MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2022.4.88.93

# A Comparative Outcome Study of Non-Union Fracture Shaft of Femur Treated by Nailing Versus Plating with Bone Grafting

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**ABSTRACT**

The present study is to compare the clinical outcome of non-union shaft fracture femur plating and nailing with bone grafting. 20 cases of fracture midshaft of femur who were admitted in department of orthopaedics have been included in this study. Prospective study of 20 cases of surgical management of fracture femur non union treated I.M nail or plate with bone grafting. In the follow up the status of wound, the signs of clinical union and range of motion were noted. Radiologically amount of union was also determined. End results evaluated with the Harris hip score. In the current study also there is a clear preponderance in for the male sex 17:3 females. In the present study RTA was responsible for 80% of fractures. In this series the average operation time is 62.5 minutes. In the present study, 16 cases had excellent results (120°) within 3 months, 3 cases had good results (80-100°) within 3 months, 1 case developed restriction of knee movements between 60-80°. In the present series the union rate was 95% and was upto 7 months post op period. The present study includes 1 case of nailing infection. In the present study one patient developed delayed union because of osteomyelitis and union took place around 28 weeks. No delayed unions reported in other series. In the present study 10 cases were operated upon with plating and 5 had excellent result, 4 good and 1 poor outcome as per radiological union and harris hip scoring system. In this study the mean duration of hospital stay for plating was 20 days. Average duration was around 15 weeks. There was no incidences of complications of locking compression plates like implant breakage, corrosion, cold welding, localized osteopenia was seen in 1 patients of the 10 patients in plating, no cases of peripheral vascular diseases were observed. Infections rate of 1 out of 10 patients was seen. no significant difference of functional outcome of plating and nailing with bone grafting for non union shaft of femur. It was concluded that in suitable cases when indicated and principles are followed carefully for plating and nailing along with bone grafting, good results are bound to occur and hence these surgeries are ideal in treatment of non union femur. No significant difference was observed in the outcome of results when compared plating with intramedullary nailing.

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**Key Words**
Clinical outcome, non-union shaft, department of orthopaedics

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**Received:** 20 August 2022
**Accepted:** 26 November 2022
**Published:** 20 December 2022

**Citation:** R. Chandra Sekhar Reddy and J. Nageesh, 2022. A Comparative Outcome Study of Non -Union Fracture Shaft of Femur Treated by Nailing Versus Plating with Bone Grafting. Res. J. Med. Sci., 16: 88-93, doi: 10.36478/ makrjms.2022.4.88.93

## INTRODUCTION

Fractures of the shaft of femur are among the most common fractures encountered in orthopaedic practice. Since the femur is the largest bone of the body and one of the principle load bearing bones in the lower extremity, fractures may result in prolonged morbidity and extensive disability unless treatment is appropriate[1]. Fractures of the femoral shaft often are the result of high energy trauma and may be associated with multiple system injuries with the exception of interactions through pathologic bone. Disability due to fracture of femur results from fracture shortening, fracture malalignment or prolonged immobilisation of the extremity by traction or casting on attempt to maintain fracture length and alignment during the early phase of fracture healing even minor degrees of shortening and malalignment can eventuate in a limp and post traumatic arthritis[2]. Therefore the art of femoral fractures care is a constant balancing of the often conflicting goals of anatomic alignment and early functional rehabilitation of the limbs. Various modalities of treatment conservative as well as surgical are available for fracture shaft of femur. Conservative method like gallows traction (pediatric cases), closed reduction and spica cast immobilization are available[3]. However, in adults it is difficult to treat with conservative methods. Because of powerful muscles that surround the femur, exert angulatory force at fracture site and may result in malunion, it is also difficult to maintain the reduction. The concept of internal fixation was originated by Pritz Koering of Germany. Hey Groves introduced the intra medullary nailing by it was popularized by Gerttard Kuntscher in 1940. Earliest recorded use of plating was reported by Petronius on 1562 who stated using a gold plate for repair of cleft palate. Hansmann of hamberg 1886 was the first to describe plate fixation of bone[4]. Nonunion remains one of the complications for femoral shaft fractures and is mainly attributed to conservative management in some cases. The open technique for fracture fixation and bone grafting is helpful for financially poor and young adults for achieving union at fracture sit and early ambulation and anatomically proper weight bearing. The present study is to compare the clinical outcome of non-union shaft fracture femur plating and nailing with bone grafting.

