



Outcome of Proximal Tibial Fracture among Patients Treated with Intramedullary Nail Supplemented with Poller Screw: A Descriptive Cross-sectional Study

Sudeep Khanal,¹ Rajram Maharjan,¹ Pratap Babu Bhandari,² Bhawana Regmi,³ Samaj Gautam¹

¹Department of Orthopaedics and Trauma Surgery, National Academy of Medical Sciences, Bir Hospital, Mahaboudhha, Kathmandu, Nepal, ²Department of Orthopaedics, Bharatpur Hospital, Bharatpur, Chitwan, Nepal, ³Department of Nursing, Kathmandu University School of Medical Sciences, Dhulikhel, Kavre, Nepal.

ABSTRACT

Introduction: It is difficult to achieve and maintain reduction during intramedullary nailing of meta-diaphyseal tibia fractures with short proximal fragments. The use of a poller screw helps to achieve and maintain reduction as it acts as the third point of fixation. This study aimed to evaluate the outcome of proximal tibial fracture among patients treated with intramedullary nail supplemented with poller screw.

Methods: This descriptive cross-sectional study was done in a tertiary care centre among patients treated with intramedullary nail supplemented with poller screw from 01 November 2021 to 30 December 2022 after receiving ethical approval from the Institutional Review Board. Patients with acute fractures, delayed union, or nonunion of the proximal tibia at the meta-diaphyseal region were included in the study. Convenience sampling technique was used. Radiological outcome was measured by varus/valgus angulation and antero-posterior angulation, while functional outcome was measured by Rasmussen's knee scoring.

Results: Among 41 patients, 30 (73.17%) had acute fractures, 6 (14.63%) had delayed union, and 5 (12.20%) had non-union. One poller screw was used in 28 (68.29%) cases and two poller screws were used in 13 (31.71%) cases. At final follow-up, there were 5 (12.20%) cases of malunion. A majority, 37 (90.24%) patients, had excellent final Rasmussen's knee grading.

Conclusions: The use of poller screw in fractures of meta-diaphyseal region of proximal tibia had similar outcome when compared with previous studies.

Keywords: meta-diaphyseal tibia fractures, poller screws, proximal tibia fracture, rasmussen's knee function grading.

INTRODUCTION

Extra-articular meta-diaphyseal proximal tibia fractures account for 5-11% of all tibia fractures.¹⁻³ The goal of treatment is to maintain the length of the initial fracture while achieving union and correcting coronal, sagittal, and rotational alignment, thus allowing early range of motion and weight bearing. Above mentioned goals are best achieved by intramedullary nailing, which remains the

treatment of choice among all the operative treatment modalities. Intramedullary nailing for meta-diaphyseal fractures of the tibia with short proximal fragment possesses an increased risk of valgus or apex anterior angulation.^{3,4} In such a case, there is an increased risk of malalignment. To prevent deformities after intramedullary nailing in proximal fractures of tibia various techniques have been suggested, including using proximal entry starting point for nail entry, lateral starting point for nail entry, femoral distractor, a neutral insertion angle in coronal and sagittal planes, nailing with the knee in semi extended position and the use of blocking or poller screw.⁵

Poller screw help to achieve three-point fixation, thereby promoting a stable mechanical environment and thus preventing translation of nail within the medullary cavity and thereby reduce the occurrence of malalignment.^{6,7}

Correspondence:

Dr Sudeep Khanal
Department of Orthopaedics and Trauma Surgery, National Academy of Medical Sciences, Bir Hospital, Mahaboudhha, Kathmandu, Nepal
Email: khanal_sudeep@yahoo.com
Phone no: +977-9846320295.

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Thus poller screw helps to heal acute fractures, delayed union and non-union.⁸ There has been paucity of literature in our settings about the outcomes of nailing in fracture of tibia supplemented with poller screws.

This study aimed to evaluate the outcome of proximal tibial fracture among patients treated with intramedullary nail supplemented with poller screw in a tertiary care centre.

METHODS

This descriptive cross-sectional study was done among patients presenting Department of Orthopedics in National Academy of Medical Sciences, Bir Hospital, Mahaboudhha, Kathmandu, Nepal from 01 November 2021 to 30 December 2022 after receiving ethical approval from the Institutional Review Board (Reference number: 1521/2080/81). Patients aged more than 18 years presenting with acute GA (Gustilo Anderson Grading) type I, II, IIIA open extra-articular meta-diaphyseal fractures of the tibia, closed acute fractures, delayed union and nonunion of closed diaphyseal fractures of proximal tibia were included in the study while those with pathological fractures, intra-articular fractures, diaphyseal tibia fractures and infected fractures were excluded from the study.

