48 hours of admission, the mean time between admission and theatre being 2.31 days (median 2, range : 0-9). The operating surgeon was a consultant in 18 cases and a registrar or staff grade in 18 cases. The mean anaesthetic time was 129 mins (median 120, range : 85-210). Open reduction was performed in 15 cases (42%), 21 fractures were reduced closed (58%). The mean anaesthetic time for closed reductions was 120 mins (median 120, range : 85-210). The mean anaesthetic time for open reductions was 142 mins (median 140, range : 90-210). This difference is statistically significant ($p = 0.012$).

The mean peri-operative drop in serum haemoglobin was 3.6 g/dl (median 3.7, range : 0.6-7.1). The mean drop for closed reductions was 3.56 g/dl (median 3.5, range : 0.6-6.9). The mean drop for open reductions was 3.54 g/dl (median 4.2, range : 1.0-7.1). This difference is not statistically significant ($p = 0.070$). Twenty six patients (72%) required blood transfusion post-operatively, receiving a mean of 2.65 units (median 2, range : 2-6).

Twenty six patients (72%) were mobilised fully weight-bearing after their operation, 8 partially weight-bearing, and 2 non-weight-bearing.

The inpatient mortality rate was 11%. The 4 patients that died in hospital had an average CCI

of 6.5 (median 7, range : 5-7). Of the 32 patients (89%) who recovered and left hospital, the mean length of stay in the acute orthopaedic unit was 17.1 days (median 14, range : 3-63). Seventeen patients were transferred to a rehabilitation unit where they spent a mean of 30.7 further days (median 25, range : 4-103). In total, patients spent an average of 33.4 days institutionalised post-operatively (median 22, range : 5-124).

Thirteen patients (36%) suffered medical complications post-operatively. There were 4 pressure sores, 2 deep vein thromboses, 3 myocardial infarctions (1 leading to cardiac arrest), 3 urinary tract infections, 1 pneumonia and 1 *Clostridium difficile* infection.

Surgical complications occurred in 6 patients (16%). Two proximal screws cut out from the femoral head but both patients had painless mobility. Delayed union was present in one case, a subtrochanteric fracture. In this case, one dynamic distal locking screw was used and one static. The fracture eventually healed 14 months post-operatively without need for removal of the static screw. There was one deep wound infection. This patient required washout in theatre and died in hospital. There were 3 superficial wound infections, 2 of which resolved with antibiotics, while one required washout in theatre. Re-operations were therefore needed in only 2 patients (6%), none of which were for failure of the construct.

Regarding the 32 patients discharged from hospital, the mean post-operative PMS was 2.8 (median 2, range : 0-7), with a mean drop in PMS of 2.7 (median 2.5, range : 0-7). Twenty-four of these patients (75%) were independently mobile and 25 (78%) returned to their pre-fracture residence. Twenty-four (75%) had a change in walking aids and 5 (15%) reported post-operative pain (2 mild, 3 moderate).

Twenty six of the 36 patients were alive at one year post-fracture, meaning a 1-year mortality of 28%.

In-hospital death was 8% (2 of 25) in those patients who underwent surgery within 48 hours of admission. It was 18% (2 of 11) in those patients who underwent surgery more than 48 hours after admission. This difference is not statistically

significant on chi-square testing ($p = 0.213$). One-year mortality was 24% (6 of 25) in those patients who underwent surgery within 48 hours of admission. It was 36% (4 of 11) in those patients who underwent surgery more than 48 hours after admission. This difference is not statistically significant on chi-square testing ($p = 0.337$).

Mean CCI of those operated on within 48 hours was 5.3 (median 5, range : 3-9). Mean CCI of those operated on after 48 hours was 5.9 (median 6, range : 4-9). One of the patients who waited more than 48 hours was admitted to the intensive care unit from Accident and Emergency with renal failure secondary to rhabdomyolysis. Another suffered an ST-elevation myocardial infarction during induction of anaesthesia.

Of the 26 patients who received a blood transfusion, in-hospital death was 15% ($n = 4$) and 1-year mortality was 31% ($n = 8$). Of the 10 patients who did not receive a blood transfusion, no patients died in hospital and 1-year mortality was 20% ($n = 2$). Chi-square testing shows the difference in 1-year mortality to not be statistically significant ($p = 0.169$).

