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Original Research Article

Subtrochanteric locking screw–The key to success in intertrochanteric fractures

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ABSTRACT

Background: The introduction of proximal femoral nail improved the results in unstable intertrochanteric fractures. Several factors determine the outcome of intramedullary nail including working length of the nail. Addition of subtrochanteric locking screw to a reconstruction nail will reduce the working length providing biomechanical advantage.

Materials and Methods: 177 adult patients treated with reconstruction nail with a subtrochanteric locking screw for intertrochanteric fracture of the femur in our institution from January 2011 to December 2020 were prospectively analyzed. Final outcome is assessed by radiological union after a followup period of minimum 6 months postoperatively.

Results: 3 patients had varus malreduction, 4 patients had screw backout and one patient had screw migration. We didn't encounter any wound complications in our study. Complication rates were much lesser when compared with studies done on standard proximal femoral nail.

Conclusion: Reconstruction nail with a subtrochanteric locking screw reduces the working length of the nail and improves the outcome in intertrochanteric fractures.

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1. Introduction

Trochanteric fractures are one of the commonest fractures in geriatric population usually occurring as a result of trivial trauma.¹ Severe osteoporosis in elderly population has been attributed to this higher incidence.² The incidence of these fractures has increased substantially over the last few decades as the longevity of the population has substantially increased.³ More than 35 to 40% of trochanteric fractures are unstable in nature.⁴ Surgical management of these fractures is preferred method of treatment with the aim of restoring pre-fracture mobility. Several fixation devices have been developed to overcome the difficulties encountered in the management of the unstable trochanteric fractures. Initially, most of these fractures were treated by

lateral devices like dynamic hip screws. These devices were associated with high rates of complications due to its longer moment arm causing femoral neck collapse.⁵ Therefore intramedullary fixation devices have become gradually more prevalent. The proximal femoral nail (PFN) improves the result of unstable trochanteric fractures due to its intramedullary location. PFN in unstable fracture patterns is progressively becoming standard method of fixation in view of its superior biomechanics and prevention of varus collapse in comparison to extramedullary devices. However, the evolution of the procedure may include complications associated with the migration of the interlocking head screws (Z-effect and reverse Z-effect), varus collapse, screw backout, peri-implant fracture, non-union, delayed union and shortening. In order to reduce the above said complications we started using reconstruction nail instead of PFN. Reconstruction nail has an advantage of faster union

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when compared with proximal femoral nail.⁶ The idea is to reduce the working length of the nail by a subtrochanteric locking screw. Further long nail is used in all our cases as it has biomechanical advantage over short nail.⁷ The objective of our study is to find the role of sub trochanteric locking screw in a reconstruction nail operated for both stable and unstable intertrochanteric fractures.

2. Materials and Methods

177 adult patients with intertrochanteric fractures of the femur admitted in our institution from January 2011 to December 2020 were prospectively analysed. The fractures were classified as per Boyd-Griffin classification for intertrochanteric fractures. Informed consent was obtained from all the patients included in the study.

2.1. Inclusion criteria

1. All patients above 18 years of age with intertrochanteric fractures.
2. All intertrochanteric fractures of Boyd and Griffin types 1 to 4.

2.2. Exclusion criteria

1. Pathological fractures.
2. Open fractures.
3. Peri-prosthetic fractures.

During admission, clinical and radiological examination was done and all the patients were given initial care with analgesics, intravenous fluids and were maintained on skin traction or Thomas splint pre-operatively. X-rays in both anteroposterior and lateral views were taken preoperatively and basic blood investigations were done. Anaesthetic fitness was obtained for all patients and prophylactic antibiotic with Injection Cefuroxime was given to all the patients 30 minutes before surgery.

Patients were operated on fracture table with closed reduction technique. In case of failed closed reduction, manipulation with Steinmann pin or minimal open reduction was done. Full length reconstruction nail is used in all patients. Proximal locking is done with two cervical screws and one subtrochanteric screw. For distal locking we mostly used anteroposterior locking screw to prevent dangling effect.