Whole sampling method was used.

Surgery was done under spinal or epidural anaesthesia. Stainless steel hollow nails of appropriate diameter and length were used for fixation. The knee was held in a semi-extended position. Under fluoroscopic guidance, a poller screw was placed on the side opposite to the deformity's apex, along the concave border in the anteroposterior view and lateral view. One or two cortical screws of 4.5 mm were used as poller screws to obtain and maintain reduction. True antero-posterior and lateral views were used for precise insertion of poller screw and to correct the malalignment, using intraoperative fluoroscopy.^{4,9-12} By using a bone awl, an entry portal was created following mobilization of the patellar tendon. The guide wire was passed and confirmed in both views. Sequential reaming was done, and then a nail of appropriate diameter and length was inserted and locked proximally and distally. The poller screws remained in place. On the second postoperative day, partial weight bearing as tolerated and quadriceps exercises were started. Patients were followed up to 2, 6, and 12 weeks and at 6 and 12 months to assess alignment, fracture healing, and complications. The functional outcome as measured by Rasmussen's knee scoring.^{1,13}

The Modified Rasmussen's Knee grading consists of criteria for clinical assessment and radiological assessment. The clinical assessment considers pain, walking capacity, knee extension, total range of motion, stability, and power of quadriceps. The total score is 30. It is graded excellent if the score is 28-30, good if the score is 24-27, fair if the score is 20-23, and poor if the score is <20. Similarly,

the radiological assessment takes into account articular depression, condylar widening, valgus/varus angulation, and osteoarthritis. The total score is 10. It is graded as excellent if the score is 9-10, good if the score is 7-8, fair if the score is 5-6, and poor if the score is <5. Alignment and deformity of the tibia were measured by drawing the anatomic axis of the tibia in the proximal and distal segments of the fracture. Fracture was considered to be healed if there was radiological evidence of callus in at least 3 cortices and the patient was able to do full weight bearing without pain.

The data collected were entered in Microsoft Excel 2016 and analyzed using IBM SPSS Statistics version 22.0. Point estimate was calculated for binary data.

RESULTS

Among 41 cases, the majority were males 27 (65.85%), whereas 17 (34.15%) were females. Mean age was 36.56±14.83 years (range 18-66 years). There were 30 (73.17%) acute fractures, 6 (14.63%) delayed unions, and 5 (12.20%) cases of nonunion. Among the acute fractures, 21 (51.22%) cases were different Gustilo-Anderson Grades of open fractures, while 9 (21.95%) cases were closed fractures.

Road traffic accidents were the most common cause accounting for 25 (60.97%) patients. A total of 8 (19.51%) had sustained injury by fall from height, 5 (12.19%) sustained injury during sports activities and 3 (7.31%) during household trauma.

The majority of the fractures were oblique 15 (36.59%), whereas the comminuted fractures were the least common type 5 (12.20%) (Table 1).

Table 1. Fracture geometry of study participants (n= 41).

Type of fracture geometry	n (%)
Oblique	15 (36.59)
Transverse	12 (29.27)
Spiral	9 (21.95)
Comminuted	5 (12.20)

There were 20 (48.78%) closed fractures and 21 (51.22%) open fractures (Table 2).

Table 2. Type of fracture of study participants (n= 41).

Type of fracture	n (%)
Closed	20 (48.78)
Open GA-I	11 (26.83)
Open GA-II	6 (14.63)
Open GA-III	4 (9.76)

The mean length of the proximal fragment was 8.5 cm (range 7-14 cm). One poller screw was used in 28 (68.29%) cases and two screws in 13 (31.71%) cases. The poller screws were used in lateral aspect in the coronal plane and posterior in the sagittal plane. The second of two screws used were in cases where posterior poller screws were used to prevent anterior angulation. The diameter of the screw was 4.5 cm. At final follow-up, there were 5 (12.20%) cases of malunion in the coronal plane. A total of 3 (7.32%) cases had varus angulation of 10° and 2 (4.88%) cases had valgus angulation of less than 7° . A total of 12 (29.27%) had procurvatum, among which 10 (24.39%) cases had less than 5° and 2 (4.88%) cases had procurvatum of 5- 10° . The mean Rasmussen radiological score at final follow up was 9.87. There were no cases of nonunion.

Anterior knee joint pain was present in 14 (34.15%) cases which was managed with analgesics and physiotherapy. (Table 3).

Table 3. Frequency of complications (n= 41).

