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"A Prospective Study Evaluating Functional Results in Closed Reduction with Internal Fixation Using Intramedullary Interlocking Nail in Fracture Shaft of Femur Management"

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ABSTRACT: OBJECTIVE: To compare the functional outcome of closed intramedullary nailing vs open intramedullary nailing fracture shaft of Femur management.
DESIGN OF STUDY: Prospective study
MATERIALS AND METHODS: A total of 20 cases of diaphyseal femur fractures in adults, who have been treated with closed intramedullary interlocking nailing were studied from 2018-2021. Data was analyzed both with regards to the functional and radiological outcome to evaluate the effectiveness, functional outcome and morbidity associated with the CRIF with IMIL nailing.
RESULTS: Average age of the patients was 28 years with male preponderance. Road traffic accidennts were the most common mode of injury; middle third shaft fractures were most commonly seen (40%); transverse fractures (25%) were the commonest fracture pattern. The union rate was 100%. 1 patient had superficial infection, 2 patients had deep infection, 2 patients had ER deformity and 1 patient had screw breakage. Excellent results were seen in 75%, good results were seen in 20% cases and poor results in 5% as per Thoresen BO et al. criteria.
Conclusion: Closed intramedullary interlocking nailing has now become the treatment of choice for closed diaphyseal fractures of femur in adults, especially those with high comminution, long spiral, and segmental fractures. Interlocking nail offers the added advantages of early joint mobilization, early weight bearing, early muscle rehabilitation, shortened hospital stay, and most importantly early return to work and pre fracture state.
Keywords: Closed interlocking nailing, diaphyseal fractures of femur, Thoresen BO et al. criteria.

I. INTRODUCTION

Fractures of femoral shaft are among the most common fractures that orthopedic surgeons encounter. Advances in mechanization and acceleration of travel have been accompanied by an increase in the number and severity of fractures. Since the femur is the largest bone of the body and one of the principal load-bearing bones in the lower extremity, femoral shaft fractures are associated with considerable mortality and morbidity whether they are caused by high- or low-energy trauma. Femoral shaft fractures resulting from high-energy trauma are often associated with concomitant injury of internal organs.[1]

The treatment of femoral shaft fractures has evolved from the historical non-operative management to the most recent methods of intramedullary nail fixation. Interlocking nails have greatly expanded the indications for closed intramedullary nailing of femoral fractures. Early mobilization following fractures of the femoral shaft has been shown to have a significant advantage in terms of both jointmobility and economic impact, which are very well attained by the use of interlocking nails.[1-4]

II. MATERIALS AND METHODS

A prospective case series study of 20 cases of closed and Gustilo Anderson type I[1] open diaphyseal fractures of femur was done during the period between 2018 and 2021. Patients of age above 18 years and both the sexes were included in the study. Pathological and Gustilo Anderson type II [1] were excluded from the study. Institutional ethical committee approval was taken. After a careful history and examination of the injured limb, antero-posterior and lateral radiographs were obtained. Closed reduction and Thomas's splint immobilization were done in all cases. The operative procedure and its advantages were explained in detail to each patient and an informed consent was obtained. All patients were operated as early as possible after improving the general condition and considering their medical co-morbidities and management as directed by physicians. Most of the femoral shaft fractures in our study resulted from high-velocity injuries. All patients were operated using standard operative

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guidelines [1,2,4] and all fractures were fixed with standard AO femoral intramedullary interlocking nail using closed technique[1,2,5] under image intensifier.

All patients were encouraged to do static quadriceps exercises and straight leg lifting from first postoperative day with active and passive knee exercises within 48 hours or as tolerated by the patient. Partial weight bearing was started for all cases with the help of crutches or walker frame by the time of suture removal or once the acute pain subsided. Full weight bearing was started within 2 weeks postoperatively in case of stable fractures, but in unstable fractures (comminution >50%), it was delayed till radiographically visible callus was seen or around 6 weeks' time. Sutures were removed on 10th postoperative day and the patient was discharged on the following day.

