

Review Article

Comparative Study of Outcome of Treatment of Fracture Shaft of Femur by Open Intramedullary Kuntscher's Nail and Closed Intramedullary Interlocking Nail

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Fractures of the femoral shaft are one of the most common injuries treated by orthopedic surgeons. These fractures are often associated with polytrauma and can be life-threatening. For physiologically stable individuals, Intramedullary Nailing (IMN) is the most prevalent therapy. Early healing and long-term functional recovery are the goals of fixation. Treatment of modern-day femoral shaft fractures results in excellent outcomes.

Aims : To assess the results of intramedullary nailing of femoral shaft fractures by both open and closed methods.

Methods : Primary, non-randomized, prospective cohort study, Patients having fracture shaft of femur who was admitted in MGM Medical College & LSK Hospital, Kishanganj was taken for the study, The study period from October 2019 to April 2021. Total 40 cases were enrolled, Open Kuntcher's Nail-20 cases & Closed Interlocking Nail-20 cases.

Results : Male cases are predominantly high than females among the two groups. Maximum number of fracture (70% in Closed Interlocking Nail group and 80% in Open K-nail group) Radiological union within 15 weeks. Maximum number of the cases found excellent results in both groups. ie, 70% & 65% respectively. In this study, we have not found any poor & fair patients after surgical outcome. Chi-square value 0.1139 & P-value- is 0.735.

Conclusion : Except for the period from injury to surgery and operating time, there was no significant difference between the two groups in terms of demographic data, fracture type, and associated co-morbidities and radiological union. When utilised to fix short oblique and transverse fractures near the isthmus of the femur, Kuntscher's intramedullary nailing can yield a comparable rate of union to interlocking intramedullary nailing.

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Key words : Femoral shaft fracture, OKN, CIN, Polytrauma, Union.

Femoral Shaft Fractures (FSF) have a bimodal distribution, with high-energy trauma in the young population and low-energy trauma in the elderly. FSFs are also linked to other comorbidities, demanding a multidisciplinary examination and Advanced Trauma Life Support (ATLS). For physiologically stable individuals, intramedullary nailing (IMN) is the most prevalent therapy. Early healing and long-term functional recovery are the goals of fixation. Treatment of modern-day femoral shaft fractures results in excellent outcomes.

The gold standard of care for these fractures is now intramedullary nailing^{1,2}. Due to decreased infection rates, earlier weight-bearing, and a lower risk of non-union, intramedullary fixation is preferred over plate fixation. For intramedullary internal fixation of femoral shaft fractures, the cloverleaf nail was first introduced

Editor's Comment :

- Unlocked Kuntscher nails, are only suitable for femur fractures of the Winquist types I and II. Due to their lack of rotational stability, other types of femoral shaft fractures could not be stabilised by K-nails.
- An interlocking intramedullary nail is used to treat nearly all femoral shaft fracture types in developing country due to its greater rotational stability.

by Gerhard Kuntscher in 1940⁴.

Unlocked Kuntscher nails (K-nails) are exclusively appropriate for Winquist type I and type II fractures of the femur. Other types of femoral shaft fractures could not be stabilized with K-nails due to their lack of rotational stability. In industrialized countries, practically all types of femoral shaft fractures are treated using an interlocking intramedullary nail due to its superior rotational stability.

However, the use of K-nail in Winquist type I and type II fractures is still contested in countries like India with insufficient healthcare facilities. For example, the operation can be done without an image intensifier, and it has a similar functional effect to an Interlocking Nail (ILN) in these types of fractures.

Because it can preserve the soft tissue envelope,

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which is very important for fracture healing, Intramedullary (IM) nailing is the first-line treatment and gold standard for femoral shaft fractures⁷⁻⁹. It is important that the fracture site is not directly exposed during the operation, as IM nailing was designed to be a minimally invasive treatment. Because the muscles around the femur are powerful and thick, both closed reduction and maintaining the reduction effectively during IM nail implantation are challenging for orthopaedic surgeons, and these procedures are experience-dependent and require repeated attempts, resulting in a long duration of radiation exposure. The fracture table is widely used in surgery and is effective in restoring the length of the femur. However, the fracture table cannot achieve alignment independently¹⁰.

