A PROSPECTIVE STUDY OF SURGICAL MANAGEMENT OF FRACTURE SHAFT FEMUR WITH CLOSED INTRAMEDULLARY INTERLOCKING NAIL.

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ABSTRACT: Orthopaedic surgeons often encounter diaphyseal femur fractures, because these fracture most often result from high-energy trauma, one must have high index of suspicion for complications. Currently surgery is indicated for most femur fractures because of high rate of union, low rate of complications and advantage of early stabilization which decreases the morbidity and mortality rate in patients. While the main stay of the treatment has been reamed interlocking intramedullary nailing. The present study is hospital based prospective study of 40 adult patients admitted in SSMC Hospital, TUMKUR between October 2010 – March 2012 and cases were followed regularly. The common age group involved was from 18-65 yrs. with mean age of 33.5, 36 patients were males, 4 were females. 16 fractures were on right side, 24 were on left side. Two (5%) fractures was in proximal third, 26 (65%) were in the middle third and 12 (30%) were in the lower third. Surgery was done at an average 3 days ranging from 2 –5 days. Duration of hospital stay was 12 days ranging from 10-15 days. Mean time for union was 20 weeks. There was one case of distal bolt backing out and there were three cases of superficial infection. Excellent to good result were seen in 75% of cases.

INTRODUCTION: Orthopaedic surgeons often encounter diaphyseal femur fractures because these fractures most often result from high energy trauma, one must have a high index of suspicion for complications or other injuries. Advance in mechanization and acceleration of travel have been accompanied by increase in the number and severity of the fracture. Fracture femur results from the drawbacks of fast life and violence and are major source of mortality and morbidity in patients with such injury. The art of femoral fracture care is a constant balancing of the often-conflicting goals of anatomical alignment and early functional rehabilitation of limb.

Closed nailing causes no damage to extra periosteal soft tissues and the biological environment round the fracture is least disturbed. Another important feature of the closed intramedullary interlocking nail is the chance for early ambulation of the patient which reduces the complications of prolonged bed ridden patient.

Comminuted and segmental fractures of femoral diaphysis are often difficult to treat. When intermediate fragment is split or there is comminution of either level of segmental fracture, the interlocking nail is the only best available implant, since the conventional IM nailing does not provide adequate fixation.

Proximal & Distal shaft fractures where one cannot get three point fixations can also be stabilized by use of interlocking nails. Intramedullary nail being close to centre of femur can tolerate bending and torsional loads better than plates and the locking mechanism provides less tensile and shear than plates. IM interlocking nail is a load sharing device and are less loaded than plates causing less cortical osteopenia of stress shielding which is a feature of the load bearing plates.

The magnitude of the local femoral release of IL-6 after femoral fracture was independent of the injury severity score and whether the fracture was closed or open. In patients who underwent intramedullary reaming of the femoral canal a further significant local release of IL-6 was demonstrated, providing evidence that intramedullary reaming can cause a significant local inflammatory reaction.¹

Crist BD, Wolinsky PR in 2009² studied reamed intramedullary nailing is the current gold standard for the treatment of diaphyseal fractures of the femur.

Attal R, Blauth M in 2010³ studied effect of reaming and non-reaming of intramedullary nails in long bone fractures as a controversial and even emotional topic in recent decades. This study gives an historical overview of the development in this field and presents the background to the need for unreamed nailing.

Closed, intramedullary exchange nailing with reamed insertion for femoral shaft nonunion previously treated with intramedullary nails has proved to be a successful sole procedure in most cases. A nail at least 2 mm larger in diameter than the first nail should be used if possible. Risk factors of treatment failure should alert the surgeon to consider an alternative treatment to closed exchange nailing⁴.

MATERIALS & METHODS: This prospective short term study was done from October 2010 to March 2012 in 40 patients with 40 fracture diaphysis of femur who were admitted in SSMC Hospital Tumkur and who were treated with A.O. femoral interlocking nail.

Two patients for whom interlocking was done, but failed to come for follow-up have been excluded from the study.

