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Fixed angle blade plating versus intramedullary nailing for Subtrochanteric femoral fractures: A case series

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Abstract
Aim: To compare closed intramedullary nailing to open reduction and internal fixation using a fixed angle blade plate for the management of subtrochanteric femoral fractures.
Methods: 58 patients were equally randomised to undergo either an intramedullary nailing (IN) or fixed angle blade plating (BP).
Results: There were no significant differences between the 2 groups with regard to age, time to surgery, operating time, receipt of blood transfusions, duration of hospital stay, or fracture classification. The revision rate was significant (28%) in the BP group and none in the IN group.
Conclusion: Internal fixation using a fixed angle blade plate for subtrochanteric femoral fractures has higher implant failure and revision rates, compared to closed intramedullary nailing.

Keywords: Subtrochanteric femoral, intramedullary nailing, subtrochanteric femoral fractures

Introduction
Subtrochanteric femoral fractures are common and account for 7 to 44% of all proximal femoral fractures, depending on the classification used [1-3]. A bimodal age distribution is noted where young patients (usually male) mostly present with high-energy injuries, and the elderly (usually female) present with osteoporotic low-energy fractures [4, 5]. Such fractures are associated with high complication rates, and include non-union and implant failure, which occur regardless of the fixation method, because of the unique anatomical and biomechanical features of the subtrochanter [2, 3]. Its cortex is thinner than the rest of the femoral shaft; it starts with the cancellous bone at the distal end of the intertrochanteric region and extends into the thick cortical bone of the proximal diaphysis [6, 7]. High compressive medial stresses and tensile lateral stresses were placed on fracture fixation devices [8, 9]. A medial buttress is important to minimise implant stress and fatigue failure [10-12].
In the 1970s and 1980s, internal fixation was the standard treatment for femoral fractures, whereas open anatomic reduction and internal fixation with fixed angle blade plates was recommended for subtrochanteric fractures [13-15]. Intramedullary nailing to incorporate fixation of the femoral neck and head has advantages, namely shorter operating times and less blood loss, as well as lower rates of infection, non-union, and implant failure.16–18 Plating is still recommended for fractures with proximal trochanteric extension, especially when medial cortical contact can be restored [3, 19, 20].
We aimed to compare closed intramedullary nailing without anatomic reduction to open reduction and internal fixation using a fixed angle device for subtrochanteric femoral fractures. The null hypothesis was that there was no difference in treatment outcomes between the 2 methods.

Materials and Methods
A subtrochanteric fracture was defined as a fracture with its centre between the lower border of the lesser trochanter and a point 5 cm distal to the lesser trochanter. Fractures with intertrochanteric extensions were included. Fractures were classified according to the system proposed by Seinsheimer. 1 Type I fractures are those that are undisplaced or displaced <2 mm. Type II are 2-part fractures, type III are 3-part fractures, and type IV are comminuted with ≥ 4 fragments.

Type V include any subtrochanteric fractures with extension through the greater trochanter.

All skeletally mature patients presenting to our hospitals with acute subtrochanteric femoral fractures between August 2001 and August 2003 were included. Those with ipsilateral femoral shaft or neck fractures were excluded. Informed consent was obtained from each patient and the human research ethics committee of each hospital approved the study protocol.

Patients were randomised to intramedullary nailing (IN) or blade plating (BP) treatments. The IN group was treated with closed reduction using a traction table, and percutaneous insertion of a Proximal Femoral Nail (Synthes AG, Chur, Switzerland) without anatomic reduction. The BP group was treated with open anatomic reduction, minimising soft-tissue stripping of fracture fragments, and internal fixation using a 95o-angled blade plate (Synthes AG, Chur, Switzerland) and interfragmentary screws. Bone grafting was at the discretion of the surgeon. Non-weight bearing mobilisation was allowed postoperatively for 12 weeks, or until callus was seen on radiographs.

A sample size of 100 was needed based on an underlying revision rate of 25%, with 80% power to detect a difference of 12.5% with a significance level of 5%. An interim analysis was planned after 50 patients were recruited.

The main outcome measure was revision surgery. Secondary outcome measures were: infection, non-union, mortality, duration of hospital stay, blood loss, operating time, and general health (as measured by the SF-36 general health survey21). Infection was considered present with or without evidence of an organism, if antibiotics or debridement were deemed necessary. Non-union was defined as the absence of bridging callus on 2 radiographic views 9 months after injury. Fixation failure was defined as migration or failure of the implant, or loss of reduction deemed to require revision surgery.

