

Operative internal fixation of isolated femoral diaphyseal fractures - is interlocking nail the best option?

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ABSTRACT

Femoral fractures are one of the commonest fractures encountered in orthopaedic practice. Over the years, treatment of this injury has evolved tremendously. The initial non-operative methods of reduction and stabilization have largely been replaced by operative fixation. There are currently three basic modes of internal fixation of femoral diaphyseal fractures in the adult age group: plate and screws, intramedullary Kuntscher nailing, and interlocking nailing. The objective of this study is to determine whether the so-called more 'technologically advanced' interlocking nailing results in better outcome compared to the more 'traditional' plate and screws, and Kuntscher nailing. It is found that, in terms of time to union and final function after an average of just under 2 years post-operative period, the group of patients who had interlocking nailing fared poorer. A review of relevant literature will then be presented.

KEYWORDS: Femoral diaphyseal fracture, Plating, Kuntscher nailing, Interlocking nailing.

INTRODUCTION

Operative internal fixation of femoral diaphyseal fractures can currently be described as having been through a full circle in its evolution: beginning with attempts by surgeons to fix these fractures using plates and screws to the introduction of intramedullary nails by Kuntscher in the 1940's and the advent of interlocking nails in the 1980's. Now, plates and screws are making a 'comeback' with the development of low contact plates, minimally invasive percutaneous osteosynthesis, and locking plates. Better understanding of the biology of fracture healing, anatomical dissection and implant fixation, and the construct of the implant themselves lend to this reversal of trend. The purpose of this article is to report the outcome of isolated diaphyseal fractures of the femur in our institution that undergo either one of the three standard methods of internal fixation: conventional plate and screws, Kuntscher intramedullary nailing, and interlocking nailing.

MATERIAL AND METHODS

Our institution is a tertiary referral center, being responsible for the care and treatment of a multitude of trauma cases. A major portion of the trauma workload involves patients with more than a single bone fracture, as well as 'polytrauma' patients, ie those with multiple system involvement. As a prerequisite,

only patients with isolated femoral diaphyseal fractures and with no other system involvement such as head injuries, were included in the study. This was necessary so that any other compounding factors did not influence neither the healing process nor the patient's recovery.

Of the number of trauma-related cases received, a total of 72 patients were admitted for isolated fractures of the femoral diaphyseal between January 2001 and December 2001. The femoral diaphyseal was defined as the portion between the lower edge of the lesser trochanter and a line parallel to and 6cm above the knee joint line. From the total of 72 patients, 39 patients were excluded from the study for the following reasons:

- a. refusal for operative fixation.
- b. previous lower limb injuries.
- c. defaulted follow-up following surgery.
- d. follow-up at other centers.

Furthermore, patients who had pathological fractures through weakened bone (e.g. those with metastatic lesions) and those who had prophylactic internal fixation for any impending fractures were excluded.

Thus, only 33 out of 72 patients were available for the outcome evaluation. Patients' case records were scrutinized and data was collected which include:

- a. Age
- b. Classification of fracture (according to the Arbeitsgemeinschaft fur Osteosynthesefragen/ Association for the Study of Internal Fixation [AO/ASIF] Classification System)

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- c. Type of surgical intervention employed (either plate and screws, intramedullary nailing, or interlocking nailing)
- d. Duration of surgery and amount of intra-operative blood loss (reflective of the difficulty of the surgical procedure)
- e. Time to radiological union (defined as the bridging of the fracture site by callus in at least three cortices in two radiological views)
- f. Complications encountered, if any

weeks.

The average operating time was 82.87 minutes while the average blood loss was 555mls. Union time was averaged at 20.06 weeks for all 33 patients regardless of the method of operative fixation. By distinguishing the patients in terms of the type of operative fixation performed, the following table was constructed:

Additionally, these patients were interviewed via telephone to determine if they had any complications that had been treated elsewhere, and their current perceived level of function (on a scale of 1 to 10) particularly in reference to their return to the original employment.

Surgical techniques

The choice between which type of implant to be used was at the discretion of the attending surgeon. For plating of the femur, patients were placed in the lateral decubitus position. Exposure was through a direct lateral approach down to the fracture. The fracture was then reduced under direct vision and the appropriate length plate secured. Patients receiving Kuntscher nailing were similarly placed in a lateral decubitus position, and the fracture ends exposed through a direct lateral approach under direct vision. A retrograde technique was used for insertion of the appropriate length and size of nail. Finally, for patients receiving interlocking nailing, they were placed supine with traction applied to the affected limb. The fracture ends were reduced, closed, reaming and appropriate nail insertion, and screw fixation was performed through an incision just above the greater trochanter using image intensifier. Proximal locking of the nail was achieved using an attached proximal screw guides while distal locking was done free hand. No fractures were reduced via an open reduction, and all patients had static locking. For all open fractures, patients initially underwent initial wound debridements and skeletal traction prior to definitive fracture fixation. No patients underwent initial external fixation. All patients received either prophylactic or therapeutic antibiotics depending on whether the fracture was closed or open.

Statistical analysis

Results from these 33 patients were reviewed and statistical analysis to detect significant difference was performed using the Kruskal-Wallis test for non-parametric comparison of median.

RESULTS

The age of the patients ranged between 17 to 43 years with an average of 23.6 years. There were 23 males and 10 females. Follow-up of these patients ranged between 52 to 124 weeks with an average of 101.1

Table I. Characteristics of evaluation data obtained according to type of operative fixation.