Inclusion Criteria:

1. Age >18 yrs
2. All patients with fracture femur between inferior margin of lesser trochanter and upper border of a square containing the distal end of the femur.
3. Closed and grade I open fracture (Gustilo Anderson classification)
4. ASIF Type A & B fractures.
5. Winquist & Hansen Classification of fractures comminution grade I, II & III

Exclusion Criteria:

1. Age < 18 yrs.
2. Open grade II and III fractures
3. Pathological fractures
4. Patients lost in follow up.

The material for this study consists of 40 cases of fractures diaphysis of femur admitted during October 2010 to March 2012. Selections of these cases were at random.

Road traffic accidents were responsible in 36 patients and in 4 patients the cause of fracture was fall.

There was two case of open fracture grade-I according to Gustilo Anderson classification, which was treated with interlocking nail.

The interval between injury and operative intervention ranged from 2 to 5 days with an average of 2 days.

The delay was due to poor medical conditions or associated head injury.

Preoperative evaluation and treatment: On admission, all patients were clinically assessed for general condition and skeletal and soft tissue injuries.

Haemodynamic instability was treated with appropriate fluids and blood replacement.

Head injury, pelvic injury, abdominal injuries were given priority treatment.

The emergency management for fracture proper included immobilization of fractured limb in a Thomas splint with or without skin traction.

Routine preoperative investigation assessment included.

- Haemoglobin percentage
- CT, BT
- Recording of blood pressure
- RBS, Blood urea, Sr.Creatinine
- E.C.G.
- Radiological assessment.
 - AP and lateral radiograph of thigh with hip and knee
 - Chest PA/AP view – as a baseline radiograph to assess any development of fat embolism later.

Implant and Instrumentation: Interlocking nails used are AO femoral nails (Indian version). These nails are universal in type i.e. left and right side nails are same. They are made up of 316L stainless steel.

The shaft of the nail is clover leaf in section. The nail is available in diameters 9-13 (1mm difference per size) and length 360 mm to 440 mm (20mm difference per size), Locking bolts; 4.5 mm diameter, 22 to 60 mm in length.

Selection of implant: Length of the nail was selected by measuring the normal femur from tip of greater trochanter to knee joint. Diameter measured at the level of isthmus and finally pre-operatively as per reaming.

OPERATIVE PROCEDURES: Nailing was done under spinal and general anaesthesia on fracture table. Thorough scrubbing of the operative limb was done with savlon, betadine and spirit and the part was draped in sterile towels.

Skin incision was taken 2 cm distal to the greater trochanter and extended proximally in line with the gluteus maximus, the landmark proximally.

A 5-10 cm incision was sufficient. The fascialata and gluteus maximus fibres were divided in line with the skin incision. Interval between gluteus medius tendon insertion on greater trochanter and piriformis tendon are identified. Piriformis fossa was visualised by retracting the abductor muscles anteriorly.

The entry point was made under 'C' arm guidance and guide wire was passed from proximal to distal fragment. After its position confirmation, nail mounted on proximal jig was introduced, after appropriate reaming.

Distal locking was done by free hand technique.

Proximal locking was done with the help of proximal jig. Wound closed in layers.

Post-operative care: Intravenous 3rd generation cephalosporin antibiotic were given.

All patients were encouraged to do static quadriceps exercises within 48 hrs, or as tolerated by the patients. Patients were mobilized out of bed and partial weight bearing with help of crutches or walker frame started by the time of suture removal or once the acute pain subsided. This was done in those cases where fracture fixation was stable. In unstable fractures (comminution > 50%) partial weight bearing was delayed till radiographically visible callus was seen or around 6 week time.

By the end of 10 – 12 weeks, if radiological evidence of fracture callus is seen, full weight bearing was advised.

RESULTS: The study consists of 40 cases of diaphyseal fractures of femur treated surgically by intramedullary interlocking nailing.

Age distribution: The age ranges from 18-65 years with mean age of 33.4 years. Maximum incidence of fracture was between 20-40 year age group. Most of the patients were either manual labourers or agriculturists and earning member of the family.

Sex distribution: 36 patients were males (90%) and 4 patients were females (10%).

Side involved: Right sided fractures in 16 patients (40%) Left sided fractures in 24 patients (60%).