Complications	n (%)
Knee stiffness	4 (9.76)
Anterior knee pain	14 (34.15)
Superficial infection	3 (7.32)
Varus/valgus angulation	5 (12.20)
Procarvatum deformity	12 (29.27)

All patients achieved $>110^{\circ}$ range of motion at final follow-up. Rasmussen's knee function grading was excellent in 37 (90.24%) patients and radiological assessment was excellent in 38 (92.68%) patients (Table 4).

Table 4. Final Modified Rasmussen criteria for clinical assessment (n= 41).

Clinical result	n (%)
Excellent	37 (90.24)
Good	4 (9.76)
Rasmussen radiological assessment	
Excellent	38 (92.68)
Good	3 (7.32)
Final Rasmussen grading	
Excellent	37 (90.24)
Good	4 (9.76)

DISCUSSION

In this study, four cases had knee stiffness at 3 months but improved with physiotherapy and all patients achieved $>110^{\circ}$ range of motion at final follow-up. Bhangadiya described full range of motion in 45 cases with limited

range of motion in four cases.¹ In our study, at final follow-up, there were 12.20% cases of malunion. A total of 3 (7.32%) cases had varus angulation of 10° and 4.88% cases had valgus angulation of less than 7° . A total of 29.27% had procurvatum, among which 24.39% cases had less than 5° and 4.88% cases had procurvatum of 5- 10° . The mean Rasmussen radiological score at final follow up was 9.87. There were no cases of nonunion. Kulkarni et al described four cases of malunion: one case of varus angulation of $+7^{\circ}$ and three cases of procurvatum deformity upto 10 degrees.³

Use of poller screws as blocking screws has excellent functional outcome and has re-established the intramedullary nail as an effective fixation device for proximal third tibial fractures. It is easier to achieve and maintain reduction with poller screws. All fractures in our study united at an average of 18.2 ± 4.3 weeks. This finding was similar to studies by Kulkarni et al and Guo et. al.^{2,3} There was no significant loss of reduction after poller screw placement in intraoperative and post-operative radiographs in our study which was similar to the study by Krettek et al.⁴

We had 34.15% cases of anterior knee pain that did not require any treatment. There were 7.32% cases of superficial infection and 9.76% cases of knee stiffness. There were no complications related to poller screws and none of the cases had nonunion. Kulkarni et al described one case of nonunion.³ Goldzak et. al. described two cases of infection that were managed with exchange nailing and antibiotics therapy but not any poller screws related complications.¹⁴ Krettek et. al. also did not have any complications related to poller screws in his study of 21 cases.⁴

RK Shah¹⁵ retrospectively analyzed 60 patients who underwent intramedullary nailing supplemented by poller screws. According to the Knee Surgery rating scale of the Hospital for Special Surgery, outcome was excellent in 15%, good in 40%, satisfactory in 35% and fair in 10%. In our study, Rasmussen's functional grading was excellent in 90.24% and good in 9.76% patients.

Abdel-Aal M included 30 patients in his study where blocking screws were used as adjunct to intramedullary nailing in proximal third fractures of tibia.¹⁶ Excellent alignment was obtained in 90% patients. Two patients got superficial infection 2.7%. Final functional score was evaluated using Modified Karlstorm-Olerud Score which was excellent in 66.7%, good in 23.3%, satisfactory in 6.7% cases and poor in 3.3% cases (Knee and ankle joint range of motion were equivalent to the normal side in 82% patients. Our study had 9.76% cases of knee stiffness that needed physiotherapy. We had 7.32% cases of superficial infection that needed debridement and antibiotics.

Rasmussen's knee function grading was excellent in 37 (90.24%) cases and good in 4 (9.76%) cases. Bhangadiya et al described an excellent outcome in 41 cases, good in five cases, fair in two cases and poor outcome in one case.¹

In this study, 14 (34.15%) patients had anterior knee pain. Solanki et al¹⁸ had five patients who experienced anterior knee pain out of 60 patients. This study had 6 cases of delayed union and 5 cases of nonunion. The 6 cases of delayed union united when the intramedullary nail was supplemented with anterior and posterior poller screws. Among the 5 nonunion cases, 3 needed exchange nailing with larger nail and poller screws, while 2 needed only supplementation of poller screws. None

of the cases of delayed union and non-union needed bone grafting. There were no cases of new fracture through poller screw site or nail breakage.

The limitations of this study is that it is constrained by a small number of cases that were part of research. Nonetheless, it offers a solid foundation for future randomized controlled research.

CONCLUSIONS

The use of poller screw in fractures of meta-diaphyseal region of proximal tibia had similar outcome when compared with previous studies.

Conflict of Interest: None.

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