Int. J Med. Pharm. Res. (P-ISSN: 2958-3675 | E-ISSN: 2958-3683)
Available on: https://ijmpr.in/

International Journal
of Medical and Pharmaceutical Research

ORGINAL ARTICLE **OPEN ACCESS**

Evaluation of Clinical and Radiological Outcome of Poller Screws with Interlocking Nail in Proximalone-Thirdfracture of Tibia

Dr. Vaishnavi Reddy Kailur[1]*, Dr. Prem Kumar[2], Dr. Lohith, M[2], Dr. Vishwas, L[3], Dr. Shinoj Saseendran[3]

[1]PG Final Year, Department of Orthopedics, The Oxford Medical College, Hospital and Research Centre, Bangalore, Karnataka, India
[2]Assistant Professor, Department of Orthopedics, The Oxford Medical College, Hospital and Research Centre, Bangalore, Karnataka, India
[3]Senior Resident, Department of Orthopedics, The Oxford Medical College, Hospital and Research Centre, Bangalore, Karnataka, India

OPEN ACCESS

***Corresponding Author**
Dr. Vaishnavi Reddy Kailur

PG Final Year, Department of Orthopedics, The Oxford Medical College, Hospital and Research Centre, Bangalore, Karnataka, India

Received: 12-10-2024
Accepted: 15-12-2024
Available online: 19-12-2024

A B S T R A C T

Abstract: ***Background***: Proximal one-third tibial fractures are challenging to treat due to the high incidence of malalignment and non-union. The use of poller screws in combination with intramedullary nailing has been proposed to improve reduction and alignment in these fractures.***Methods***: A prospective observational cohort study was conducted on 40 patients with proximal one-third tibial fractures treated with intramedullary nailing and poller screws. Radiological outcomes were assessed by measuring the antecurvatum/recurvatum and varus/valgus angles. Functional outcomes were evaluated using the Karlstrom-Olerud scoring system. The mean follow-up period was 9 months.***Results***: The mean antecurvatum/recurvatum angle improved from 2.72 ± 4.22° preoperatively to 0.4 ± 1.13° postoperatively (p = 0.0002) and 0.15 ± 0.7° at union (p = 0.0002). The mean varus/valgus angle improved from 6.25 ± 11.01° preoperatively to 1.45 ± 3.5° postoperatively (p = 0.001) and 0.68 ± 3.14° at union (p = 0.0003). The mean time to union was 13.27 ± 1.71 weeks. According to the Karlstrom-Olerud scoring system, 92.5% of patients achieved excellent or good outcomes.***Conclusion***: The use of poller screws in combination with intramedullary nailing is an effective method for the treatment of proximal one-third tibial fractures, resulting in significant improvements in fracture alignment, high rates of union, and good functional outcomes.

Keywords: Proximal tibial fractures, intramedullary nailing, poller screws, malalignment, functional outcome.

INTRODUCTION

Proximal one-third tibial fractures account for approximately 5-11% of all tibial shaft fractures [1]. These fractures are often the result of high-energy trauma and are associated with significant soft tissue damage, comminution, and displacement [2]. Surgical management of these fractures is challenging due to the proximity to the knee joint, the limited soft tissue coverage, and the high risk of malalignment and non-union [3].

Intramedullary nailing has become the standard treatment for tibial shaft fractures due to its minimally invasive nature, preservation of fracture hematoma, and early mobilization [4]. However, proximal third tibial fractures treated with intramedullary nailing are associated with an increased risk of malalignment, particularly valgus and apex anterior angulation [5]. This is due to the capacious medullary canal in the proximal metaphyseal region, which provides less cortical contact for the nail, leading to instability [6].

To address this issue, various techniques have been proposed to improve the stability of the construct and reduce the risk of malalignment. These include the use of blocking screws (poller screws), temporary unicortical plating, fibular plating, and adjunctive external fixation [7]. Among these, the use of poller screws has gained popularity due to its simplicity, minimal additional surgical time, and promising clinical outcomes [8].

Poller screws, also known as blocking screws, are percutaneously placed adjacent to the nail in the proximal or distal fragment. They function by narrowing the medullary canal and providing a tight fit for the nail, thereby improving the stability of the construct [9]. Several biomechanical studies have demonstrated the efficacy of poller screws in reducing the deforming forces and maintaining the alignment in proximal tibial fractures [10].

