Critical Evaluation Of Management Of Fracture Shaft Femur By Brooker Willis Nail

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Abstract

Fifty consecutive femoral shaft fractures of the femur were treated with the Brooker-Wills locking nail system. Choice of this device was based on the desire to use a closed nailing system that provides improved fixation of the distal femur. This nail differs from conventional interlocking nails in providing the distal locking by a pair of blades or fins. Per operative technical difficulties were encountered early in the series during nail insertion and in the deployment of the distal fins. In ten patients there was perforation of the femoral cortex by the distal locking fins. Shortening of more than 2.5 cm was seen in 8 cases and 1-1.5 cm in 6 cases. There was no case of angulatory or rotatory malunion. The average time to union was 16.1 weeks. No patient required postoperative traction or external support. Brooker Willis nail is an attractive alternative to the conventional interlocking nails in the management of fracture shaft femur. It is a versatile device, which can be used to treat complex fractures of the entire femoral shaft in acutely injured patients. Although very effective in opposing the angulatory and rotatory stresses, it is found lacking in providing adequate axial support. This study also highlights the technical difficulties encountered and post operative complications.

INTRODUCTION

The basic principles in treatment of fractures of the femur are restoration of position and alignment, maintenance of length, immobilization until bony union occurs and restoration of normal function after union 1 . Intramedullary nailing is biomechanically the ideal method of internal fixation for weight bearing long bones. Closed nailing concept was first given by Kuntscher in 1940. The introduction of locked nailing systems has now made it possible to provide excellent stabilisation of almost all femoral shaft fractures, however comminuted and at whatsoever level between the lesser trochanter and the condyles 2 . Besides excessive radiation hazard to the surgeon, technical problems associated with the insertion of distal locking screw, breakage of the screw especially when weight bearing is commenced early on and persisting pain over the screw heads, preempt the universal use of locked nail in femoral fractures. This is more applicable in small and district level hospitals especially in third world countries, which are lacking in costly instrumentation, imaging systems and surgeon expertise.

Brooker Willis intramedullary nail (BWIN) provides for both proximal as well as distal locking. Proximal stability is obtained by inserting a diagonal screw and distal stability is obtained by passing a double bladed transverse fixator down the nail using a detachable insertor/extractor and then deploying the blades/fins through a small slot on each side of the distal end of the nail 3 .

Keeping in view the advantages of this new type of interlocking device and the paucity of Indian studies on the same we decided on a prospective trial using the same.

MATERIAL AND METHODS

Fifty consecutive fractures of shaft femur were treated with Brooker Willis locking nail system (BWIN). All operations were done by the same operating team and a minimum follow up of 12 months was ensured before evaluation. A supine position on a fracture table after spinal anaesthesia was employed in all. Closed reduction by traction and manipulation was used and after satisfactory reduction was achieved under image intensifier, a 6-8 cm incision was given starting from the tip of greater trochanter going superiorly. The medullary canal was opened just medial to the tip of grater trochanter using an awl. Initial reaming of the proximal fragment was done with an 8 mm reamer to facilitate the passage of a ball tipped 3.2 mm guide wire with pre-curved tip. The guide wire was passed across the fracture site into the distal fragment by traction, manipulation and by

rotating the pre-curved guide wire tip. If after a few attempts we were not able to pass the guide wire across the fracture site, we used a minimal invasive technique in which a small incision of 2-3 cm was made at the fracture site. Without delivering the fracture fragments we reduced the fracture using bone hook, passed the guide wire across the fracture site and then closed the wound before proceeding further.

Sequential reaming with increments of 0.5 cm was done using the flexible reamers and power drill. The nail was mounted on the insertion jig and was introduced by pushing with the force of hand and only light taps of hammer. The distal locking transverse fixator rod was inserted into the proximal end of nail and passed down inside the nail. The fins were deployed distally through the slots on each side of nail under image intensifier. A negative suction drain without negative pressure was introduced through the proximal incision into the nail. Static knee exercises were started same day evening, partial weight bearing at 4-6 weeks depending on patient's confidence and fracture geometry. Full weight bearing was allowed after clinical union and radiological evidence of sufficient callus formation (figure II, IV, VI). The results were evaluated as per criteria laid by Thoresen et al 4 .