Dichotomous outcomes were analysed using the Chi squared and Fisher's exact tests, and Student's *t* test was used for continuous outcomes. A p-value of < 0.05 (2-tailed) was considered statistically significant.

Results

Due to a significantly higher revision rate in the BP group, recruitment was terminated after an interim analysis of the first 50 patients. By this time, 60 patients had been recruited, 30 in each group. Intention-to-treat analysis was performed. One patient in the IN group was diagnosed with a simple intertrochanteric fracture intra-operatively and treated with a sliding hip screw. One patient in the BP group was treated with a Proximal Femoral Nail, because of the surgeon's non-compliance with the allocation. These 2 patients did not develop any complications.

Eight patients in the BP group required revision for non-union, 7 of which sustained implant failure and loss of reduction. This was significantly higher than that in the IN group, in which no revisions were deemed necessary (P=0.025). One patient in the IN group had non-union at 9 months without fixation failure, eventually achieving union without surgery or implant failure.

No significant differences were noted between the 2 groups with respect to duration of hospital stay, operating time, receipt of blood transfusions, infections, or mortality; though both infection and mortality rates were higher in the IN group. One BP patient received an operative washout, whereas 3 IN patients were treated with antibiotic therapy alone (without debridement). All infections resolved without implant removal.

41 patients (20 IN and 21 BP) were interviewed 12 months after injury using the SF-36 form. Those not interviewed were dead, demential, or uncontactable. Differences between the 2 groups were not significant in each of the 8 domains.

Reduction was anatomic in all BP patients, but not in all IN patients. In some patients, reduction was poor, with major displacement in the lateral view, due to flexion of the proximal fragment. Despite this, patients in the IN group had a low non-union rate of 3%.

Only 2 BP patients were primarily grafted; one of them had a non-union and implant failure. Autologous bone grafting has been advocated for subtrochanteric femoral fractures, especially in high-energy trauma 12 or when medial wall comminution 22 or a fracture gap5 exists.

Discussion

Comparison between intramedullary nailing and fixed-angle plating for intertrochanteric femoral fractures has been reported.23,24 One study specifically looked at transverse and reverse oblique (often classified as subtrochanteric, analogous to a Seinsheimer IIC fracture) intertrochanteric fractures as per the classification of the Orthopaedic Trauma Association, but excluded fractures extending ≥ 5 cm from the distal lesser trochanter.25 An implant failure rate of 32% in the fixed-angle plating (Dynamic Condylar Screw) group versus zero in the intramedullary nailing group (Proximal Femoral Nail) was reported.25

Despite anatomic reduction, the mode of failure in the BP group was from plate or screw breakage, rather than loss of fixation in osteoporotic bones. The strength of blade plates may not be sufficient for such fractures. The dissection needed for BP also devascularises the bone and the surrounding soft tissues, leading to delay in healing. Our findings were consistent with the trend towards intramedullary nailing over fixed-angle plating for the treatment of subtrochanteric femoral fractures.

We only considered 2 implants, for which reason our findings may not be applicable to other devices or techniques, such as the Dynamic Condylar Screw. New techniques on percutaneous insertion of plates, including Dynamic Condylar Screws and locking plates are being developed. Percutaneous plating may have advantages similar to those of closed intramedullary nailing, by minimising the disruption to soft tissues around the fracture. Randomised controlled trials on percutaneous plating versus intra-medullary nailing are needed.

Conclusion

subtrochanteric femoral fractures present unique challenges in treatment due to their anatomical and biomechanical characteristics. Our study aimed to compare closed intramedullary nailing (IN) without anatomic reduction to open reduction and internal fixation using a fixed-angle blade plate (BP). Results revealed a significantly higher revision rate in the BP group, primarily due to non-union and implant failure. Despite concerns regarding reduction quality in the IN group, it demonstrated a lower non-union rate. These findings support the trend favoring intramedullary nailing over fixed-angle plating for subtrochanteric femoral fractures. Further research comparing different techniques and implants is warranted to optimize patient outcomes.

Conflict of Interest
Not available

Financial Support
Not available

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