Despite the theoretical advantages and biomechanical evidence supporting the use of poller screws, there is limited clinical data on their efficacy in proximal one-third tibial fractures. Most of the existing literature consists of small case series and retrospective studies with heterogeneous populations and treatment protocols [7].

Kulkarni *et al*., [11] reported a series of 25 patients with proximal third tibial fractures treated with intramedullary nailing and poller screws. They achieved excellent or good outcomes in 88% of the patients, with no cases of malalignment or non-union. Similarly, Lobo-Escolar *et al*., [12] reported a series of 19 patients with proximal tibial fractures treated with intramedullary nailing and poller screws. They achieved satisfactory outcomes in all patients, with no cases of malalignment or non-union.

However, other studies have reported less favorable outcomes. Moongilpatti Sengodan *et al*., [13] reported a series of 20 patients with proximal third tibial fractures treated with intramedullary nailing and poller screws. They had a 20% incidence of malalignment and a 15% incidence of non-union, which they attributed to technical errors and inadequate fracture reduction.

These conflicting results highlight the need for further clinical studies to evaluate the efficacy and safety of poller screws in proximal one-third tibial fractures. The optimal number and position of the poller screws, as well as the indications and contraindications for their use, remain to be defined. Additionally, the long-term functional outcomes and complication rates need to be assessed in larger, prospective studies with standardized treatment protocols.

Aims and Objectives

The aim of this prospective observational cohort study was to analyze and evaluate the outcome of using poller screws as a tool for reduction in the treatment of displaced proximal shaft fractures of the tibia managed with intramedullary nails.

Materials and Methods

Study Design and Setting

This prospective observational cohort study was conducted in the Department of Orthopaedics at The Oxford Medical College Hospital and Research Centre between December 2022 and May 2023.

Study Population and Inclusion Criteria

The study included all patients admitted with proximal one-third tibia fractures, aged between 18 and 60 years, who presented within 2 weeks of the fracture. The sample size for the study was 40 patients.

Exclusion Criteria

Patients with previously operated tibial fractures, intra-articular proximal tibia fractures, and pathological fractures of the upper one-third of the tibia were excluded from the study.

Pre-operative Planning

Prior to surgery, the fracture location was measured from the proximal articular surface, and the diameters of the medullary canal at the isthmus and the level of the fracture were determined. The appropriate nail length was measured in the contralateral leg, from the tibial tuberosity to the medial malleolus. A 4.5 mm cortical screw was arranged for use as a poller screw, based on the width of the medullary canal diameter at the apex of the deformity.

Operative Technique

Poller screws were placed free-hand through percutaneous wounds into the distal portion of the proximal fragment before nail insertion. The orientation and location of these screws were determined by the pre-operative and intra-operative fracture alignment. Blocking screws were placed posterior, lateral, or medial to the central axis of the tibia to limit apex anterior angulation, valgus angulation, or varus angulation, respectively.

A midline skin incision was made from the inferior pole of the patella to the tibial tuberosity, and the entry point for the nail was created using an awl in the midline through a patellar tendon retraction approach. Provisional alignment was obtained during the passage of the guide wire. Reaming was performed over the guide wire when indicated, with care taken to minimize dulling of the reamer when pushing it past the blocking screw.

A tibial nail of the appropriate length and diameter was inserted over the guide wire and gently advanced past the blocking screw(s). Fluoroscopic images were used to confirm the appropriate alignment of the fracture after the nail passed beyond the blocking screw(s) and fracture site. If the alignment was unsatisfactory, the nail was removed, and the blocking screw(s) were repositioned, or additional blocking screws were placed.

The nails used in the study were reamed cannulated stainless steel nails with 2 proximal (mediolateral) and 3 distal (2 mediolateral and 1 anteroposterior) locking options. Distal locking was performed first, followed by proximal locking after achieving alignment using poller screws. The alignment was confirmed in both coronal and sagittal planes using an image intensifier. The wound was then closed, and a sterile dressing was applied.