RESULTS

This prospective trial included 42 males and 8 females. The average age was 22.5 years (range 19–31 years). High velocity vehicular accident was the mode of injury in 92% cases. According to A.O classification, 72% fractures were A3.3 type, 20% were A2.3 and 8% of A3.2, A2.2 and C2.1 type. 68% fractures were in the lower one third of diaphyses (Fig 1, 2). Two cases were Gustilo type 1 compound. Maximum cases were operated within one week of injury (average=12.6 days). Closed nailing could be done in 30 cases out of 48 tried (Fig 3, 4). In 18 cases minimal invasive technique was employed to negotiate the guide wire past the fracture site. In two cases, we opened the fracture site primarily as it was a pathological fracture and required bone grafting.

Figure 1

Fig. 1. Transverse fracture in lower third femur

Figure 2

Fig. 2. Sound union with abundant callus at 16 weeks

Figure 3

Fig. 3. Comminuted fracture in lower third femur

Figure 4

Fig. 4. Fracture united with shortening due to collapse at fracture site

The average time for radiological union was 16.1 weeks. Full range of knee movements was achieved in 84% cases while in two patients could get only 40% of normal range of knee movement. In these two patients there was penetration of one of the distal fins anteriorly into the suprapatellar pouch (Fig 5, 6). Following removal of nail after fracture union almost full range of motion was achieved in both the cases.

Figure 5

Fig. 5. Penetration of the distal locking fin anteriorly into the suprapatellar pouch

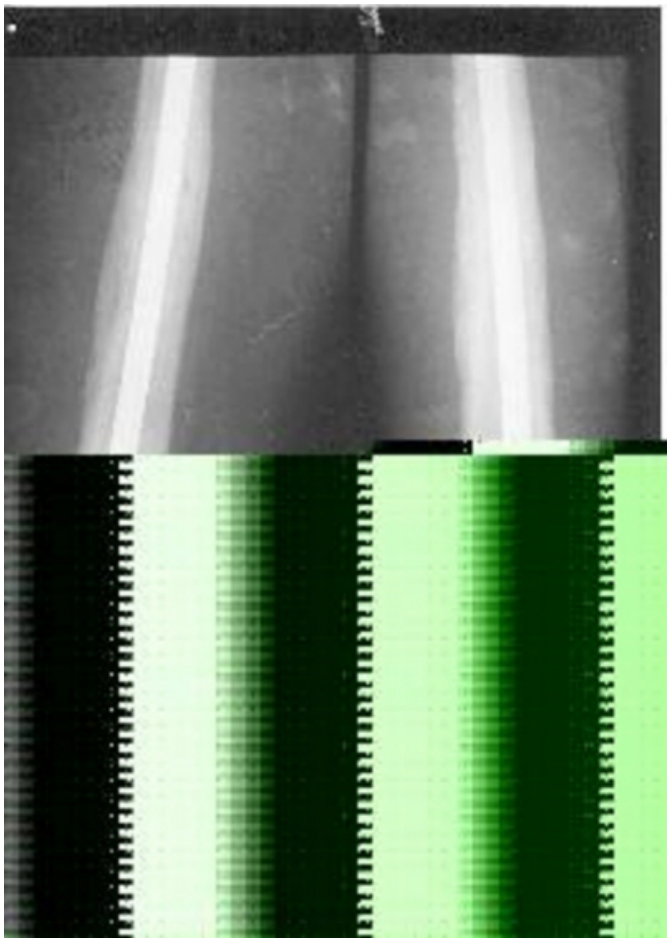

Figure 6

Fig. 6. Nonunion of segmental fracture with anterior cortical perforation

Table 1 shows the important complications encountered by us during the course if this trial. The overall results achieved were – excellent in 54%, good in 17%, fair in 18% and poor in 11% cases.

