Outcome of Femoral Shaft Fractures Treated With Interlocking Nails: Dynamization Mode Versus Static Mode.

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ABSTRACT

OBJECTIVE: To evaluate and compare the radiological and functional outcome of interlocking nail femur in dynamized with static mode.

STUDY DESIGN: Prospective Randomized trial.

PLACE AND DURATION: Orthopaedic and Traumatology Department Lady Reading Hospital from 3rd February 2014 to 10th January 2018.

METHODOLOGY: Transverse and oblique fractures shaft of femur meeting the inclusion criteria were randomly divided into two equal groups. Group I was treated with reamed antegrade interlocking nail in dynamized mode while group II in static mode. Both groups were followed for two years. Radiologically union time, delayed union, non union and implant failure was assessed and compare in both groups. Functional evaluation was assessed with Thorensen’s criteria as excellent, good, fair and poor. P value was considered significant if < 0.05.

RESULTS: Both group I and II had 50 patients each. Mean age of group I and II was 36.1±SD 11.41 and 37.4±SD11.24 years respectively. Dynamic nails were associated with early fracture healing(15th week) than static nailing(22nd week).Excellent functional results were achieved in 84% patients in group I and 22% patients in group II.(P value < 0.05) Delayed union was noted in 8% patients in group I and 26% in group II(P value < 0.05) while non union in 2% patient in group I and 16% patients in group II(P value < 0.05)

CONCLUSION: Dynamic interlocking nail femur for oblique and transverse shaft fractures results in excellent radiological and functional outcome in majority of patients than static interlocking nails.

KEYWORDS: Fracture, Shaft of Femur, Interlocking Nail, Radiological Outcome, Functional Outcome, Dynamization, Static, Delayed Union, Non Union.

INTRODUCTION

Fractures shaft of femur are one of the major cause of morbidity and mortality worldwide.¹ The objectives of treating these fractures are to achieve rapid fracture union with early weight bearing and return to workplace.²³ The standard gold treatment for femoral and tibia shaft fractures is intramedullary nail fixation with reported rates of femur union approaching 97% ⁴. Intramedullary nail fixation is a minimally invasive operative technique having features of lower impairment of the perfusion at the fracture site, low complications and a high stability ⁵. In orthopedic surgery, intramedullary nailing techniques include antegrade and retrograde both reamed and unreamed methods, static and dynamic locked nail respectively. Application of techniques are growing day by day, due to advancement in technology and development of implants and because of the progress of operational techniques ⁶ ⁷. In static nail fixation, there is one proximal and two distal locking screws which prevent malrotation and shortening. Dynamization is achieved either through one locking screw placed in proximal dynamization screw hole and two locking screws placed on distal side of the fracture or inserting locking screws only in smaller portion of the fracture fragment while leaving the larger portion without screws.⁸ ⁹. Dynamized mode of interlocking nail allows early weight bearing which accelerates fracture healing.¹⁰ The main target of fracture treatment and management especially in lower extremities is to rapidly maintain the integrity of the
bone and to twitch physical therapy. The consequence of fracture healing is highly associated with the quality and performance of surgery. Low incidence of infection, high stability and strength of fragments union, the opportunity of early mobilization with conserving soft structure and peripheral circulation are an assurance of achievement and quality of fracture healing of the femur, treated using static and dynamic intramedullary osteosynthesis.

The treatment of choice for femoral shaft fractures in our department is the interlocking Nail. But unfortunately because of lack of local clinical evidence and standard protocol, the mode of locking of interlocking nail is subject to surgeon’s personal experience and choice. The results of our study will help us in forming a standard protocol for interlocking nail in our department. Moreover, mode of locking will determine patient’s post operative weight bearing, rehabilitation and return to his workplace. The objective of the study is to evaluate and compare the radiological and functional outcome of interlocking nail femur in dynamized with static mode.