MATERIALS AND METHODS

Primary, non-randomized, prospective cohort study, Patients having fracture shaft of femur who was admitted in MGM Medical College & LSK Hospital, Kishanganj was taken for the study, The study period from October 2019 to April 2021. Total 40 cases were enrolled, Open Kuntcher's Nail-20 cases & Closed Interlocking Nail-20 cases.

Inclusion Criteria :

- Patient medically, physically and mentally fit
- Duration of fractures maximum 2 weeks
- Fractures involving the narrow part of the femur shaft i.e.its proximal and middle third
- Short oblique and transverse fractures
- Age between 16 to 60

Exclusion Criteria :

- Open fracture
- Any associated fracture in the same limb
- Pelvic fracture and associated with serious internal organ injury and soft tissue injury.
- Fracture with vascular injury
- Comminuted fractures
- Pathological fractures

METHODOLOGY

Initial Management : Traction

After initial resuscitation, the patient was given upper tibial skeletal traction.

The relevant blood and other investigations were done and Anesthetics and physician's opinion was taken for surgical fitness during this period.

Surgical Management : All the patients of our study were treated operatively by either open kuntscher's nail or closed interlocking nail.

Pre-operative Planning : Proper pre-operative

planning is very much essential for any injury, which helps the surgeon to prepare an operative strategy. Good quality radiographs were taken in all the patients. The type of fracture and degree of comminution was assessed.

Tetanus prophylaxis was given to patients.

Broad-spectrum antibiotic was given one hour prior to surgery after proper skin sensitivity test. Availability of all the equipments and implants were ensured before surgery. Pre-anesthetic check-up was done properly with blood reports,

ECG, Chest X-ray, cardiologist's and physician's reports.

Open Intramedullary Nailing¹¹ :

Operative procedure :

Expose the fracture through a posterolateral incision. Follow the intermuscular septum to the bone and retract the soft tissue anteriorly to minimize damage to the quadriceps muscle. After exposing the fracture; proceed as follows.

First, mobilize the fragments and reduce the fracture with due regard for correct rotary alignment.

A series of rigid reamers corresponding to the diameter of the nail are then passed, first proximally, and then distally, to ream the medullary cavity to the exact diameter of the nail to be chosen to be used. The smallest reamer is introduced into the proximal fragment. If it passes too easily the next size is introduced and so on until the medulla is reamed to take the selected nail with a comfortable push-fit.

Since the fracture tends to bow anterolaterally, exert manual pressure to overcome this. As the nail is driven into the distal fragment of the femur, fair resistance is desirable because it indicates a snug fit.

If all is proceeding well, drive the nail into the distal fragment while the assistant holds firm pressure against the flexed knee to maintain reduction and prevent distraction at the fracture site.

When the nail is properly seated, its eye faces posteromedially and its proximal end does not extend more than 2.5 cm proximal to the trochanter. The distal end of the nail should extend to the level of the proximal pole of the patella.

Close the wound in a conventional manner over suction drainage tubes.

After Treatment :

For simpler fractures an optional program of after treatment can be used. Support not immobilization, is provided by a Thomas splint for 5 to 7 days. Quadriceps – and hamstring setting exercises should be practiced faithfully as soon as the reaction after surgery permits.

The patient can be allowed crutch ambulation as

soon as muscular control of the leg is obtained, usually at 7 to 10 days in a young patient. The patient ambulates with crutches and just toe touches on the extremity for the first 4 to 6 weeks. As bridging callus appears, progressive weight-bearing with crutches can be permitted. In young patients with a stable fracture at the optimal level, full weight-bearing without crutches may be allowed as early as the twelfth week if healing appears to be progressing satisfactorily.

Toe touch weight bearing is allowed after overcome of surgical reaction, and hip and knee range of motion is encouraged. Quadriceps-setting and straight leg raising exercises are begun before hospital discharge. Hip abduction exercises are begun after wound healing. Weight-bearing is progressed as callus formation occurs. There is no specific time at which dynamization (removal of either the proximal or the distal locking screw to allow axial loading of the femur) should occur, and it is not always indicated to promote fracture healing.

Follow-up :

Routine follow up done at OPD with proper rehabilitation protocol with proper clinical and radiological assessment-at 2 weeks, 4 weeks, 6 weeks, 3 months, 6 months, 12 months, 18 months and in between if required. The patients were assessed regarding wound healing, painless motion, time of fracture healing, alignment and complication like infection, nail bending, nail migration, non-union etc. The result were graded as excellent, good, fair and poor as compared with the grading system done by Thoresen Scoring System, that include parameters such as valgus/varus, procurvatum/recurvatum, shortening and rotation (internal and external).