Figure 7

Table 1: Complications

COMPLICATIONS	NUMBER OF CASES (n = 50)
Penetration of distal fins through femoral cortex	10
Splintering of femur (peroperative)	2
Non Union	4
Malunion	-
Knee stiffness (< 90 degrees ROM)	2
Infection	1
Shortening	
> 2.5 cm	8
< 2.5 cm	6

DISCUSSION

A major advantage of Brooker Willis locking nail system is the ease of distal locking and a subsequent significant decrease in image intensifier time thereby reducing the radiation hazard to the surgeon. Levin et al 5 in their study of interlocking nailing found that the doses of radiation received during closed nailing and insertion of proximal interlocking screw was approximately the same as that received during the distal interlocking procedure alone. The average radiation exposure in our series was 2.92 minutes. This is significantly less as compared to other studies (Table 2). As distal screw fixation is not required in this type of nail, the surgeon as well as patient is saved from a substantial exposure to the radiation. Distal interlocking in a conventional interlocking nail is either done with a jig or by using a free hand technique both of which are cumbersome and not very reliable; hence Brooker Willis nail with its distal locking fins is an attractive alternative.

Figure 8

Table 2: Average Operating Time Under Image Intensifier

Author	Type of Osteosynthesis		Operative time under Image Intensifier (minutes)
Levin et al[5]	Gross Kempf nail		12.54
Grosse & Kempf[7]	Gross Kempf nail		3.4
Miller et al[8]	Closed Kuntscher nailing		5.4
Muller et al[9]	Reamed locked nailing		4.6
Goldstone et al[10]	Reamed intramedullary nailing		5.2
Our study	Brooker Willis nail	2.92	

As the concept of locking with distal fins was new to us we encountered quite a few technical difficulties. In ten patients the distal fins penetrated out of the distal femoral cortex. In one case they were discovered to have penetrated out both anteriorly and posteriorly peroperatively, necessitating the immediate removal of the distal fixator device. Fortunately no important structure was damaged. Fins had to be extracted and distal locking was achieved by using a conventional locking screw. In two cases there was penetration of anterior cortex into the supra patellar pouch. These patients had knee stiffness and persisting pain in the postoperative period. The nail was removed as soon as the fracture union occurred leading to subsidence of pain and full range of knee movements over a period of time. In four patients the fins penetrated the medial cortex but caused no pain or discomfort. We could identify two reasons for this

distal fin perforation. One is due to rotation of the nail while insertion due to loosening of the insertion jig. Care should be taken to repeatedly check for any loosening of the insertion jig while insertion of the nail especially when hammering is done. Further confirmation should be done by adequate radiological visualization of the rod in the lateral view before insertion and deployment of the fins. One must be able to see through both the slots in the rod in perfect lateral view of the distal femur. Second reason is too lateral placement of the entry portal in the trochanter. This causes the nail to occupy an eccentric position in the medullary canal resulting in penetration of the medial cortex of the distal femur when the fins are opened. Ebraheim et al 6 reported penetration of the distal femoral cortex by the fins in 11% of their cases.

Difficulties were also encountered with deployment of the fins in five cases. In one case the nail size and the transverse fixator size was unequal leading to difficult insertion of the fins.

There were three cases of nonunion. Two cases had ipsilateral compound fracture tibia for which external fixator was applied. The patients did not bear weight on the extremity for a long time, which probably led to non-union. In the other case of non-union, infection was the causative factor.

Eight (16%) cases developed shortening of more than 2.5 cm while three cases (12%) had shortening of 1-1.5 cm. There was no case of angulation or rotatory malunion in our series. Brooker Willis nail system although very sound in opposing the angulatory and rotatory stresses was found lacking in providing adequate axial support especially when the fracture is inherently unstable. The distal locking fins that embed themselves in the femoral cortex do not provide a strong enough bone – metal interface to prevent axial macromovements and excessive collapse at the fracture site more so in segmental and comminuted fractures. All the eight cases, which had shortening, had either comminuted, long oblique or spiral fractures. Fractures that are severely comminuted (grade III) and therefore inherently unstable should preferably not be fixed with this nailing system.

The minimal diameter of the nail available through which the transverse fixator rod can be passed is 11 mm. Too much reaming of a narrow marrow and tight insertion of the nail is liable to cause splintering (two cases in our series). As compared to western population the Indian femora especially in females are generally quite narrow, therefore there is a need for smaller diameter Brooker Willis nail in order to suit the Indian population

This study concludes that the Brooker Willis intramedullary nail is a simpler and safer alternative to the conventional interlocking nails provided it is nailed with caution and accuracy by expert hands. However this nail does not provide adequate axial stability so it is less suitable for comminuted and segmental fractures.

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