FOLLOW UP

Review of the patient was 1st, 2nd 4th and 6th month to document clinical and radiological union of fracture and to assess the hip and knee range of movements. Partial weight bearing was started once the acute pain has subsided in stable fractures, but was delayed until adequate callus is seen radiographically at the end of 6 weeks in unstable fractures and full weight bearing by the end of 4 months. We considered a fracture to be united, if there was no pain on palpation or attempted motion at fracture site, no increase in warmth at the fracture site, no discomfort on full weight bearing and serial radiograph demonstrates bony trabeculae across the fracture site. Results of the treatment were evaluated using Thoresen BO et al. criteria.[6]

	Result			
	Excellent	Good	Fair	Poor
Malalignment of the femur *(degrees)*				
Varus or valgus	5	5	10	>10
Antecurvatum or recurvatum	5	10	15	>15
Internal rotation	5	10	15	>15
External rotation	10	15	20	>20
Shortening of the femur *(cm)*	1	2	3	>3
Range of motion of the knee *(degrees)*				
Flexion	>120	120	90	<90
Extension deficit	5	10	15	>15
Pain or swelling	None	Sporadic, minor	Significant	Severe

III. STATISTICAL ANALYSIS

The frequencies and crosstabs procedure were used to create two-way and multiway tables. Statistics and graphical displays (values in ascending or descending order) were used for describing variables, chart, and graphs. After tabulation, P value was determined by applying standard Chi-square and Gaussian test. P value less than 0.05 was considered to be significant. All the statistical methods were carried out through the SPSS for Windows (version 16.0).

IV. RESULTS

A total of 20 cases of diaphyseal fracture femur were seen in the study. Most common age group involved was between 21 and 30 years, with mean age of 28 years[Table 1]. All the cases were males. Right side (60%) was affected more commonly than left side (40%). RTA (80%) was the most common mode of injury. Most common location of fracture was the middle third of the diaphysis . Most common pattern of fracture was transverse fractures. Spinal anesthesia was used in 10 patients, general anesthesia in three patients and epidural in 7. Average duration of surgery was 126 minutes. 1 patient had superficial infection, 2 patients had deep infection, 2 patients had ER deformity and 1 patient had screw breakage. Mean time of bony union knee range of movements was 18.5 weeks and the union rate in our series was 100%. Functional outcome was assessed based on Thoresen BO et al. criteria[4,6,7] Excellent results were obtained in 15 cases (75%), good results in 4 cases (20%), and poor in one case (5%) [Table 3].

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Table 1

AGE IN YEARS	NO. OF PATIENTS	%
<20	2	10%
21-30	11	55%
31-40	6	30%
41-50	1	5%
51-60	0	0%
TOTAL	20	100%

Table 2

DURATION OF RADIOLOGICAL UNION(In Weeks)	NO. OF PATIENTS	%
14-16	8	40%
17-20	7	35%
21-23	3	15%
24-27	2	10%
>27	0	0%
TOTAL	20	100%