RESULTS

Age distribution among study population we have found 20 cases were treated with open Kuntscher's nail and 20 were treated with interlocking nail. The majority of the cases belong to 16-30 years of age in both groups, ie, 80 % & 70 % patients respectively. Statistical inference between the group we found chi-square value is 0.8 with no significant p-value is 0.849 (Tables 1&2).

We found in Table 2. Male cases are predominantly high than females among the two groups. In Closed Interlocking Nail group male is 80% and female is 20%, another Open Kuntcher's Nail group Male is 75% and Female 25% respectively. There is no statistical inference between the groups, p-value is 0.704 (Tables 3&4).

Maximum number of the cases injured by motor vehicle accident in both group, in Closed Interlocking

Age in Year	Closed Interlocking Nail (n=20)		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
16-30	16	80.0	14	70.0
31-40	02	10.0	04	20.0
41-50	01	5.0	01	5.0
51-60	01	5.0	01	5.0
Total	20	100.0	20	100.0
Statistical Inference : Chi-square- 0.8, P value- 0.849				
Mean & SD 28.40±8.04 28.35±9.03				

Sex	Closed Interlocking Nail		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
Male	16	80.0	15	75.0
Female	04	20.0	05	25.0
Total	20	100.0	20	100.0
Statistical Inference : Chi-square - 0.1433, P-value - 0.704				

Mode of Injury	Closed Interlocking Nail		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
Motor vehicle accident	18	90.0	17	85.0
Fall	02	10.0	03	15.0
Total	20	100.0	20	100.0
Statistical Inference : Chi-square - 0.2285, P-value - 0.632				

Duration of Surgery (Day)	Closed Interlocking Nail		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
1-4 days	04	20.0	03	15.0
5-10 days	14	70.0	15	75.0
11-15 days	02	10.0	02	10.0
Total	20	100.0	20	100.0
Statistical Inference : Chi-square - 0.1773, P-value- 0.915				

Nail group 90% cases injured by Motor vehicle accident, only 10 % cases fall from height, another Open Kuntcher's Nail group 85% cases injured by MVA and 15% cases fall from height. In between the group there was no significant difference, p-value is 0.632.

Interval between the fracture and surgery was noted in each point. We found that maximum number of patient was operated within 5-10 days (Table 5).

Maximum number of fracture (70% in Closed Interlocking Nail group and 80% in Open K-nail group) Radiological union within 15 weeks (Table 6).

With antibiotics, a superficial wound infection was cleared in one patient in the Closed Interlocking Nail group. There was no evidence of deeper infection or osteomyelitis. Medial leg sensory impairment is reported by one patient in the INL-nail group. In the Open K-nail group, there were two cases of implant

Radiological Union Time (Week)	Closed Interlocking Nail		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
Up to 15 weeks	14	70.0	16	80.0
>15 weeks	06	30.0	04	20.0
Total	20	100.0	20	100.0

Statistical Inference : Chi-square - 0.7843, P-value - 0.375

Complications	Closed Interlocking Nail		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
Superficial skin infection	01	5.0	2	10.0
Deep infection	0	0.0	0	0.0
Implant failure	0	0.0	0	0.0
Sensory deficit	1	5.0	0	0.0
Total	2	10.0	2	10.0

Statistical Inference : Chi-square - 1.333, P-value - 0.248

migration. In both groups, there were no implant failures. The p-value of 0.248 indicates that it was not statistically significant (Table 7).

Maximum number of the cases found excellent results in both groups. ie, 70% & 65% respectively. In this study, we have not found any poor & fair patients after surgical outcome. Chi-square value 0.1139 & P-value- is 0.735.

DISCUSSION

Femoral shaft fractures are observed across all age groups and are attributable to a variety of mechanisms¹². There tends to be an age and gender-related bimodal distribution of fractures with injuries occurring most frequently in young males after high-energy trauma and in elderly females after falls from standing.

The mechanisms in young patients tend to be motor vehicle crashes, motorcycle crashes, pedestrians struck by vehicles, or falls from height. The relative distribution of these fractures depends on multiple factors including the geographic location (urban *versus* rural) and country of study.