In-hospital death was 5% (1 of 21) in those patients with $CCI \leq 5$. It was 20% (3 of 15) in those patients with $CCI > 5$. This difference is statistically significant on chi-square testing ($p = 0.0056$). One-year mortality was 5% (1 of 21) in those patients with $CCI \leq 5$. It was 60% (9 of 15) in those patients with $CCI > 5$. This difference is statistically significant on chi-square testing ($p < 0.0001$). These findings are summarised in Table I.

Eighteen of the 32 discharged patients (56%) were formally followed-up with radiographs in the fracture clinic. Union was seen in all these patients, at a mean time of 16.4 weeks post-fracture (median 12, range : 6-64). For all patients, the mean total follow-up was 24.2 months (median 24.5, range : 2-49).

Table II compares this study's findings with the published literature on the second generation nail.

DISCUSSION

This data suggests that the GLN is a suitable treatment option for unstable proximal femoral

Table I. — Factors affecting mortality

		In-hospital death		P-value	1-year mortality		P-value
All patients		4 / 36	11.11%		10 / 36	27.78%	
Time from presentation to theatre	≤ 48 hours	2 / 25	8.00%	0.213	6 / 25	24.00%	0.337
	> 48 hours	2 / 11	18.18%		4 / 11	36.36%	
Blood transfusion	Yes	4 / 26	15.38%		8 / 26	30.77%	0.169
	No	0 / 10	0.00%		2 / 10	20.00%	
Grade of operating surgeon	Consultant	2 / 18	11.11%	1.000	5 / 18	27.78%	1.000
	Junior surgeon	2 / 18	11.11%		5 / 18	27.78%	
Charlson Comorbidity Index	≤ 5	1 / 21	4.76%	0.0056	1 / 21	4.76%	< 0.0001
	> 5	3 / 15	20.00%		9 / 15	60.00%	

Table II. — Comparison of this study's findings with published literature on the Gamma2 nail

	Gamma2	Gamma3
In-hospital death	5-6%	11.11%
1-year mortality	25-45%	27.78%
Anaesthetic time (mins)	93-133	129
Units transfused	2.2	2.65
Surgical complications	10-17%	16.67%
Re-operation	3-11%	5.56%
Medical complications	10-17%	36.11%
Days in orthopaedic unit	6-19	17.1
Return to pre-# residence	89-92%	78.12%

fractures in the District General setting. One-year mortality is comparable to published literature on the second generation nail (25-45%) and the typically reported figure of between 20% and 35% for elderly neck of femur fractures (1,4,11). In-hospital deaths were higher than other studies at 11% but the sample size is small and the patients in the study had significant medical comorbidities. Medical complications were also higher than with the second generation nail but this might be expected in a population with such pre-existing morbidity, represented by the high CCI. It should also be noted that the average age of the patients in the studies that provided data on in-hospital death and medical complications was 73 years, 11 years younger than our study population.

Surgical complications and re-operation rates compared favourably. Importantly, there were no

re-operations for metalwork failure, cut-out or non-union. In terms of average operating time, this nail proved no quicker to insert than its predecessor and more blood was transfused on average, both facts suggesting little tangible benefit of the new instrumentation. However, it should be noted that only 37 nailings were performed over a period of 41 months.

There was significant reduction in function post-operatively, in terms of independent mobilisation, change in walking aids, drop in PMS and relatively low return to pre-fracture residence.

This study identified a predictor of increased mortality. CCI > 5 was clearly linked with increased in-hospital death and 1-year mortality. Receiving transfused blood and waiting more than 48 hours from presentation to surgery were associated with increased mortality but statistical significance could not be attributed. When considering this last point, it should also be remembered that patients with more medical comorbidities are more likely to have their surgery delayed, demonstrated by the higher mean and median CCI in those patients whose surgery was performed more than 48 hours after presentation.

Sample size is an obvious limitation of the study. However, the fact that only 37 nailings were performed in the hospital over a 41 months period stands as evidence for the relevance of the study, in order to demonstrate that this procedure has satisfactory outcomes, even when rarely performed in a centre.

CONCLUSIONS

This study shows the Gamma3 Long Nail™ to be a suitable implant for the fixation of unstable proximal femoral fractures distal to the intertrochanteric line. It can be performed in a District General Hospital by surgeons of differing experience on an infrequent basis. This study did not demonstrate any advantages of the third generation nail over its predecessor.

Ethics

Local ethical committee approval was obtained for this study. Consent was not obtained from individual patients as it was a retrospective casenote review.

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