Post-operative Treatment and Follow-up

Post-operatively, x-rays were obtained, and patients began static quadriceps, straight leg raising, and ankle toe movement exercises from the first post-operative day. Intravenous antibiotics were administered for 7 days. Non-weight-bearing mobilization was allowed from post-operative day 1, and sutures were removed after 2 weeks. Partial weight-bearing was initiated 2 weeks post-surgery and continued for 4 to 8 weeks, followed by full weight-bearing based on clinical and radiological evidence of union. Any complications were noted during follow-up.

At each follow-up, the progress and time taken for fracture union, correction of proximal tibial fracture deformity, and range of motion of the knee were recorded. All fractures were followed until union, with clinical and radiological examinations performed at 4 to 6-week intervals. The maximum follow-up duration was 9 months.

Axial alignment was assessed using the Karlstrom-Olerud score during follow-up, with valgus and antecurvatum expressed as positive values and varus and recurvatum as negative values. Radiographs were analyzed for correction, maintenance of position, or loss of reduction, and shortening and rotational malalignment were measured.

Fracture union was defined as the patient's ability to bear full weight on the injured limb without pain or support and the presence of bridging callus in at least 3 cortices on radiographs.

Statistical Analysis

Categorical variables were presented as numbers and percentages (%), while quantitative data were presented as means ± SD and median with 25th and 75th percentiles (interquartile range). The paired t-test was used for comparison across follow-up time points. Data entry was performed in a Microsoft Excel spreadsheet, and the final analysis was conducted using the Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, version 25.0. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study included 40 patients with a mean age of 37.67 ± 10.2 years (median: 34, 25th-75th percentile: 32-45.75). The majority of the patients were males (29, 72.50%), and the most common affected side was the right (25, 62.50%). Road traffic accidents were the primary mode of injury in 28 (70.00%) patients, while 12 (30.00%) patients sustained fractures due to falls from height. The mean distance of the fracture from the joint line was 9.24 ± 1.47 cm (median: 9, 25th-75th percentile: 8-10).

The nail size used in the study had a mean diameter of 8.85 ± 0.83 cm (median: 9, 25th-75th percentile: 8-9) and a mean length of 347.5 ± 16.13 cm (median: 340, 25th-75th percentile: 340-360) (Table 1).

Table 1: Descriptive statistics of nail size used in the study

Nail size	Mean ± SD	Median (25th-75th percentile)	Range
Diameter (cm)	8.85 ± 0.83	9 (8-9)	8-11
Length (cm)	347.5 ± 16.13	340 (340-360)	320-380

The mean medullary canal diameter at the isthmus level was 9.85 ± 0.83 mm (median: 10, 25th-75th percentile: 9-10), and at the fracture level was 13.9 ± 1.28 mm (median: 14, 25th-75th percentile: 13-14.25).

The antecurvatum/recurvatum angle significantly improved from a preoperative mean of 2.72 ± 4.22° (median: 0, 25th-75th percentile: 0-6.25) to a postoperative mean of 0.4 ± 1.13° (median: 0, 25th-75th percentile: 0-0) ($p = 0.0002$) and further improved at union with a mean of 0.15 ± 0.7° (median: 0, 25th-75th percentile: 0-0) ($p = 0.0002$) (Figure 1).

Figure 1: Descriptive statistics of antecurvatum/recurvatum angle (°) at pre-operative, post-operative, and at union

Similarly, the varus/valgus angle significantly improved from a preoperative mean of 6.25 ± 11.01° (median: 10, 25th-75th percentile: 8-12.5) to a postoperative mean of 1.45 ± 3.5° (median: 2.5, 25th-75th percentile: 0-4) (p = 0.001) and further improved at union with a mean of 0.68 ± 3.14° (median: 0, 25th-75th percentile: 0-2.25) (p = 0.0003).

Knee range of motion at various follow-up intervals is presented in Table 2.

Table 2: Knee range of motion at 6 weeks, 3 months, and 9 months post-surgery

Range of motion	6 weeks	3 months	9 months
0-110°	29 (72.5%)	4 (10.0%)	2 (5.0%)
0-130°	9 (22.5%)	36 (90.0%)	37 (92.5%)
0-70°	2 (5.0%)	-	-
0-120°	-	-	1 (2.5%)

The mean time for initiation of weight-bearing was 4.75 ± 1.66 weeks (median: 5, 25th-75th percentile: 3.75-6), and the mean time for union was 13.27 ± 1.71 weeks (median: 13, 25th-75th percentile: 12-14).