Graph 1

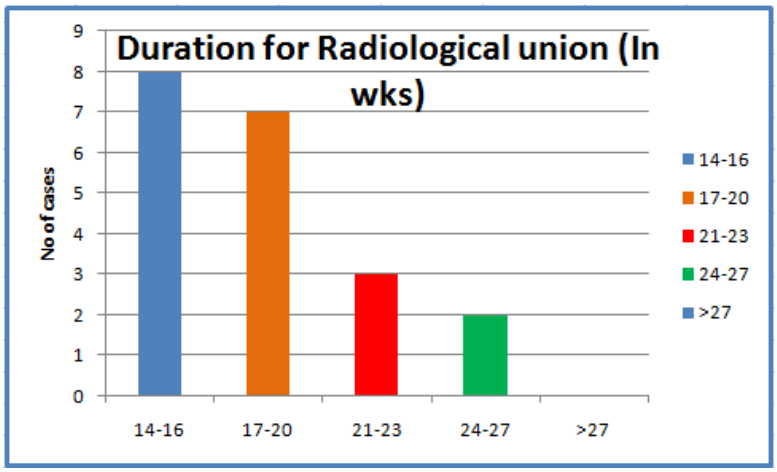

Table 3

Grading	NO. OF PATIENTS	%
Excellent	15	75%
Good	4	20%
Fair	0	0%
Poor	1	5%

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Case No. 1

Fig 1. A. Pre op B. Post op C. Final union

Fig 2. Hip and knee Range of movements

Case No. 2

Fig. 3 A. Post op B. At 6th week C. Xray at final union

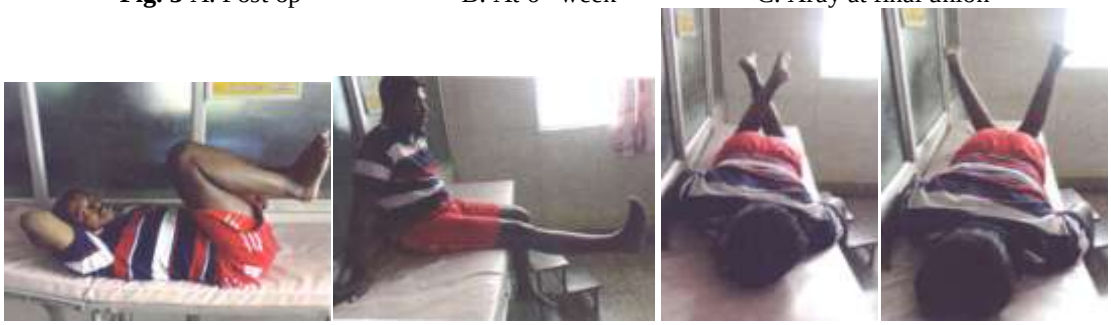

Fig. 4 Hip and knee Range of movements

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V. DISCUSSION

The art and science of fracture management has tremendously advanced over the years. From the use of external splints in the Hippocratic age to the recent sophisticated instrumentation, treatment of fractures has made an impact in the surgical field. The intramedullary techniques that are in common use today are derived mainly from the work of Sir Gerhard Kuntscher[7] in Germany and the Rush family in USA. Kuntscher is no doubt the father of reamed intramedullary nailing. Intramedullary nailing has become the gold standard for the treatment of femoral shaft fractures. [1,7-10] At the beginning of intramedullary nail era, this type of fixation gained wide popularity in the fixation of transverse fractures of the middle third of the femur due to no disturbances of periosteal blood supply, fracture hematoma, and rapid healing of fracture with lesser risk of complications like infection, nonunion, and shortening. A shortcoming of this technique in the fixation of comminuted diaphyseal fractures was the failure to provide rotational stability and axial length. The advent of interlocking nailing has widened the spectrum of femoral shaft injuries that can be stabilized by intramedullary technique. Use of interlocking nailing minimizes the incidence of leg length discrepancies, rotational and angular deformities. The intramedullary nail, with its location close to center of femur, can tolerate bending and torsional loads better than plates and the locking mechanism provides less tensile and shear stress than plates. The intramedullary interlocking nail is a load-sharing device. It is less loaded than plates causing less cortical osteopenia of stress shielding, which is a feature of the load-bearing plates. Closed nailing technique is preferred because no damage to extraperiosteal soft tissue occurs and the biological environment around the fracture is minimally disturbed. Another important feature of the closed intramedullary interlocking nail is the chance of early ambulation of the patient which reduces the complications of prolonged bed confinement.[1,2,10,11] The mean patient's age (28 years), mode of injury (road traffic accident,80%), side involved (right > left), level of fracture shaft of femur (middle third,40%), average duration of surgery (126 minutes), postoperative complications were present 1 patient had superficial infection, 2 patients had deep infection, 2 patients had ER deformity and 1 patient had screw breakage. In authors' opinion, administration of antibiotic for a period of 10 days (5 days intravenous followed by 5 days orally) drastically reduces the incidence of deep-seated infections. The average diameter of nail used in our study was 10 mm, which was less comparable with other series. The skeletal framework of Indian population is on the lower side compared with the western population. In authors' opinion, this is probably the reason of using a smaller diameter nail in the study. The average time taken for bony union in our study was 18.5 weeks with union rate of 100%. The high union rate in our study can be attributed to the preservation of fracture hematoma, using closed technique, early surgical intervention, early mobilization, and early weight bearing.

The incidence of femoral fracture due to road traffic accident is on the increase. With our study, we recommend and re-establish the fact that closed intramedullary interlocking nailing is the current treatment of choice for closed diaphyseal fractures of femur in adults, especially those with significant comminution, long spiral fractures, and segmental fractures. Intramedullary nails have added advantages over plating in these cases, like restoration of anatomical length and alignment of comminuted fractures, biological fixation resulting in high union rates, less likely to fail in fatigue, strength for femoral shaft fracture in all three planes of loading-bending, compression, and torsion, early joint mobilization, early muscle rehabilitation, shortened hospital stay, reduces the incidence of complications like infection, cortical osteopenia, malunion, and nonunion, and most importantly early return to work and prefracture state. Moreover, the anatomy of femur and the loading conditions by gravitational, muscular, and ligamentous forcesare in favor for intramedullary nail fixation. There is no significant change in union rate when compared with age, gender, level, and pattern of fracture.

VI. CONCLUSION

Closed intramedullary interlocking nailing has now become the treatment of choice for closed diaphyseal fractures of femur in adults, especially those with high comminution, long spiral, and segmental fractures. Interlocking nail offers the added advantages of early joint mobilization, early weight bearing, early muscle rehabilitation, shortened hospital stay, and most importantly early return to work and pre fracture state.

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