ORIGINAL ARTICLE

Locked Intramedullary Nailing For the Treatment of Femoral Shaft Fractures: Experience and Result in 19 Cases

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Abstract

Background: *Fractures in the proximal or distal third of the femoral shaft or those with severe comminution are known to be less suitable for intramedullary nailing with Kuntscher nail. With the introduction of interlocking intramedullary nailing the problems of rotational malalignment and shortening that accompany such fractures are now less common. At the National Orthopaedic Hospital Igbobi, Interlocking Intramedullary Nailing was introduced as a form of surgical treatment for fractures of the femur, our initial experience in this type of intramedullary nailing form the basis of this report.*

Method: *This is a retrospective study of all cases of fractured femur that were treated with locked intramedullary nailing between March 2002 and September 2003.*

Results: *During a 19-month period, 19 patients with 19 fractures were treated for fracture of the femoral shaft with locked intramedullary nailing using the Russell-Taylor (18 fractures) and Grosse-Kempf (1 fracture) nails. Thirteen fractures (68.5%) had comminution of the Winquist-Hansen type III and IV, 12 of which were statically locked.*

There were three intra-operative technical problems including the case of a subtrochanteric fracture, where the nail missed the medullary canal of the proximal segment. There were 2 cases of superficial wound infection, which responded to local wound care and antibiotics. Although limb length discrepancy and rotational mal-alignment were not assessed routinely during the follow-up of patients, no symptomatic malrotation was recorded.

Sixteen out of the 19 patients were available for follow-up for an average period of 11 months. All these cases progressed to union, without the need for dynamization in statically locked fixations.

Conclusion: *In spite of the initial problems encountered with this relatively new procedure in our centre, we were able to achieve a reasonably good result in addition to supporting the notion that dynamization of a statically locked nail is not always necessary for healing of fractures.*

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INTRODUCTION

The first recorded attempt at internal fixation with a metal rod was by Hey-Groves in 1916, but owing to various complications arising from the method, it was abandoned[1]. Internal fixation of femoral shaft fractures became popular after World War II, when open intramedullary nailing was introduced[2]. The Kuntscher nail which was the standard of intramedullary fixation at that time[3] provided the ultimate treatment for a noncomminuted fracture through the narrowest portion of the medullary canal. Fractures in the proximal or distal third of this shaft, or those with severe comminution, however, are less suitable for this form of internal fixation[1,2]. Fractures of these types are now being treated with techniques of interlocking nailing, the shortening and malrotation which plagued the earlier methods of treatment without capability of interlocking are now well controlled with available interlocking fixation[3].

The interlocking technique had been in existence as far back as the 1960's, when Kuntscher developed the prototype interlocking nail. Other first-generation nails include Klemm and Schellman (1972) and Grosse-Kempf (1976)[4].

The Russell-Taylor interlocking intra-medullary nail, which was used for most of the fractures in this study, belongs to the second-generation. Recently the third-generation femoral nails manufactured from Titanium alloy have been developed and include the solid AO unreamed femoral nails.[2]

The use of closed interlocking technique was not popular in our centre until the year 2002 due largely to non-availability of image intensifier. The purpose of this

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study was to retrospectively review our experience with the use of the interlocking nail in the treatment of femoral shaft fractures.

PATIENTS AND METHODS

The medical records of the patients with femoral shaft fractures treated with interlocking intramedullary nail were reviewed.

Data was collected regarding age, sex, mechanism of injury, nail diameter, and degree of fracture comminution. Radiographs of the fractures were reviewed. The femoral shaft from the sub-trochanteric area to the supracondylar area was divided into five zones[5] Proximal third, middle third, distal third, junction of proximal and middle third and junction of middle and distal third.

Pre-treatment x-rays were reviewed, and the locations of the fractures, fracture pattern and Winquist grade of fracture comminution[2] were recorded. Open fractures were classified according to Gustillo classification[6]. After treatment x-rays of the fractures were also reviewed and healing determined to have occurred when bridging callus was seen on the radiographs.

The length of the operative procedure was determined by reviewing the anaesthetic record. Two periods were assessed: Induction of anaesthesia and time of preparation and draping; and time of actual surgical procedure (time from incision to the end of wound closure). All intra-operative and post-operative complications were noted.