METHODOLOGY

This perspective randomized study was conducted in Department of Orthopaedics Lady Reading Hospital Peshawar Pakistan from 3rd February 2014 to 10th January 2018. All patients with radiologically and clinically diagnosed cases of femoral shaft fracture sustained within two days and classified according to the AO types [32A2 oblique fracture (>30°), 32A3, transverse fracture (<30°)] and including all locations like proximal 1/3(a), middle 1/3(b) and distal 1/3(c) were included. Patients with 32A1 (spiral fracture), bilateral femoral shaft fractures, neck of femur or intertrochanteric fractures, open fractures, neck or intertrochanteric fractures, open fractures [Gustilo Anderson type III(B) & C], pathological fracture and with poly trauma were excluded. The study protocols were approved by Hospital Ethical Review Board and written consent was taken from all the participant of the study. In the included subjects after initial resuscitation according to ATLS protocols, the X-ray of the affected limb including hip and knee was taken and fracture was classified. Closed fractures were initially stabilized and open fractures (type I, II, IIIA) were given 1gm of IV Cefuroxime and wound site thoroughly debrided and washed under anaesthesia. All the patients were operated on the immediate available operation list with same standard operative technique. All the surgeries were performed on traction table in supine position and under image intensifier. Preoperative second generation Cephalosporin was given. Fracture was reduced closely with traction and checked in AP and lateral views in image intensifier. Closed antegrade nailing with piriformis fossa entry site was used. Fracture site was not opened. Reaming with flexible reamers followed by insertion of possible maximum diameter and length of nail was used in each case. After insertion of the nail all the patients were randomized into two groups intraoperatively, dynamized (group I) and static (group II). The operating surgeon was not aware which mode of locking was to be used till the scrub nurse opened one among the 10 sealed envelopes and announced the mode of locking. In dynamized mode either single proximal locking screw was used if the proximal fracture fragment was smaller or two distal distal locking screws were inserted if distal fracture fragment was smaller. Middle 1/3 fractures were locked only proximally in dynamized group. In static mode one proximal locking screw and two distal locking screws were used in all cases. Maximum fracture reduction was tried in all cases. All surgeries were performed by the same experienced orthopaedic surgeon with same surgical procedure adopted in all cases. Check x-ray was done on first post operative day. All Patients were started knee and hip exercises by physiotherapist on the first post operative day. Both groups were encouraged to start partial weight bearing within a week and full weight bearing once tolerated. All the patients were discharged home on second or third post operative day with intravenous salbactum plus cefoperazone antibiotics for three days. First follow up visit was done at two weeks with stitch removal and wound examination. Further follow up visits were done monthly for first three months and then at 3 months interval till two years. Swabs for culture and sensitivity were taken from patients with suspected infection and treated accordingly. Deep infections were treated with debridements. The fracture was termed united when callus was seen across the fracture site in 3 out of 4 cortices on AP and Lateral X-rays. Delayed union and non union was defined as no progress of callus to bony union seen by six months and nine months respectively. Functional outcome was evaluated with Thoeresen’s criteria. (Table I) at 10th post operative month. Patients with delayed unions were dynamized with removal of locking screws. Non union/broken nail was treated with exchange nailing.

Data analysis: Data was analysed using the SPSS version 22. Mean and standard deviation were computed for quantitative variables. Comparisons between qualitative variables were performed by Chi square test. P value was considered significant if < 0.05.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varus or valgus (degrees)</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Antecurvatium or recurvatium (degrees)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>&gt;15</td>
</tr>
<tr>
<td>Internal rotation (degrees)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>&gt;15</td>
</tr>
<tr>
<td>External rotation (degrees)</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>&gt;20</td>
</tr>
<tr>
<td>Shortening (cm)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>&gt;3</td>
</tr>
<tr>
<td>Knee flexion (degrees)</td>
<td>&gt;120</td>
<td>120</td>
<td>90</td>
<td>&lt;90</td>
</tr>
<tr>
<td>Extension deficit (degrees)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>&gt;15</td>
</tr>
<tr>
<td>Pain or oedema</td>
<td>Absent</td>
<td>Sporadic, low</td>
<td>Moderate</td>
<td>Intense</td>
</tr>
</tbody>
</table>
RESULTS

This study included a total of 100 patients divided randomly into two equal groups each containing 50 patients. Group I consists of patients with femur fracture stabilized with interlocking nail in dynamized mode while group II consisted of static interlocking nail patients. The mean age of group I and group II patients were 36.1±SD 11.41 and 37.4±SD11.24 years respectively. Male patients were 38(76%) and female 12(24%) in group I. In group II male were 35(70%) and female 15(30%). Predominant site of injury in both groups was the right side i.e. 64% in group I and 58% in group II. Road side accident was the cause of fractures in 72% patients in group I and 64% in group II. Open fractures were documented in 24% patients in group I and 30% in group II. The fracture geometry in majority (62%) of group I patients were oblique while majority (72%) of group II had transverse fractures. Middle 1/3 fractures were the commonest (40%) location in group I while distal 1/3 (38%) in group II. The type of fracture in most (62%) of patients in group I was AO type 32A2 while in group II, AO type 32A3 was noted in 72% patients. Majority of surgeries in both groups i.e. 64% in group I and 56% in group II were performed under general anaesthesia. All others were done under spinal anaesthesia. Maximum number of fractures were stabilized with 11mm diameter and 40 cm length nail in both groups, i.e. 54% in group I and 62% in group II followed by 10 mm nail in 28% patients in group I and 24% patients in group II and 12 mm nail in 18% in group I and 14% in group II. Dynamized nails achieved earlier union than static nails as majority (76%) of fractures in group I had shown union at 15th post opt week while only 16% patients at 22nd week in group II. Delayed union was reported in 4% patients in group I and 26% in group II. This was statistically significant (p value 0.001) Non union was reported in 2% patient in group I and 16% in group II (P value 0.007). Delayed union in group I was treated with removal of locking screws in both patients. One patient achieved union while the other one went into non union and was treated successfully with exchange nailing at 10th months post operatively. Delayed union in group II patients were treated with removal of locking screws in all, out of which only 10% achieved union while 16% went into non union and were successfully treated with exchange nailing. The functional outcome of both groups at 10th months were evaluated according to Thorensen’s criteria. (Table II).