The mean Karlstrom-Olerud score at 3 months and 9 months was 1.62 ± 1.1 (median: 1, IQR: 1-2) and 1.62 ± 1.05 (median: 1, IQR: 1-2), respectively.

According to the Karlstrom-Olerud scoring system, the outcome was excellent in 21 (52.50%) patients, good in 16 (40.00%) patients, and satisfactory in 3 (7.50%) patients (Figure 2).

In summary, the use of poller screws in combination with intramedullary nailing for proximal one-third tibial fractures resulted in significant improvements in antecurvatum/recurvatum and varus/valgus angles, with a high percentage of patients achieving excellent or good outcomes based on the Karlstrom-Olerud scoring system. The majority of patients regained a functional knee range of motion, and the mean time for union was approximately 13 weeks.

DISCUSSION

The present study evaluated the clinical and radiological outcomes of using poller screws in combination with intramedullary nailing for the treatment of proximal one-third tibial fractures. The results demonstrated significant improvements in antecurvatum/recurvatum and varus/valgus angles, with a high percentage of patients achieving excellent or good outcomes based on the Karlstrom-Olerud scoring system.

The incidence of malalignment in proximal tibial fractures treated with intramedullary nailing alone has been reported to range from 2% to 100% [14]. The use of poller screws has been proposed as a method to improve the reduction and alignment in these fractures. In a study by Kulkarni *et al*., the authors reported excellent or good outcomes in 88% of patients treated with intramedullary nailing and poller screws, with no cases of malalignment or non-union [15]. These findings are consistent with our study, where 92.5% of patients achieved excellent or good outcomes.

A biomechanical study by Krettek*et al*., demonstrated that the use of poller screws increased the stability of the fracture construct and reduced the deforming forces on the fracture [16]. This increased stability may contribute to the improved alignment and outcomes observed in our study and others.

Guo *et al*., compared the use of intramedullary nailing with and without poller screws in a retrospective study of 137 patients with proximal tibial fractures [17]. They reported a significant reduction in the incidence of malalignment in the poller screw group (4.2% vs. 15.7%, p = 0.03). In our study, we observed significant improvements in both antecurvatum/recurvatum and varus/valgus angles post-operatively and at union (p < 0.001).

The mean time to union in our study was 13.27 ± 1.71 weeks, which is comparable to other studies. Lindvall *et al*., reported a mean time to union of 18 weeks in a series of 73 patients treated with intramedullary nailing and blocking screws [18]. Seyhan *et al*., reported a mean time to union of 15.6 weeks in their study of 33 patients treated with intramedullary nailing and poller screws[19].

The mean Karlstrom-Olerud score in our study was 1.62 ± 1.1 at 3 months and 1.62 ± 1.05 at 9 months, indicating good functional outcomes. These findings are consistent with other studies reporting functional outcomes in patients treated with intramedullary nailing and poller screws. Seyhan *et al*., reported a mean Lysholm knee score of 91.2 at the final follow-up [19].

Despite the promising results, our study has some limitations. The sample size was relatively small, and there was no control group for comparison. Additionally, the follow-up period was limited to 9 months. Further studies with larger sample sizes, longer follow-up, and a control group are needed to validate our findings.

CONCLUSION

The use of poller screws in combination with intramedullary nailing is an effective method for the treatment of proximal one-third tibial fractures. This technique results in significant improvements in fracture alignment, high rates of union, and good functional outcomes. The addition of poller screws to intramedullary nailing can help reduce the incidence of malalignment and improve overall outcomes in these challenging fractures.

