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Is Distal Locking of Long PFNA Necessary in Stable Intertrochanteric Fracture of Femur?

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ABSTRACT
Stable intertrochanteric fracture of femur (AO 31-A1) is an extracapsular fracture with intact posteromedial cortex. Recent trends shift towards use of intramedullary nails over extramedullary devices. Distal locking screw of intramedullary nail, designed to provide axial and rotational stability. Though distal locking is often routinely done, it has certain disadvantages. This study aims to determine whether distal locking is necessary for the treatment of stable intertrochanteric fracture. 42 patients were selected and randomized equally into distal locked and distal unlocked group from August 2020 to August 2021. Patient were assessed on basis of duration of operation, fluoroscopy exposure, intraoperative blood loss and postoperative complications. Outcomes were assessed on basis of Harris Hip score clincally and serial radiographs. Patients were followed up for 12 months. In distal unlocked group there was reduction in duration of operation (42.90±1.497 min versus 63.19±2.343 min, $p<0.0001$), fluoroscopy exposure time (69.05±1.925 secs versus 79.05±2.176 secs, $p = 0.0014$) and intra-operative blood loss (140.0±7.003 mL versus 168.1±5.632 mL, $p = 0.0033$) compared to distal unlocked group. Union was seen in all 42 cases. 2 cases (1 from each group) had varus collapse. 1 case had breakage of implant. There was no significant advantages in terms of Harris hip score (88.31±5.654 versus 87.00±6.990, $p = 0.6465$) By abandoning the use of distal locking screw in long PFNA in stable intertrochanteric fracture of femur (AO 31-A1), there were advantages in terms of reduction in duration of operation, fluoroscopy exposure time and intra-operative blood loss which was statistically significant. In terms of union, Harris Hip Score and recovery, distal locking or unlocking has no significant influence.

INTRODUCTION

Intertrochanteric fracture of femur is an extracapsular fractureoccurring between the greater and lesser trochanters. Most patients are elderly individuals who are suffering from other diseases and severe osteoporosis. Thus, it is difficult to achieve satisfactory clinical results using current available remedies. As aging process is continuous, there has been an annual increase in incidence of intertrochanteric fracture[1].

Epidemiological survey data revealed a total of 1.66 million patients with hip fractures are secondary to osteoporosis worldwide in 1990, which is expected to reach 6.26 million by 2050[2]. Intertrochanteric fracture can be stable or unstable. The stability of intertrochanteric fracture is defined by an intact posteromedial cortex. These stable fracture will resist medial compressive loads once reduced. An unstable intertrochanteric fracture is one where there is posteromedial comminution, reverse obliquity or subtrochanteric extension. These fractures have the tendency to collapse into varus.

The treatment of intertrochanteric fractures is a challenge in orthopaedic surgery. Early surgical treatment can allow for an early mobilisation with functional exercises, thereby reducing complications caused by long-term bed rest, reducing disability and mortality, and improving the patients' quality of life. Debate between extramedullary versus intramedullary implants for the fixation of intertrochanteric fractures has been continuing for a very long time. Intramedullary fixation has gained dramatic popularity over extramedullary implants (eg. DHS) among surgeons during recent years from 3%m in 1999 to 67% in 2006[3].

At present, the intramedullary nail fixation system includes Gamma nails, InterTAN, PFNA, and TFN. Advantages of intramedullary fixation are small surgical trauma, short surgery time, and firm bone fixation and early weight bearing. Furthermore, intramedullary nails may be beneficial in treatment of unstable and subtrochanteric fractures[3].

A distal locking screw of the intramedullary nail was designed to control proximal rotation and fracture shortening, and to prevent axial and rotational instability. Although distal locking has been a routine procedure for intramedullary fixation in the treatment of intertrochanteric fractures, it has some disadvantages.

Use of distal locking screws of intramedullary nails has various complications including fascia lata irritation, additional operative time, intraoperative bleeding, radiation exposure, superficial femoral artery tear, implant loosening, and secondary femoral fractures[5,6]. Thigh pain, erosion of the femoral cortex, and femoral fracture are consequences of the stress load at the distal screw[7]. Simmermacher *et al*.[7] highlighted that an imprecise aiming device can weaken the femur and increase stress at the head of the locking screw. Many controversies still exists regarding the use of distal locking screws of intramedullary nails for stable intertrochanteric fractures.