## MATERIALS AND METHODS

Prospective study of 20 cases of surgical management of fracture femur non union treated I.M nail or plate with bone grafting. Follow-up done on 6 weeks, 12 weeks and 6 months post-operatively. At every visit check radiographs to be taken to assess the radiological union.

**Selection of Cases:** The patients in the age group 20-60 years who sustained fracture shaft of femur and went into non union were selected.

**Inclusion Criteria:**

- All patients aged between 20-60 yrs.
- Patients presenting with fracture femur non union
- Patients willing to give consent

**Exclusion Criteria:**

- Pregnant women.
- Patients with neurological deficit.
- Patients managed conservatively for other medical reasons.

Patients general condition was stabilized and the fracture non union limb was put on skeletal traction(high tibial traction with 1/10th of body weight over bohler's splint) to distract the over riding fragments and to overcome soft tissue contractors. Serial skiagrams were taken to assess the distraction of over riding of fracture ends.

**Surgery:** Pre operatively patients blood grouping and cross matching was done and 2 pints of packed red blood cells were put in reserve in case of emergency. The length of the nail was determined by measuring the length(in the normal limb) from the tip of greater trochanter to the tip of lateral condyle and substracted 4cm. The diameter of the nail to be used was measured by noting the width of medullary cavity at isthmus in x ray films and deducting 10% from it. But all size nails were kept over table to avoid any complications during surgery. Similarly 6.5mm DCP were selected length being 3 times that of the fracture site. All the patients received pre/per/post operative antibiotics.

**Technique:** Type of anaesthesia was left to the discretion of anaesthetist.

**IM Nailing:** Two assistants were required, the patient was made to lie on lateral position, with the fractured limb uppermost. After painting the parts from umbilicus to the tibial tuberosity (including the knee joint) and including back and buttock, the leg was draped leaving free knee and whole thigh and buttock exposed. The non union site was exposed through lateral approach. The non union site was freshened and sclerotic bone ends were removed. Both fracture fragments were examined separately and carefully with minimum stripping of periosteum. Trial reduction was done and all the loose fragments if present with soft tissue attachments were retained. Butterfly fragments when present were fixed by circlage wires then reaming and nailing was done. The gaps were filled with cancellous bone grafting taken from contralateral side or ipsilateral side. The upper fragment was delivered out of the wound in an adducted position using bone holding forceps by the operator. The first assistant controls the lower fragment, while second assistant adducts the leg across the normal leg when full adduction has been

gained, the medullary cavity was reamed and the nail inserted and tapped upwards. We used nail size which was 1mm bigger than that of the last reamer used. Care was taken to see that nail eye faced posteromedially and slot oriented along the tension side of femur, which greatly strengthens the fixation. The resistance suddenly diminished as the tip of upper end comes out of trochanter. Upper end of nail is felt through the skin and gluteal muscles and a vertical incision is made over it. Nail is tapped upwards until it was in flush with the proximal fragment. Then the fracture was reduced by delivering the fragments into the wounds by increasing the deformity to 90 degrees and allowing the cortices to hook on after maintaining the reduction, nail from the upper fragment driven into the distal fragment until 1.3 cm nail protrudes out from the tip of the greater trochanter. Depending on the fracture stability, additional procedures like encirclage wiring was done to fill the gaps. Wound closed in layers over a suction drain, hemostasis achieved and post op radiographs were taken later to confirm quality of reduction and position of nail with respect to knee and trochanter.

**Plating Technique:** Patient in supine position, parts scrubbed painted and draped. Under strict aseptic precautions a longitudinal skin incision given along the lateral aspect of thigh centering the fracture site. Subcutaneous tissue dissected tensor facia lata identified and a longitudinal incision along the length of skin incision given, vastus lateralis visualised and retracted anteriorly. Fracture ends were identified and periosteum was stripped upto 2 cm from the fracture site, sclerosed ends were excised until fresh cortical bleed was seen, 3 tiimes the length of fracture plate was selected and was fixed to bone with cortical screws, bon graft was placed in between the fracture ends, wound closed in layers over a drain hemostasis achieved.