Post-operatively foot end elevation was advised to reduce limb edema and standard wound care was given. Sutures were removed usually after 10-12 days. Patients were advised for quadriceps strengthening exercises and hip and knee mobilization in the immediate post-operative period as per subjective tolerance to pain. All the patients were followed up every week during the first month and every month during the next six months. Patients were evaluated clinically and radiologically during each visit. The final



Fig. 1: Reconstruction femoral nail with subtrochanteric locking screw

outcome is assessed by Harris hip score and presence of radiological union in follow up X-rays. Being a fracture, the patients were followed up only till the fracture union or a failure was detected. Loss of union is not possible after the fracture has united. Therefore the maximum follow up was 6 months before which one of the end points would have occurred.

3. Results

A total of 177 patients with intertrochanteric fractures were followed up and following results were obtained.

Table 1:

Boyd and Griffith classification	No of patients
Type 1	74
Type 2	76
Type 3	19
Type 4	8

Type 1 and 2 were considered as stable fractures whereas 3 and 4 were considered as unstable fractures.

The following complications were observed during our study

One patient sustained fracture just above the distal locking screw which has been managed conservatively which is an additional benefit of using a long reconstruction nail. There were no wound related complication observed in our study.



Fig. 2: Intertrochanteric fracture in a 60 years old female

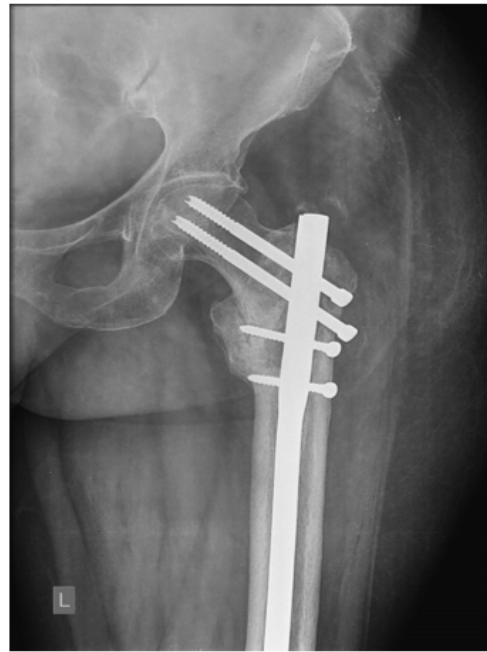


Fig. 4: Followup radiograph at third month



Fig. 3: Immediate postoperative radiograph



Fig. 5: Varus malreduction

Table 2:

Complications	Number of patients
Varus mal reduction	3
Lag screw back out	4
Non union	2
Z Effect/Reverse Z Effect	1
Technical complication	1

Table 3: Harris Hip score

SCORE	Number of Patients	Percentage
Excellent	83	46.8
Good	82	46.3
Fair	7	3.95
Poor	3	1.69
Bad	2	1.12
Total	177	100

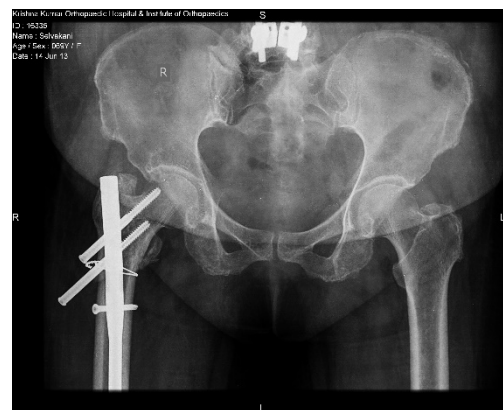


Fig. 6: Lag screw backout



Fig. 7: Technical failure showing medialisation of distal fragment



Fig. 8: Reconstruction nail with subtrochanteric locking screw and shorter working length z effect

4. Working length of the nail

Working length is defined as the length of a nail spanning the fracture site from its distal point of fixation in the proximal fragment to its proximal point of fixation in the distal fragment. Working length depends on variety of factors such as

1. Communion at the fracture site
2. Nail endosteal contact
3. Interlocking screws

Torsional rigidity is inversely proportional to the working length whereas bending rigidity is inversely proportional to square of working length. With short working length, nail will be inherently stable and with long working length, nail will be less stable and may require stronger implant to maximize stability and reduce the risk of implant fatigue failure. Addition of a subtrochanteric locking screw in a proximal femoral nail will reduce the working length of the nail improving the biomechanics of the nail providing improved outcome.