The patients were seen in the out-patient clinics at 6 weeks, 12 weeks,6 months, and one year. At these follow-up visits patients were assessed clinically and radiologically to determine the fracture healing time and complications of wound healing.

The data was analyzed by computer using the SPSS (Statistical Package for Social Sciences) software package.

RESULTS

Patients

Between March 2002 and September 2003 19 femoral fractures in 19 patients were treated with locked intramedullary nail.

There were 16 acute fractures. Three fractures had previous surgery: 2 had plate and screws with implant failure while the third case was a pathological fracture secondary to bony metastasis from suspected carcinoma of the prostate who previously had intramedullary fixation with a Kuntscher nail.

There were 16 male and 3 female patients. The average age was 37.8 years with a range of 19 71 years. The mechanisms of injury are shown in Table I. Eleven fractures were due to motor vehicle accidents and 1 was due to motorcycle accident. Eleven of the fractures involved the right femur while 8 involved the left.

Fourteen were closed fractures, while 5 were open fractures. The classification of the open fractures is shown in Table II. The anatomical location of the fractures is shown in Table III while Table IV illustrates the degree of comminution of the fractures according to Winquist-Hansen classification. The fracture pattern is also shown in Table V. Most associated injuries were orthopaedic injuries (Table VI).

TABLE I. MECHANISM OF INJURY

MECHANISM	NUMBER OF FRACTURES	PERCENTAGE
Vehicular Crash	11	57.89
Motorcycle Crash	1	5.26
Pedestrian Struck	4	21.05
Domestic Fall	1	5.26
Gunshot	1	5.26
Industrial Accident	1	5.26
	19	99.98

TABLE II. DISTRIBUTION OF OPEN FRACTURES (Gustillo & Anderson classification)

GRADE	NUMBER
Type I	1
Type II	3
Type III A	1
	5

TABLE III. ANATOMICAL LOCATION OF FRACTURES

LOCATION	NUMBER	PERCENTAGE
Proximal third	9	47.37
Junction of proximal and middle third	2	10.52
Middle third	3	15.79
Junction of middle and distal third	3	15.79
Distal third	2	10.52
Total	19	99.99

TABLE IV. DEGREE OF COMMINUTION (Winquist and Hansen classification)

GRADE	NUMBER	PERCENTAGE
0	3	15.79
1	2	10.53
2	1	5.26
3	5	26.31
4	8	42.11
	19	100

TABLE V. FRACTURE PATERN

PATTERN	NUMBER	PERCENTAGE
Oblique	2	10.53
Comminuted	8	42.10
Transverse	3	15.79
Segmental	6	31.58
	19	100

TABLE VI. ASSOCIATED INJURIES

INJURIES	NUMBER OF PATIENTS
Fracture pelvis	3
Radius ulna	2
Post hip dislocation	1
Fracture femur	1
Fracture Tibia/Fibula	1
Fracture Clavicle	1
Head and neck (lacerations)	8
	17

TABLE VII. TIMING OF SURGICAL STABILIZATION

TIME POST INJURY	NUMBER
< 72 Hours	-
4 7 days	2
8 13 days	6
15 21 days	5
26 days	3
	16

OPERATING PROCEDURES

All fresh femoral fractures were placed in skin traction on presentation. Table VII shows the timing of operation for 16 fresh cases.

Implant diameter was 10mm in 9 cases, 11mm in 9 cases and 12mm in 1 case. Only one nail was Grosse-Kempf while the remaining 18 were Russell-Taylor nails.

Three methods of nailing were used: static interlocking nailing (Fig.1) in 12 patients (63%) who had Grade III or IV comminuted fractures, dynamic nailing with proximal locking screws (Fig.2) in 3 patients (16%) and distal locking screws (Fig.3) in four patients (21%) depending on the location of the fracture.

The average operative blood loss was 600mls (range 400 850 mL) in closed nailing and 1950 mL (500 3500 mL) in open nailing.

Antibiotics were administered commencing at induction for the closed fractures. The average anaesthesia and set up time was 39.6 min. (range 20 65 min) whereas the average time for the actual operative procedure was 153.5 min. (range 100 240 min.).