**Bone Grafting Technique:** Removal of iliac bone graft -incision made along the subcutaneous border of iliac crest at the point of contact of the periosteum with the origins of gluteus and the trunk muscles, carry the incision down to the bone. When the crest of ilium is not required as part of the graft, split off the lateral side or both sides of the crest in continuity of the periosteum and the attached muscles. Elevate only the muscles from the outer or inner table of ilium. The inner cortical table with underlying cancellous bone may be preferable owing to body habitus. After removal of the crest, considerable cancellous bone may be obtained by inserting a curette into the cancellous space between the two intact cortices. After removal of the graft, accurately oppose and suture the periosteum and muscular origins with strong interrupted sutures.

**Post Operative Management:** In the post operative period we have not used any external immobilization like Thomas splint. Knee immobilization started on second post operative day itself. Which was managed to get by flexing the knee progressively and knee extension was taught along with active knee extension and static quadriceps exercises. The drain tube was removed 48-72 hrs, depending upon the collection of fluid in the suction box. Depending on the status of wound antibiotics were continued for 10-12 days. Sutures were removed between 10-12 days. Later patient was asked to sit on the bed, where he was taught active and passive knee extension and flexion exercises. Next he was mobilized on a wheel chair and non weight bearing crutch walking was started depending on the age of the patient and presence or absence of associated injuries. Once the patients were trained for crutch walking and after attaining fairly good range of movements, they were discharged with advice to attend OPD for follow up once in three weeks. At the time of discharge status of the wound, knee movements and quadriceps lag was noted, illiterate and rural patients were strictly warned about consequences of early weight bearing at the time of discharge. In the follow up the status of wound, the signs of clinical union and range of motion were noted. Radiologically amount of union was also determined. Depending on this the patients were advised partial weight bearing at 6- 8 weeks period and after second or third follow up of four weeks interval patients were advised to bear full weight. All the patients were followed up for a minimum of 28 weeks.

**End Results Evaluated with the Following Criteria and Harris Hip Score Excellent:**

- Good clinical and radiological union.
- Range of motion 80-100 % or normal.
- No quadriceps lag.
- No pain/ discomfort in everyday use of limb.
- Return of the same occupation and no disability.

**Good:**

- Good clinical and radiological union.
- Range of motion 50-80% of normal.
- Pain not enough to cause any modifications of the patients daily activities.
- Return to same occupation and no disability.

**Poor:**

- Poor consolidation of the fracture as evidenced by x- ray.
- Knee movements less that 50% of the normal.
- Pain and disability severe enough to cause permanent change in life style.
- As we noted shortening and infection in some cases the following criteria were used.

**Shortening:**
- No shortening-excellent.
- 0.5-2 cm-good.
- >2cm-poor.

**Infection:**
- No infection-excellent.
- Superficial infection-good
- Deep infection-poor.

**Stiff Knee:**
- Full range of movements-excellent.
- Flexion 90°-good.
- Flexion 20°-poor.

## RESULTS AND DISCUSSIONS

Our study included patients age ranging from 18-50 years, adults between the age 20 and 30 years the most commonly affected. Male patients dominated over female patients, younger the age group better were the results.

**Table 1. Age and Sex Distribution**

| Age in years | Male | Female | Percentage (%) |
|---|---|---|---|
| 20-30 | 6 | 0 | 65 |
| 30-50 | 10 | 3 | 30 |
| >50 | 1 | 0 | 5 |

Majority of the patients hail from low socio economic groups. Our study shows the road traffic accidents are the commonest cause.

**Table 2.Mode of Injury**

| Mode of injury | Numbers | Percentage |
|---|---|---|
| RTA | 16 | 80 |
| Domestic | 3 | 15 |
| Others(industrial accident) | 1 | 5 |

15 patients had sustained fracture on right side and 5 on the left side.

**Table 3. Type and Pattern of Fracture**

| Pattern of fracture | No. Of cases | Percentage |
|---|---|---|
| Transverse | 5 | 25% |
| Oblique | 5 | 25% |
| Comminuted winquist-type 1 and 2 | 10 | 50% |

**Period of Hospitalization:** Average pre operative period was 12 days and post operative 25 days. Average hospital stay from admission to discharge was 34 days. The shortest duration of hospital stay was 15 days and longest was 40 days.