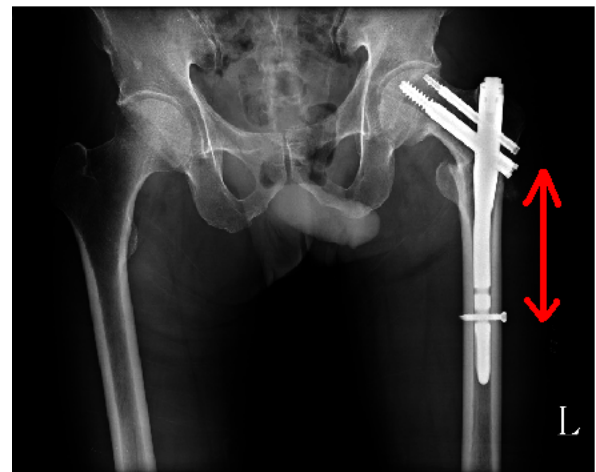


Fig. 9: Standard PFN with longer working length

4. Discussion

Intertrochanteric fractures has been traditionally treated with dynamic hip screw. Proximal femoral nails developed during early 90s gave both biomechanical and biological advantage over DHS. The moment arm of intramedullary device is shorter than that in DHS. The load gets transmitted through the long axis of nail which is more medial thereby reducing the risk of femoral neck collapse. Nail has further advantage of preventing shortening at the fracture site and also it prevents medialisation of femoral shaft providing buttressing effect. Therefore, intramedullary device remains the treatment of choice in unstable fractures.

Several factors contribute to the overall biomechanical profile and resulting structural stiffness of an IM nail. Important among them include

1. Material properties
2. Cross sectional shape
3. Total Length of the nail

We compared our results with studies done with standard PFN for intertrochanteric fractures and following inferences were made.

Table 4:

Studies	Varus malreduction(%)
Present study	1.69
Mohit J Jain et al ⁸	3.63
Herode P et al ⁹	4.00
Pulin Bihari Das et al ¹⁰	4.00
Yasir S Siddique et al ¹	9.52
Nazir Nawaz et al ¹¹	4.52

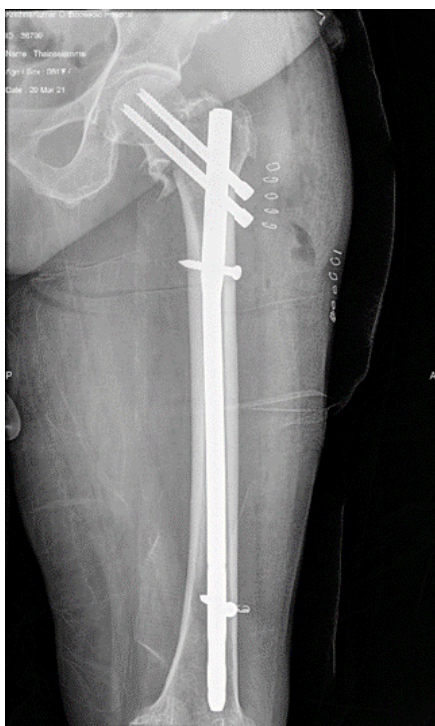


Fig. 10: Reconstruction nail with subtrochanteric locking screw and shorter working length

Table 5:

Studies	Screw backout (%)
Present study	2.25
Mohit J Jain et al ⁸	1.81
Kairui Zhang et al ¹²	2.43
Cyril Jonnes et al ¹³	13.00
Pulin Bihari Das et al ¹⁰	1.33
Yazir Siddique et al ¹	4.76

Table 6:

Studies	Screw migration (%)
Present study	0.56
Pulin Bihari Das et al ¹⁰	2.66
Mohit J Jain et al ⁸	1.81
Yazir Siddique et al ¹	7.14

Complication rates were less in our present study when compared with other studies except for screw cut out rate which is lesser in studies done by Mohit Jain et al. and pulin Bihari et al.

5. Limitations of our Study

Studies which we compared had a smaller sample size when compared to our study.

6. Conclusion

Shorter working length provided by addition of subtrochanteric locking screw in reconstruction nail provides better biomechanical stability when compared to conventional PFN. This leads to improved outcome and lesser complication rate in patients with intertrochanteric fractures.

7. Source of Funding

None.

8. Conflict of Interest

The authors declare no conflict of interest.

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