Type of fractures: 38 were closed fractures and 2 were of Grade –I open fracture.

Mode of injury: 36 patients (90%) sustained fracture because of road traffic accident and 4 patients (10%) from fall. Motor vehicle accident consists of two wheeler, tractor and four wheeler injuries.

Location of fractures:

2 fracture involved the proximal third (5%).

6 fractures involved the middle third (65%).

12 fractures involved the distal third (30%) among the femoral diaphyseal fractures.

Pattern of fracture: Majority of fractures were oblique-18 cases(45%), spiral fractures were seen in 10 cases (25%), comminution seen in about 6 cases (15%), and transverse in case of 6 (15%) of fractures.

Associated injuries: Two patients who had had femoral fractures had associated head injury, who recovered uneventfully. One patient had ipsilateral fracture shaft tibia and fibula, which was treated by interlocking nail too.

Statistics of surgery: After the patients admission surgery was done on an average 3 days, ranging from 2-5 days. Delay was due to poor general condition of the patient or associated head injury. Among the 40 patients all were treated with closed intramedullary nailing under C-arm image intensifier given.

In 36 patients spinal anesthesia was used and in 4 patients general anesthesia was Average duration of surgery was around 90 minutes with the range of 75-150 minutes. Average amount of blood loss was < 400 ml in closed interlocking. All patients underwent reamed nailing. Of the 40 patients, static locking was done in 26 patients and in 14 patients dynamic locking was done.

Complications: Complications during surgery: In one case the distal bolt backed out and in other the reamer had bent due to narrow canal.

Postoperative complications: There were no case of deep infections but there were three cases of superficial infection, which settled down after obtaining the culture sensitivity and starting on

appropriate antibiotics.

Delayed complications: There was one case where backing up of interlocking bolt was seen due to improper engagement of far-cortex. There were no cases of nail bending or breakage of bolts. Delayed union in 2 cases. Restricted knee motion to $<90^{\circ}$ in 2 cases

Time of discharge: Patients were discharged at an average of 12 days with range from 10 to 15 days.

Follow-up period: The patients were followed up in the outpatient department regularly and were assessed clinically and radiologically at 6 weeks, 12 weeks, 18 weeks, and 24 weeks.

The results were assessed on clinical examination and radiological appearance based on Donald A. Wiss criteria⁵. Functional outcome was assessed based on modified Klauss and Klemm et al criteria⁶. Excellent result were obtained in 6 cases (15%), good results were obtained in 24 cases (60%) and fair results in 10 cases (25%).

DISCUSSION: The treatment of fracture diaphysis of femur has evolved from the old conservative management to the most recent methods of interlocking nails. This is the era of biological fixation. Interlocking nails have greatly expanded the indications for closed IM nailing of femoral fractures. Early mobilization following fractures of the femoral diaphysis has been shown to have a significant advantage in terms of both joint mobility and economic impact which has very well attained by the use of interlocking nails.

Majority of our patients were in the age group 18-39 years which is the prime earning group in the Indian families. Most of the patients were manual laborers and agriculturist whose early return to work was important.

In our series, 65% of fractures were located in the middle third, while in reported series of conventional nailing, this figure ranged from 60-80% and 50% in the series of Thoresen et al⁷, where G.K. interlocking nail was used. Even the distribution of both comminution and type of fracture is similar to those in other series; where in interlocking nails were used.

The mode of injury in this series we had 36 cases of road traffic accident i.e. around 90%. The incidence of road traffic accident has been on the increasing scale. The optimal time for nailing of closed femoral diaphyseal fracture has been suggested by Brumback et al⁸ as 7 – 10 days for elective cases and immediately for patients with polytrauma, to allow prompt mobilization. In our study the nailing was done between 2 – 5 days with an average of 3 days.

The average time of hospital stay in our study was an average of 10-15 days, compared to Wiss et al⁹ 12 days.

The average time for union in our series was 20 weeks ranging from 17 – 24 Weeks. Gross Kempf et al¹⁰, (1985) reported union at 18 weeks, Thoresen et al⁷ (1985), Wiss et al⁹ (1986) obtained at 18 week.