**Radiological Union**: The duration of healing varied, the study reveals that 16 cases (80%) showed radiological union between 12-13 weeks. Earliest radiological union was seen in the 10th week and the longest was seen around 20th week. Average duration was around 15 weeks. After radiological union patients were advised to bear full weight.

**Range of Knee Motion:** We have not immobilized the knee externally in this series. Knee motion was started on 2nd post operative day and at the time of discharge patient had an average of 80° of movement. Full range of movement was achieved within 8-12 weeks. In total 17 patients achieved knee motion of 120° flexion, 2 patients had 80-100° flexion and 1 patient had 60-80° of flexion. Similar to both plating and nailing.

**Ambulation:** Patients were mobilized on wheel chair after 2 weeks and non weight bearing crutch walking advised after 3 weeks and partial weight was advised after 3 weeks and partial weight bearing was advised after 5-7 weeks. Full weight bearing was advised after 13-15 weeks depending on the radiological union, for both plating and intramedullary nailing patients.

**Complications:**

**Intermittent Pain:** 3 patients complained of pain in gluteal and hip region, which was relieved after analgesics prescription.

**Shortening:** One patients developed shortening of 0.5 -1cm and Since shortening of 1cm was not perceptible nor did it make any significant affection in patient's gait, it was ignored.

**Infection**: One patient had superficial infection on 8th post operative day, culture yielded staphylococcus sensitive to ciprofloxacin. One case developed fever and induration of thigh on 5th post op day. It was drained by removing a suture and opening the wound with a sinus forceps. The discharge persisted and the culture yielded pseudomonas and acerbic streptococci, resistant to routinely used antibiotics. Third generation cephalosporins, amikacin along with metronidazole were given. In spite of this patient developed osteomyelitis later, but union of fracture progressed well and full union was achieved around 28 weeks. After 30 weeks sequestrectomy was done, after extracting the nail.

**Stiff Knee:** No case developed restriction of knee movement, full range of motion (120°) was achieved.

**Re Hospitalization:** One patient who developed osteomyelitis was readmitted at 30 weeks time and intramedullary nail was extracted and sequestrectomy was done.There was no evidence of non union, foot drop, break in nail, bent nail, or migration of nail.

There was no incidences of hardware complications of locking compression plates like implant breakage, corrosion, cold welding, localised osteopenia was seen in 1 patients of the 10 patients in plating, no cases of peripheral vascular diseases were observed. Infections rate of 1 out of 10 patients was seen. End result of the

entire series was assessed and following groups defined excellent, good and poor results.

**Table 4: Difference of Functional Outcome of Plating and Nailing with Bone Grafting**

| | Plating | Nailing |
|---|---|---|
| No of patients | 10 | 10 |
| Excellent | 5 | 6 |
| Good | 4 | 4 |
| Poor | 1 | 0 |

P value when calculated was found to be <0.5, no significant difference of functional outcome of plating and nailing with bone grafting for non union shaft of femur