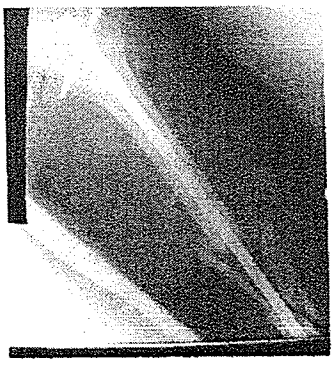

Figure 1a-Static locking (proximal screw)

Figure 1b - Static locking (distal screws)

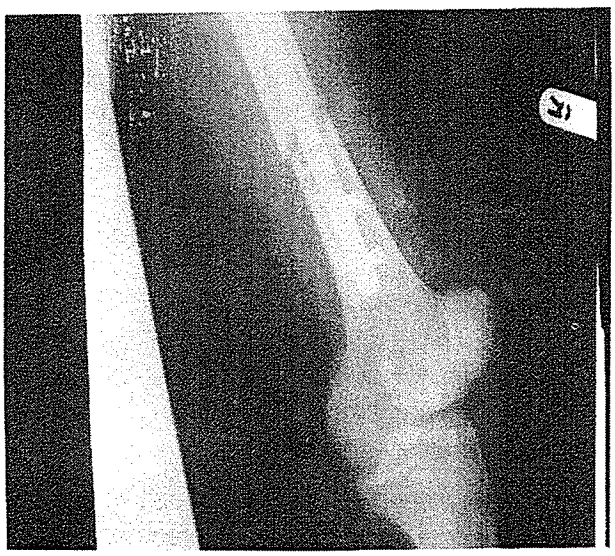

Figure 3 - Dynamic locking (Distal)

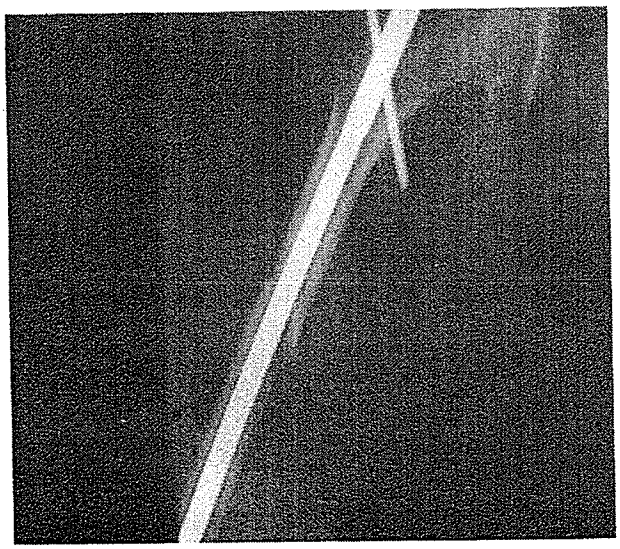

Figure 2 - Dynamic locking (Proximal)

INTRA OPERATIVE COMPLICATIONS

There were two experiences of intra-operative technical problem. In one case, the proximal locking bolt was inserted but missed the nail hole. In another case, a subtrochanteric fracture, the nail missed the medullary canal of the proximal segment; the nailing was done closed. Unfortunately, this problem was not detected until good quality x-rays were obtained some days postsurgery[4].

There was a case of iatrogenic unicortical fracture during the insertion of one of the distal screws.

EARLY COMPLICATIONS

Three patients developed superficial wound infection, which resolved completely with wound care and antibiotics. In two of the cases, the nailing was done closed and open in the third case.

The patient in which, the inserted proximal screw missed the nail hole had a proximal migration of the nail with complete loss of reduction of the fractured fragments. The plan was to go back to adjust the nail but the image intensifier was then unavailable, and a tibia skeletal traction was then applied with subsequent reduction of the fracture fragments which were maintained for eight weeks. The case of subtrochanteric fracture in which the nail missed the proximal fragment had repeat surgery a week later.

POST OPERATIVE CARE

Apart from those with associated skeletal injuries such as pelvic fracture and contralateral hip dislocation, most of the patients were mobilized 10 days post surgery non-weight bearing with axillary crutches, having been commenced on quadriceps strengthening and range of motion exercises immediately after surgery.

The patients were discharged from the hospital once they were comfortable with the use of bilateral axillary crutches.

The average time interval between admission and discharge for all patients was 50 days (range 17 to 105), which was dependent upon concomitant injury resolution and 37 days (range 17 - 103) for patients with isolated femoral fracture. The patient with isolated femoral shaft fracture that spent 103 days on admission was the one that had skeletal traction applied post surgery.