Therefore, studies were performed to evaluate whether distal locking was necessary for intertrochanteric fractures[4,7]. Biomechanical studies revealed that distal locking of stable intertrochanteric fractures may not be required[4]. Rosenblum *et al*.[4] found that the use of distal locking screw doesn't change femoral stress load for stable intertrochanteric fractures and the tension of the proximal femoral bone does not change.

To more comprehensively evaluate the therapeutic effects of the two methods, we are conducting a study to determine the safety and efficacy of distal locking or unlocking in the nailing of stable intertrochanteric fractures of femur.

MATERIALS AND METHODS

From August 2020 to February 2022, 42 cases of stable intertrochanteric fractures of femur (AO 31-A1) presenting to Department of Orthopaedics, Jorhat Medical College, Jorhat, Assam were selected for the study. The patients were randomized equally into two groups. Group A consisted of 21 patients treated with closed reduction and internal fixation with long PFNA with distal locking screw. Group B had 21 patients treated with closed reduction and internal fixation with long PFNA without distal locking screw (Fig. 1 and 2).

Inclusion criteria:

- Patients withstable IT fracture of femur (AO/OTA 31 A1)
- Age>18 years of both sexes
- Community ambulatory patient in case of elderly

Exclusion criteria:

- Patients with unstable IT fracture AO/OTA 31 A2, A3
- Patients with pathological fractures
- Patients with previous ipsilateral hip or femur surgery
- Patients with open fractures
- Patient with hip joint pathology
- Paediatric fractures

Post-operatively weight- bearing was started immediately as per patients' pain tolerance along with