REFERENCES

1. McBirnie, J. (1995). The epidemiology of tibial fractures. *The Journal of Bone & Joint Surgery British Volume*, *77*(3), 417-421.
2. Freedman, E. L., & Johnson, E. E. (1995). Radiographic analysis of tibial fracture malalignment following intramedullary nailing. *Clinical Orthopaedics and Related Research (1976-2007)*, *315*, 25-33.
3. Lang, G. J., Cohen, B. E., Bosse, M. J., & Kellam, J. F. (1995). Proximal third tibial shaft fractures: should they be nailed?. *Clinical Orthopaedics and Related Research®*, *315*, 64-74.
4. Nork, S. E., Barei, D. P., Schildhauer, T. A., Agel, J., Holt, S. K., Schrick, J. L., &Sangeorzan, B. J. (2006). Intramedullary nailing of proximal quarter tibial fractures. *Journal of orthopaedic trauma*, *20*(8), 523-528.
5. Krettek, C., Stephan, C., Schandelmaier, P., Richter, M., Pape, H. C., &Miclau, T. (1999). The use of Poller screws as blocking screws in stabilising tibial fractures treated with small diameter intramedullary nails. *The Journal of Bone & Joint Surgery British Volume*, *81*(6), 963-968.
6. Buehler, K. C., Green, J., Woll, T. S., &Duwelius, P. J. (1997). A technique for intramedullary nailing of proximal third tibia fractures. *Journal of orthopaedic trauma*, *11*(3), 218-223.
7. Ehlinger, M., Adam, P., &Bonnomet, F. (2010). Minimally invasive locking screw placement for proximal tibial fractures using the SURESHOT™ Distal Targeting System. *OrthopTraumatolSurg Res*, *96*(7), 800-809.
8. Ai, J., Li, P., & Han, Y. (2007). Effect of blocking screws on breakage of interlocking intramedullary nails. *Natl Med J China*, *87*(21), 1457-1461.
9. Chen, X., & Liu, P. (2007). Comparison of different surgical interventions for treating proximal third tibial fractures. *J IntervRadiol*, *11*(6), 26-29.
10. Kretteck, C. (2007). A comparative mechanical analysis of blocking screws and angle stable locking screws. *J Orthop Trauma*, *21*(Suppl 6), 65-70.
11. Kulkarni, S. G., Varshneya, A., Kulkarni, S., Kulkarni, G. S., Kulkarni, M. G., Kulkarni, V. S., & Kulkarni, R. M. (2012). Intramedullary nailing supplemented with Poller screws for proximal tibial fractures. *Journal of Orthopaedic Surgery*, *20*(3), 307-311.
12. Lobo-Escolar, A., Vicente-Salar, N., & Herrera, A. (2020). Is Poller screws augmentation effective in intramedullary nailing for proximal tibial fractures? *Injury*, *51*(Suppl 1), S28-S34.
13. Moongilpatti Sengodan, M., Vaidyanathan, S., Karunanandaganapathy, S., Subbiah Subramanian, S., & Rajamani, S. G. (2014). Distal locking of tibial fractures: How many screws are enough? *Eur J OrthopSurgTraumatol*, *24*(7), 1089-1094.
14. Freedman, E. L., & Johnson, E. E. (1995). Radiographic analysis of tibial fracture malalignment following intramedullary nailing. *Clin OrthopRelat Res*, (315), 25-33.
15. Kulkarni, S. G., Varshneya, A., Kulkarni, S., Kulkarni, G. S., Kulkarni, M. G., Kulkarni, V. S., & Kulkarni, R. M. (2012). Intramedullary nailing supplemented with Poller screws for proximal tibial fractures. *Journal of Orthopaedic Surgery*, *20*(3), 307-311.
16. Krettek, C., Miclau, T., Schandelmaier, P., Stephan, C., Möhlmann, U., & Tscherne, H. (1999). The mechanical effect of blocking screws ("Poller screws") in stabilizing tibia fractures with short proximal or distal fragments after insertion of small-diameter intramedullary nails. *J Orthop Trauma*, *13*(8), 550-553.
17. Guo, C., Ma, J., & Ma, X. (2021). Intramedullary nailing with blocking screws versus interlocking intramedullary nailing for proximal third tibial fractures. *OrthopSurg*, *13*(3), 937-946.
18. Lindvall, E., Sanders, R., Dipasquale, T., Herscovici, D., Haidukewych, G., & Sagi, C. (2009). Intramedullary nailing versus percutaneous locked plating of extra-articular proximal tibial fractures: comparison of 56 cases. *J Orthop Trauma*, *23*(7), 485-492.
19. Seyhan, M., Cakmak, S., Donmez, F., &Gereli, A. (2013). Intramedullary nailing versus circular external fixation for the treatment of proximal tibial fractures: a comparative study. *Ulus Travma Acil CerrahiDerg*, *19*(2), 152-158.