Fracture of the shaft of femur are commonly encountered, however fracture non union shaft of femur is relatively rare nowadays due to increased public awareness about orthopaedic treatments and demerits of traditional bone settings. Still the uneducated rural population are more inclined towards traditional bone setting techniques leading to malunion and non union of fractures. Plating or intramedullary nailing techniques with bone grafting have shown promising results for the treatment of non union of fractures, regaining knee motion and preventing deformities. In the present study RTA was responsible for 80% of fractures. In the current study also there is a clear preponderance in for the male sex 17:3 females. In this series the average operation time is 62.5 minutes. The average operative time in 91 cases of open intramedullary nailing was 58.7 minutes. In the past 90° of flexion was considered as an acceptable result. The average motion required for normal sitting is 93°, for climbing stairs 100° of flexion often means difficulty in sitting and significant functional loss. In the present study, 16 cases had excellent results (120°) within 3 months, 3 cases had good results (80-100°) within 3 months, 1 case developed restriction of knee movements between 60-80°. This was due to associated osteoarthrosis of knee in the patient aged 50 years. Similarly in Kempf[5] series of 52 cases of interlocking nails 50 cases achieved full range of knee movements. However, in this study we have seen that the range of knee movements depends upon more of physiotherapy than the type of fixation with bone grafting or without bone grafting. In the present series the union rate was 95% and was upto 7 months post op period. It was 97.1% in the series of Kempf *et al* union occurred at 7 months in that study also. Time to union of a fracture was defined as time from injury to full weight bearing and healing of the fracture characterized by bridging callus seen on two radiographs with different projections. The present study includes 1 case of nailing infection. The patient with deep infection subsequently developed osteomyelitis. Rockanen[6] gave incidence of 0.6-3.8% of infection. Kempf *et al* series infection rate was 2.1%. In the present study osteomyelitis as a complication (5%) correlates with the above studies. In the present study one patient developed delayed union because of osteomyelitis and union took place around 28 weeks. No delayed unions reported in other series. In the present study 10 cases were operated upon with plating and 5 had excellent result, 4 good and 1 poor outcome as per radiological union and harris hip scoring system. According to Loomer[7], a cases study of 46 femoral shaft fractures treated with AO plating techniques suggested that plating technique offers great advantage where intramedullary nailing was not feasible and appropriate knowledge of anatomy and correct positioning of plate gives a better outcome, bone graft can be used in areas of bone loss and areas where union is expected to delay or may go for non union. In this current study the average operating time for plating was 80 minutes which is comparable to study of Loomer et al in which the average operating time was 75 minutes, hence in this current study plating took more time for surgery when compared to nailing. In this study the mean duration of hospital stay for plating was 20 days. The study reveals that 16 cases (80%) showed radiological union between 12-13 weeks. Earliest radiological union was seen in the 10th week and the longest was seen around 20th week. Average duration was around 15 weeks. After radiological union patients were advised to bear full weight. In this current study hardware related complications like screw backout were none, 1 caseof infections. The broken plate cases were found to be due to non compliancy of the patient and one of which was treated by plate extraction and replacement with a longer Locking Compression Plate with fibular bone grafting which subsequently united. Infection was treated by specific antibiotic after culture and sensitivity test. In this study iliac crest bone graft was harvested and used for augmenting the fracture site for promoting union. Nonunion are atrophic or hypertrophic types according to radiological findings. Atrophic nonunion caused by loss of bone forming power, such as large fracture leaving defect, severe vascular insult around the fracture site and infection, in our study 84% of nonunion was of atrophic. General methods for the treatment of nonunion were removal of the original cause, stable revision surgery with implant., bone grafting and soft tissue coverage. The ideal implant is still locked intramedullary nailing especially in femur and tibia. Plating in long bones is easy but unsuitable for weight bearing bones especially in mid shaft fractures, the classic concept of autologous iliac crest bone grafting and compression plating is safe and effective with excellent clinical outcome and low incidence of long term complications. When literature is examined, Locking Compression Plate was introduced for four reasons: (1)

osteoporosis bone fracture, (2) combination at the fracture site, (3) intra-articular fracture and (4) short segment peri articular fracture (72), The advantage of LCP is that stability does not depend on compression between the plate and bone and the peristyle blood supply to the fracture fragments is better preserved compared to DCP, Although some authors have reported excellent results from the open method using LCP, there may be problems in the application of the plate due to bone surface deformation associated with hypertrophy at the fracture site. However, Wagner(73) reported excellent results and showed that plate can be applied easily with no need to mould the plate in hypertrophic type of non union. The other treatment modalities for non united fractures are percutaneous autologous bone marrow grafting, autologous platelet gel, stromal cell implantation and bone morphogenic protein The non operative methods such as load bearing, electrical stimulation, ultrasound, or shock wave may be effective., the success rate is generally lower than operative methods. High energy trauma and insufficient stabilization were two major contributing factors to non-union of long bones diaphyseal fractures.

## CONCLUSIONS

Study concluded that in suitable cases when indicated and principles are followed carefully for plating and nailing along with bone grafting, good results are bound to occur and hence these surgeries are ideal in treatment of non union femur. However no significant difference was observed in the outcome of results when compared plating with intramedullary nailing.

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