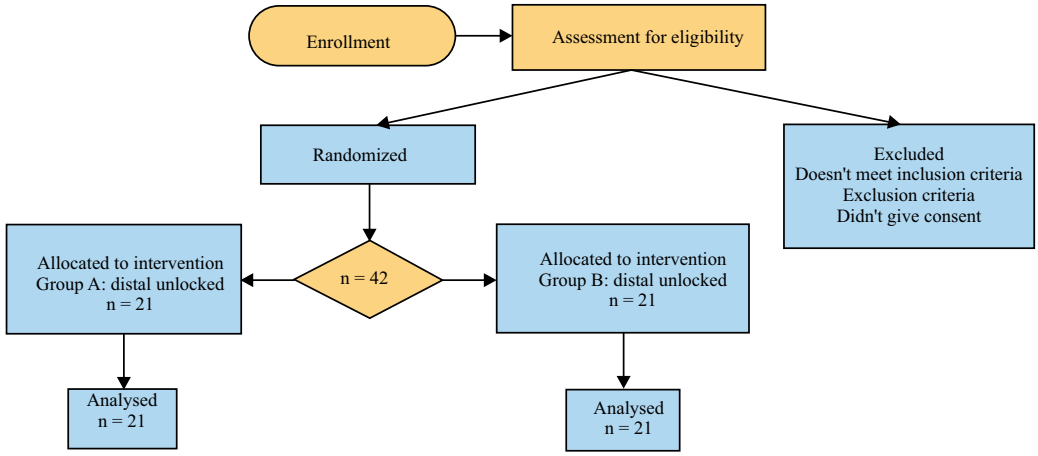

Fig. 1: Plan of study

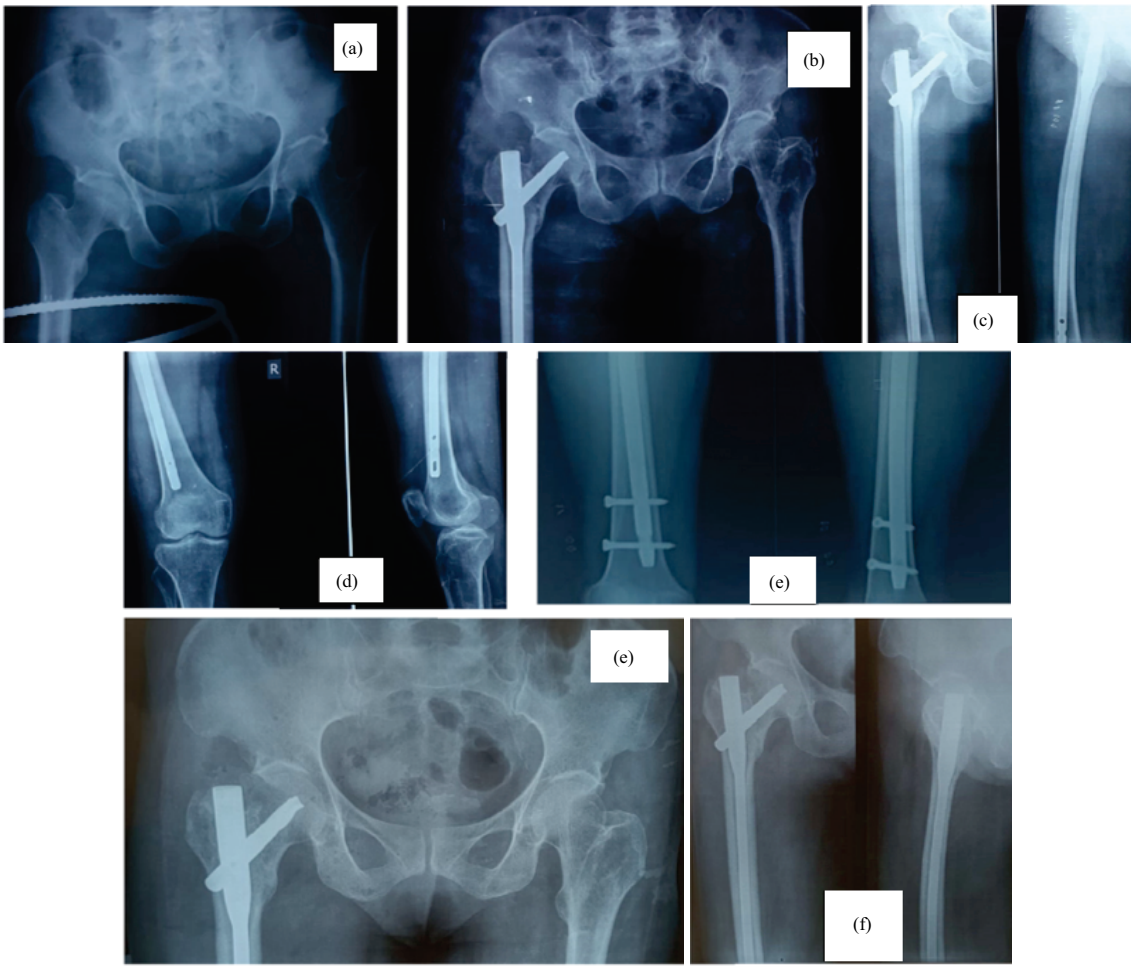

Fig. 2(a-f): X ray images showing (a) Pre-operative X-Ray, (b), (c) Immidiate Post-operative X ray, (d) Distal Unlocked long PFNA, (e) Distal locked long PFNA (f), (g) Follow up at 12 weeks showing union

knee bending and static quadriceps exercises. Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, 9 months and 12 months. In each visits the patients were evaluated clinically and radiologically. Union was assessed radiologically as well as clinically. Outcomes were assessed by Harris Hip Score. Statistical analysis was done by SPSS v26 (Fig. 3).

Fig. 3: Movements of patient in post-operative follow up

RESULTS

The mean age of the patients in our study was found to be 68.925 years (range 46 to 90 years). Of the 42 patients, 22 were males and 20 were females. Trivial trauma due to fall from standing height was the most common mode of injury (80.95%) 33 out of 42 patients (78.57%) had associated co-morbidities.

Duration of surgery: The mean duration of surgery was found to be 63.19±2.343 min for the distal locked group and 42.90±1.497 for distal unlocked group. The difference between the two groups is statistically significant (p- value <0.0001) (Table 1 and Fig. 4).

Table 1: Mean duration of surgery

Distal	Mean duration of surgery (min)
Locked	63.19±2.343
Unlocked	42.90±1.497
	p<0.0001

Intraoperative blood loss: The mean intra-operative blood loss was found to be 168.1±5.632 mL for distal locked group and 140.0±7.003 for distal locked group.