Characteristics	Plate and screws (n=12)	Intramedullary nailing (K-nailing) (n=11)	Interlocking nailing (n=10)
Average age (years)	21.27	25.91	23.6
Fracture (AO/ASIF) classification			
32-A1.1			
A2.2	1		1
A3.2		1	
A3.3	6	10	4
B1.2	1		
B2.2			2
B3.3	4		2
			1
Closed	10	9	9
Open Gd I	2	1	1
II		1	
Average operating time (min)	78.75	61.36	108.5
Average intra-op blood loss (mls)	525	490	650
Average time to union (weeks)	15.45	18.73	26
Complications			
Refracture	1		
Infection		1	2
Persistent pain			2
Delayed union			1
Protruding implant		1	
Final function			
Bad (score < 5)			2
Good (5 - 7)	2	1	2
Excellent (> 7)	10	10	6

Using the Kruskal-Wallis test to analyze the results between intramedullary nailing and interlocking nailing of fractures against that of plating of femoral fractures, no significant difference was found in terms of the age of patients, average operating time, average intra-operative blood loss, and the average time to union ($p > 0.05$). Additionally, we found that the fracture characteristics (type and classification of fracture) were almost similar although this was rather difficult to prove statistically. Also, we found that the group that had interlocking nailing of their fractures had more complications compared to the other two methods of treatment and that there were fewer favourable outcome (score of more than 7) in the interlocking nailing group in terms of final function at last follow-up.

DISCUSSION

We would like to have a larger number of patients enrolled in this study in order to achieve a powerful inference. As stated earlier, our center is a tertiary referral center and, as such, only rarely receives single, isolated femoral diaphyseal fracture. This was particularly true during the period that this study was performed.

Based on the available cases, we found no significant difference between the three methods of surgical intervention in terms of operating time and blood loss although patients having undergone intramedullary nailing seemed to be better off. Interestingly, although not statistically significant, the time of union was longest in those patients who had interlocking nailing performed despite the fact these cases were done without exposure of the fracture site. One would have expected that with exposure of the fracture site (as would have happened in both plating and intramedullary nailing), disruption of both intramedullary and periosteal blood supply would have resulted in a reduced potential to healing. We do not believe that the characteristics of the fracture pattern had much influence on the result because they appear fairly similar among the three groups. The numbers are too small to clearly define whether the fracture type and degree of comminution had a role to play in determining the level of operative difficulty. At a glance, this does not seem to be the case as the conventional plate and screws group appear at least comparable to the interlocking nailing group. It was also interesting to find that the complications encountered were more commonly found in the interlocking nailing group. We can only speculate that the techniques involved in interlocking nailing are more demanding than the

other two methods as reflected by the longer operating time and higher intra-operative blood loss. This may also explain why the fewer favourable outcomes in the interlocking nailing group.

Our findings show that there is still a significant place for the use of plates and screws, as well as intramedullary nails. Devnani has noted that for femoral diaphyseal fracture fixation, intramedullary nails definitely have a role to play, especially in the 'poorer' countries, although he did not specifically compare his results with that of other methods of fracture fixation.¹ Kesemenli et al, reached the same conclusion regarding the implant of choice in less affluent countries when they reviewed 14 diaphyseal fractures, treated using plate and screw fixation.² Fracture healing was achieved in an average of 4.07 months with only one case of non-union. While the union time between Kesemenli's patients and ours are almost similar, our group of patients were plated in the conventional manner, while the former had indirect (biological) plating. We did not have any union problems although a refracture occurred in one.

The advent of minimally invasive surgery (MIS) and less invasive fracture management, including that of 'bridge plating' and 'biological plating' have no doubt turned the tables on interlocking nailing as a primary mode of fracture fixation. More is currently known about fracture healing, vascular anatomy, and surgical technique to allow for plates and screws to be applied with minimal disruption of blood supply and thus minimal hindrance to fracture union.³⁻⁵ Severely comminuted fractures can certainly be treated very well using bridge plating.³

In instances when intramedullary devices are not feasible, such as in patients with severe thoracic injury and adult respiratory distress syndrome (ARDS), 'traditional' plate fixation may be the procedure of choice when the fracture needs to be stabilized emergently.⁴⁻⁷

One of the main reasons for this article was the belief that too much emphasis has been placed on interlocking nailing as the primary mode of femoral diaphyseal fracture fixation. Certainly, the techniques involved are more demanding with a steep learning curve with its fair share of complications such as anisomelia, torsional and angular deformity, and ARDS, and as seen here, the final outcome may not necessarily be better compared to the more 'traditional' methods of treatment.⁸ van Niekerk et al found that in comparing 19 nailings and 20 platings, the former was associated with a higher incidence of technical faults.⁹ Needless to say, meticulous attention to soft tissue technique is highly important in plating femoral shaft fractures. Geissler et al reported a 93% uneventful healing of 71 fractures with an average union time of 16 weeks.¹⁰ This time to union was very similar to ours despite the fact that 69% of their patients had medial cancellous bone grafting, while none of our patients had any.

With the increasing numbers of patients requiring emergency surgical intervention, procedures that require less operative time, costs less, and could be performed without an image intensifier, ought to be very beneficial indeed.² An interlocking nail should not be the recommended choice of implant for every femoral diaphyseal fracture. With patience and much respect for soft tissue anatomy, a similar or an even better result may be obtained with the plating or Kuntscher intramedullary nailing. It thus seems that, philosophically at least, femoral diaphyseal fracture fixation, has evolved in a circle - surgeons started off with plates and screws, then opting for the 'technologically advanced' intramedullary and interlocking nails, only to come back to plates and screws in the end. It also makes economical sense to use more plates and screws combined with more refined surgical techniques as the outcome is no worse than nailing but with less financial burden on patients.^{1,2,7}

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