In this study Age distribution among study population we have found 20 cases were treated with open Kuntscher's nail and 20 were treated with interlocking nail. The majority of the cases belong to 16-30 years of age in both groups, ie, 80 % & 70 % patients respectively. Mean age among interlocking nail group was 28.40±8.04. & 28.35±9.03was open Kuntscher's nail group. With no significant p-value is 0.849. Male cases are predominantly high than females among the two groups.

A similar study of Halil Burç, *et al*¹³ found Twenty-eight (63.6 %) patients were male and 16 (36.4 %)

Final Outcome	Closed Interlocking Nail		Open Kuntcher's Nail (n=20)	
	NO	%	No	%
Excellent	14	70.0	13	65.0
Good	6	30.0	7	35.0
Poor	0	0.0	0	0.0
Fair	0	0.0	0	0.0
Total	20	100.0	20	100.0

Statistical Inference : Chi-square - 0.1139, P - value - 0.735

were female. The average age of patients was 44 (17-70 years old).

The most common causes of injury in the two treatment groups were car accidents and slips and falls. Patients in open reduction group who had union did so in a mean of 15.53 weeks vs a mean of 15.71 in the closed nailing group (P=0.495). found in Tahir, *et al*¹⁴ study.

Discovered Only 10% of the patients in the Closed Interlocking Nail group fell from a height, while 90% of the cases in the Open Kuntcher's Nail group fell from a height. There was no significant difference between the groups; the p-value is 0.632.

For the treatment of femoral shaft fractures, there have been numerous studies comparing open and closed intramedullary nailing. The results of this investigation seem to match the conclusions presented by Telgheder¹⁵. A total of 91.6 percent of femoral fractures were successfully repaired, although there was no significant difference between the open and closed procedures. A little longer than in our study, Telgedher found that the elapsed time before union was 5.6 months (3.7 months)¹⁵.

There was an equal rate of union between the two therapy groups, and the time it took to reach union was the same for both, according to a case series published by Harper. He also discovered that closed intramedullary nailing had a greater rate of malunion. Our findings echo those of Harper, who found that almost exactly the same number of patients in both groups suffered from malunion. Unionization took about the same amount of time. There was, however, one case of malunion recorded after open intramedullary nailing by Tahririan, *et al* in a research comparing the two techniques. However, it took 3.5 months to get married. Our findings are at odds with these results. Revision surgery was required by 8.6 percent of closed group patients, compared to 16.2 percent of open group patients. Statistically, there was no difference between these two groups¹⁵.

So far, this study has found no evidence of deeper infection or osteomyelitis in any of those in the Closed Interlocking Nail group that had superficial wound

infection after receiving antibiotics. Medial leg sensory impairment is reported by one patient in the INL-nail group. In the Open K-nail group, there were two cases of implant migration. In both groups, there were no implant failures. The p-value of 0.248 indicates that it was not statistically significant.

If a fracture can't be reduced using closed procedures, open nailing can be a useful alternative. Co-morbidities and multiple severe injuries are among the conditions that these patients have to contend with. However, because the treatment takes longer, it leads to more problems and more radiation exposure. In a study of 112 patients who had closed nailing, King et al. discovered that four experienced infections and that 7 percent had limb shortening of 1 to 2 cm¹⁶.

After open intramedullary nailing,

Salawu, *et al*¹⁷ investigated the clinical results of closed femoral shaft fractures. Two patients suffered malunion, damaged nails (4.7 percent), infection, loosening of the distal screw, and limb length disparity after radiological fracture union of 14.0 1.2 weeks (2.3 percent each).

Many examples in this study showed outstanding results for both groups. In other words, 70% and 65%, respectively. In this investigation, we discovered no individuals with poor or fair outcomes following surgery. P-value of 0.735 and chi-square value of 0.1139.

Harper found that the prevalence of postoperative problems was equal in both open and closed groups, except for rational malunion, which was more common in the closed nailing group. The other findings were comparable between the two groups¹⁸.

CONCLUSION

Except for the period from injury to surgery and operating time, there was no significant difference between the two groups in terms of demographic data, fracture type, and associated co-morbidities and radiological union. When utilised to fix short oblique and transverse fractures near the isthmus of the femur, Kuntscher's intramedullary nailing can yield a comparable rate of union to interlocking intramedullary nailing. Kuntscher's intramedullary nailing is still a viable option for selected femoral fractures in many hospitals, especially those with limited financial resources or technical expertise, when considering the cost and surgical components of this treatment approach.

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