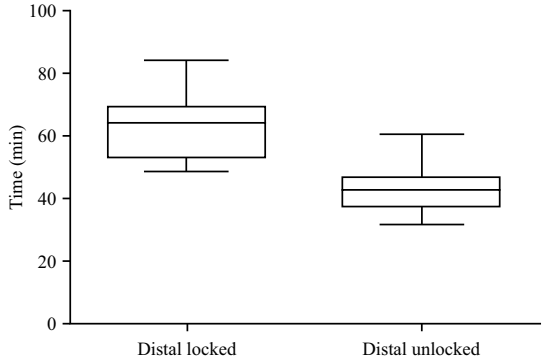

Fig. 4: Graph showing mean duration of surgery

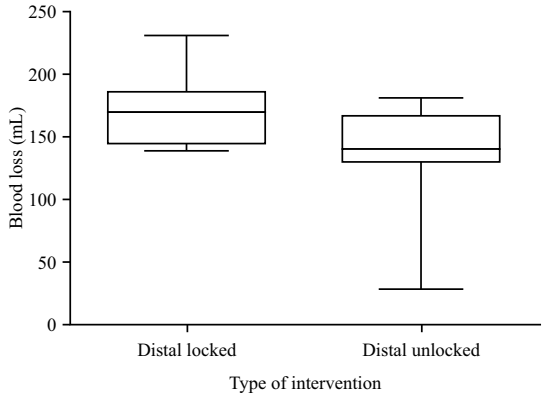

Fig. 5: Graph showing mean blood loss

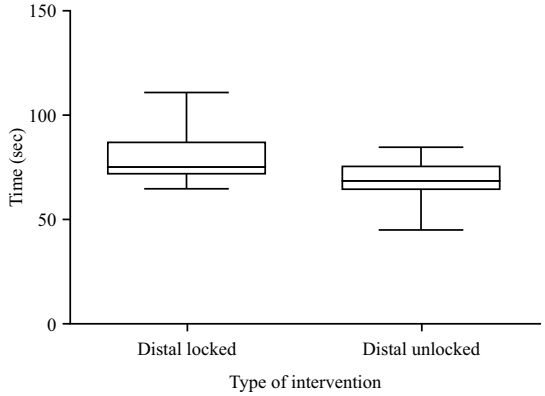

Fig. 6: Graph showing Fluoroscopy exposure time

The p- value of 0.0033 suggests that this difference is statistically significant (Table 2 and Fig. 5).

Fluoroscopy exposure time: The average fluoroscopy exposure time was found to be 79.05±2.176 seconds for distal locked group and 69.05±1.925 for distal unlocked group. The difference noted between the two groups was statistically significant (p = 0.0014) (Table 3 and Fig. 6).

Post-operative complications: In the distal locked group, 9 cases had post-operative complications compared to 5 in distal unlocked group. Among the various post-operative complications thigh pain was most common and was reported in 6 cases in distal locked group and 2 cases in distal unlocked group. 1 case from each group had varus collapse. 1 case had breakage of implant (Fig. 7).

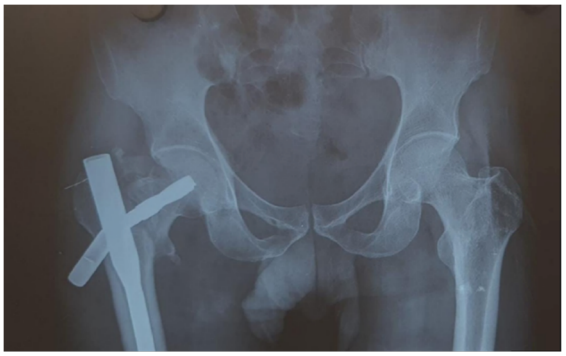

Fig. 7: Post-operative X-ray of patient in follow up showing breakage of implant

Table 2: Intra-operative blood loss

Distal	Mean intra-operative blood loss (mL)
Locked	168.1±5.632
Unlocked	140.0±7.003
	p = 0.0033

Table 3: Fluoroscopy exposure time

Distal	Mean fluoroscopy exposure time (sec)
locked	79.05±2.176
Distal unlocked	69.05±1.925
	p = 0.0014