FOLLOW UP

Three of the patients defaulted while 16 were available for adequate follow up. The average follow up was 11 months (range 5 to 24 months).

Radiographs were obtained at regular intervals until there was evidence of consolidation. In those without associated skeletal injuries that could preclude weight bearing, partial weight bearing with one axillary crutch was commenced as tolerated between 8 and 12 weeks post surgery when there was evidence of bridging callus and clinical union. These subsequently progressed to full weight bearing without any assistive device when there was radiographic evidence of healing (defined as Good callus formation with obliteration of fracture lines[8] which was achieved in an average of 6.8 months (range 3 to 15 months). The average time to union (radiographic union) for statically locked nailing was 7.4 months (range 3 to 15 months) while time for dynamically locked fracture was 6 months (range 4 9 months).

No additional operative procedure was required to achieve healing in the 3 cases of delayed union (healing after 9 months post surgery) .[9, 10] The fracture that took 15 months to heal was one of the cases of implant failure. The pathological fracture secondary to metastases has not united, the patient ambulates partial weight bearing.

Only 11 out of those followed up had the range of motion of their knees measured and none of them had less than 90^0 with 6 of them having greater than 120^0.

Although limb length and rotational mal-alignment were not objectively assessed, there was no symptomatic mal-alignment and obvious limping in any of the patients.

DISCUSSION

In this study, 16 fresh and 3 old femoral shaft fractures were treated with interlocking nail. This modest figure does not reflect the number of patients with femoral shaft fractures that present in our centre, which is, a 400-bed hospital and the largest trauma centre in the West African sub-region. High cost of nails, and unavailability of image intensifier at most times, militated against the choice of locked intramedullary nailing in the treatment of many femoral shaft fractures that presented in the same period.

The average time interval from the time of injury to the time of nailing was 15 days (range 4 26 days). The timing in our study is longer than most other series in which majority of the fractures were fixed within 24 hours of injuries [5,7,8] . Apart from the case of fracture from gunshot injury where it was necessary to allow for some days for wound care, and for the wound to become clean enough [4,8,9] , other delays were due to finance, and occasional logistic problems in the hospital.

The number of cases with open reduction was relatively high, 9 out of 19 (47.4%) compared to other studies. [7,9] It is pertinent to state that while 5 (26.3%) were as a result of

intra-operative difficulty in achieving closed reduction, 4 were planned to be performed open for various reasons which included removal of plates and screws in two previously operated cases. Anticipated difficulty of closed reduction in two cases that were operated four weeks post injury warranted an open reduction.

Three of the seven dynamically locked nails were done because of the anatomical locations of fractures; in the remaining four it was due to intra-operative technical difficulty. [4, 7] Proximal or distal dynamic locking was done depending on the location of the fracture. The average blood loss and the operative time for closed nailing were comparable with those in other reports. [8,9]

The average time to union was also comparable to those in other series.[8-10] However, it is not possible that the union (radiographic) time for individual fracture could be less because some of the patients did not do the x-rays as at when due, because of finance.

Considering the number of patients involved, and the fact that four patients (2 statically and 2 dynamically locked nails) could not be followed to union, it is difficult to conclude that fractures treated with statically locked nails take longer time to heal, but what is obvious is the fact that dynamization of a statically locked nail is not always necessary for healing of fractures. [4, 11]

Some studies [11-13] have shown that immediate weight bearing as tolerated is safe while some authors prefer immediate weight bearing for dynamic nailing and delayed for static nailing.[4, 9] The average size of nails used in those studies was 13mm, while we used smaller sizes 10mm and 11mm in our patients, hence the precaution taken in delaying weight bearing until there was significant callus formation and clinical union. No case of implant failure was noted.

None of the patients experienced any form of discomfort that could necessitate removal of the locking bolts or the entire nail as reported in other studies. [5, 11]

The presence or otherwise of limb length discrepancy and rotational deformity was not documented, but no clinically symptomatic malrotation was recorded. We found inter-locking nail very useful in the treatment of fractures that were hitherto managed non-operatively in our centre with significant reduction in the hospital stay and excellent functional results. This study supports previous studies that showed that it is not absolute for fracture treated with static locking to be dynamized in order to achieve healing.[4, 11]

We hope that in the subsequent prospective studies, documentation of other parameters such as limb length, rotational mal-alignment, and angulations will be measured in the assessment of outcome.

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