In our series the duration for union was not much different in statically and dynamically locked nails. Dynamic locking was preferred in more proximal and more distal fracture with locking bolt at the end nearer to fracture site. Static locking was preferred in badly comminuted and spiral fractures where shortening was expected.

The functional outcome in the earlier studies were excellent and good result by Thoresen et al⁷

– 89.16%, Gross Kempf et al⁶

- 90%, Wiss et al¹⁰
- 92%, Klauss Klemm et al²³
- 97%. The functional outcome in our present study was around 80% of excellent and good results.

The incidence of infection following open nailing was reported by Wiss et al⁹ as 8.3% and by John et al¹¹ interlocking as 13%. The incidence of infection was drastically low in closed.

In our series there were 3 cases with superficial infection and no case of deep infection.

One of the most common complications following fracture diaphysis femur has been shortening at the fracture site. Interlocking IM nail has virtually eliminated these complications or at least got down its incidence immensely. In our series shortening of <1cm was seen in one patient. The incidence of shortening was 3.1% as reported by Veith et al. Rothwell et al¹² reported a 6% incidence of valgus angulation and Winquist & Hansen reported a 2% of angulation in any plane¹³. In our series only 2 patients had valgus angulation both < 10°. There were no cases of lengthening or rotational deformity.

Majority of the patients of our series returned to their functional pre-fracture state and return to work by the end of 4 months.

We had one instance of distal screw backing up.

There was no incidence of neuropraxia in our study, Thoresen et al and Wies et al also reported the similar occurrence. From the comparison of the above studies, we can roughly conclude that treatment of fracture diaphysis of femur by locked intramedullary interlocking nail has many advantages. It reduces the incidence and severity of malunion, infection, secondary displacement of fracture as well as length of hospital stay by allowing early mobilization.

Closed interlocking nail is a technically difficult procedure and vast experience is needed for it. Pre-operative preparation and intra-operative difficulties have to be anticipated and appropriate steps have to be taken to make the surgery successful.

In the present study, single (i.e. either proximal / distal) locking or double locking (static) and fracture union in weeks are not found dependent on each other.

(χ^2_{VL} 2.02, $p = 0.05$ Not significant)

In our study, there is a partial positive co-relation between nailing from days of injury and fracture union in weeks ($r = 0.4580 \sim +0.5$). In conclusion, the most preferred treatment in management of fracture diaphysis of femur is closed interlocking nailing especially in skeletally mature patients.

CONCLUSION:

- The incidence of fracture diaphysis of femur due to road traffic accidents is on the increase.
- The anatomy of the femur, the loading conditions by gravitational, muscular and ligamentous forces – all are in favor for intramedullary interlocking nail fixation.
- Closed interlocking nailing of the femur has now become the treatment of choice for closed diaphyseal fracture of femur especially those with high comminution, long spiral and segmental fractures.
- Fractures in any zone from the subtrochanteric to distal supracondylar part of the femur are accessible to nailing.
- Restoration of anatomic length alignment, of comminuted fractures is possible and it extends

the use of intramedullary nail to more proximal and distal fractures.

- Interlocking nail offers the patients the added advantage of early joint mobilization, early muscle rehabilitation shorter hospitalization and most important early return to work and pre-fracture state as the incidence is more in working age group.
- Closed interlocking nail reduces the incidence of complication like infection, malunion, non-union.
- It achieves strength of femoral diaphyseal fracture shaft in all three planes of loading-bending, compression and torsion.
- There is no significant change in the union rate when compared with age, sex and level of fracture.

SUMMARY: In our prospective study 40 cases with fracture shaft femur were treated with intramedullary interlocking nail technique.

Follow up was possible for the above all 40 cases, 30 patients showed excellent to good clinical, radiological and functional outcome. Post-operatively 10 cases have shown fair.

This study proves beyond doubt that closed reduction and internal fixation of fracture shaft of femur by interlocking nail has distinct advantages of early perfect fracture stabilization and early post-operative mobilization of hip and knee joints leading to early normal function of the lower limbs, provided the correct technique and principles of internal fixation are followed.

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PRE OPERATIVE FRACTURE SHAFT FEMUR

IMMEDIATE POST OP

POST OP – AFTER 18 MONTHS

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