Table 4: Post-operative complications

Post-operative complications	Distal locked	Distal unlocked
Hematoma	0	0
Surgical site infection	3	2
Deep vein thrombosis	0	0
Hip pain	0	0
Thigh pain	6	2
Distal tip fracture	0	0
Varus collapse	1	1
Migration of blade	0	0
Cutting out of screw	0	0
Implant breakage	1	0
Non union	0	0
Delayed union	0	0

Union: Union was seen in all the 42 cases. The average time to union in distal locked group was 17.24±3.657 weeks and 17.71±1.925 weeks in distal unlocked group. Statistically, the difference between two is not significant (p = 0.4411) (Table 4).

Harris hip score: The mean Harris hip score in distal locked group was 87.00±6.990 and in distal unlocked group was 88.31±5.564. The difference between the two is not statistically significant (p = 0.6465) (Table 5).

Recovery outcomes: 16 out of total 21 cases in distal locked group and 17 out of 21 in distal unlocked groups recovered to pre-injury status. None of the patients in any group were bed ridden (Table 6).

Table 5: Harris hip score

Harris hip score	Excellent	Good	Fair	Poor
Distal locked	10	7	2	1
Distal unlocked	11	8	2	0

Table 6: Recovery outcomes

Outcomes	Distal locked	Distal unlocked
Walking to pre-injury status	16	17
Walking with aid	3	4
Wheel chair bound	2	0
Bed ridden	0	0

DISCUSSION

Though both intra medullary and extra medullary devices can be used to treat intertrochanteric fractures of femur, the modern trend shifts towards the use of intramedullary nails. Among the various intramedullary nails, proximal femur nail antirotation (PFNA) with helical blade is popularly used throughout the world. The helical blade of PFNA helps in reducing the chance of Z-effect and reverse Z-effect, seen in the earlier generation nail PFN.

The mean age of the patients in our study was 68.925 years which shows that intertrochanteric fracture is commonly seen in the elderly. Most commonly these fractures occur due to low energy trauma like trivial falls. At this age group most of the patients seem to have a poor quality of bone. However, in young patients it may occur due to high energy trauma like road traffic accidents, fall from height etc. Most of these patients have other associated co- morbidities and are unable to withstand long duration of surgery due to increased blood loss and complications due to drugs used for anaesthesia.

By omitting the application of distal locking screw in stable intertrochanteric fractures of femur (AO/OTA 31-A1) there was reduction in total duration operation, reduced fluoroscopy exposure and reduced total intra-operative blood loss which was statistically significant. Short duration of operation helps in decreasing the dose of drugs used for anaesthesia and the complications associated with it. Reduced fluoroscopy exposure helps in decreasing the radiation exposure to the patients, doctors and the surgical staff. Decreased intra-operative blood loss decreases the inta-operative or post-operative need for transfusion and the complications associated with it.

No significant difference was noted between the distal locked or unlocked group in terms of union, Harris hip score or recovery. This shows that distal locking and unlocking has no influence on the outcome of stable intertrochanteric fractures treated with long PFNA. In distal unlocked group there was better patient motility and compliance to physiotherapy. This was probably due to less incidences of thigh pain which was probably caused due to tissue dissection and fascia lata irritation due to application of distal screws. Intertrochanteric fractures unite readily because of the presence of cancellous bone and good vascular supply, and all our cases had union. But adequate reduction of intertrochanteric fractures is essential to prevent malunion and shortening.

CONCLUSION

By abandoning the use of distal locking screws in stable intertrochanteric fracture of femur (AO/OTA 31-A1), there was added advantage of reduction in duration of operation, intra-operative blood loss and fluoroscopy exposure time which was statistically significant. Distal locking or unlocking has no significant difference in terms of union, Harris hip score and recovery outcomes. So, our results showed that stable intertrochanteric fractures (AO/OTA 31-A1) can be treated with long PFNA without the application of distal locking screw with satisfactory outcome. Though, further study are required to confirm this assertion.

Limitations: Our study is a single centre based, single blinded study with a small sample size, which is the limitation of our study. A large multicentric study with a large sample size is recommended. A short follow up period of 12 months is another limitation of our study and results in a long term follow up is not clearly understood through this study.

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