Excellent results were achieved in 84% patients in group I and 22% patients in group II. This was statistically significant (P value< 0.05) Superficial infection was documented in 2% patients in group I and 12% patients in group II. All were treated with antibiotics according to the pus collected from infection site (distal locking screws site) No patient in group I developed osteomyelitis while 8% patients in group II developed deep infection at nail entry site. All were readmitted and treated with debridements. Nail breakage and screw breakage was not reported in group I while 2% patients broke the nail and 10% patients broke the locking screws. The re surgery rates of group I and group II was 6% and 54% respectively (P value< 0.05). No drop out was reported. No patient received treatment in intensive care unit (ICU). No in hospital mortality was reported.

Table II: Comparison of clinical outcome of both groups according to Thorensen’s Criteria (N=100)

<table>
<thead>
<tr>
<th>Thorensen’s Criteria</th>
<th>Number of patients Group I (dynamized)</th>
<th>Number of patients Group II (static)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>42(84%)</td>
<td>11(22%)</td>
<td>0</td>
</tr>
<tr>
<td>Good</td>
<td>8 (16%)</td>
<td>9(18%)</td>
<td>0.39</td>
</tr>
<tr>
<td>Fair</td>
<td>0(0%)</td>
<td>17(34%)</td>
<td>0</td>
</tr>
<tr>
<td>Poor</td>
<td>0(0%)</td>
<td>13(26%)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

DISCUSSION

Variable results have been documented in literature from interlocking nail shaft of femur for oblique and transverse fracture stabilized in dynamic and static mode. In our study we noted excellent functional results in majority (84%) of fractures stabilized with interlocking nails in dynamized mode while static mode gave excellent results in only a small portion (22%) of patients. It is proposed that when nail is inserted in static mode it acts as load bearing rather than load sharing and axial weight of the limb is then not transfer through fracture site but through the locking screws. 16-18 This altered biomechanics is responsible for lesser amount of callus and at a slower rate in static nails. Dynamization allows miromotion at the fracture site which causes fragment reduction and accelerated bone formation. But this dynamization should be early when the callus is soft and yet not mature.12 Khalid and Hashmi15 reported excellent results in 66.7% and 42.8% in dynamic and static group respectively. Good results were achieved in 27.8% in dynamic group and 28.6% in static group while fair and poor outcome patients were 14.3% each in static group and none to 5.5% in dynamic group. The sample size of this study was however small (32 each group) and with a shorter follow up period of one year. Omerovic12 conducted a retrospective-prospective study of 47 patients, (24 static and 23 dynamical mode) and results were more favorable for static group than dynamic group but of no significance statistically.

In our study majority of fractures (76%) in the dynamic group was more rapid to heal than static group. (15th week versus 22nd week). Our finding is supported by Khalid and Hashmi as they reported healing time of 20th week in dynamized group and 24 in static group. Khan and Ahmad19 on the other hand are in favor of using static nails rather than dynamic as they documented results opposite to our findings. ( 19.37 weeks healing time for dynamic group and 16.11 for static group). However their sample size was 50 patients (25 each group) and mean follow up period was six months.

Delayed union was noted in 4% patients in dynamic group and 26% patients in static group. The probable cause of delayed union in dynamic group was delayed weight bearing by one of the patients. We noted non union in 2% patient in dynamic group and 16% patients in static group. In literature one study19 observed no non union in both groups while 8% delayed union.
in static group and none in dynamic group. Khalid and Hashmi\textsuperscript{15} reported delayed union in 18.2\% patients in static group and none in dynamic group while nonunion was noted in 7.1\% and 9\% in dynamic and static group respectively. Superficial infection was observed in 2\% patient in dynamic group and 12\% patients in static group in our study. Deep infection was reported in 4(8\%) patients in static group and none in dynamic group. The longer operative time, frequency of more open fractures, lack of laminar flow in theatre and the presences of more comorbid conditions like diabetes can be the possible reasons for this high rate of infection in static group.

We have reported no drop out patients in our study and many patients were followed till removal of nails after union. All the surgeries were performed by single surgeon. However we recommend studies with larger sample size and with special emphasis on the possible association of other sample characteristics like gender, body mass index, smoking, comorbid conditions and fracture patterns on fracture healing in dynamic and static groups.

**CONCLUSION**

Dynamic interlocking nail femur for oblique and transverse shaft fractures results in excellent radiological and functional outcome in majority of patients than static interlocking nails.

**CONTRIBUTION OF AUTHORS**

Qureshi AR: Conceived Idea, Data Collection, Data Analysis
Shah FA: Designed Research Methodology, Data Collection
Ali MA: Manuscript final reading and approval
Naeemullah: Manuscript Writing, Data Interpretation
Khan UZ: Statistical Analysis, Literature Review

Disclaimer: None.
Conflict of Interest: None.
Source of Funding: None.

**REFERENCES**