

International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958

P-ISSN: 2706-6630

IJOS 2020; 6(4): 228-230

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www.orthopaper.com

Received: 15-07-2020

Accepted: 18-08-2020

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A short-term functional outcome of proximal diaphysis-metaphyseal fracture of tibia treated with intramedullary interlocking nail in combination with poller screw

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DOI: <https://doi.org/10.22271/ortho.2020.v6.i4d.2345>

Abstract

Non-articular fractures of the proximal third of the tibia account for 5 to 11% of tibial shaft injuries. Intramedullary nailing for metaphyseal tibial fractures with a short proximal fragment (unlike diaphyseal tibial fractures) is associated with an increased risk of frontal and sagittal plane malalignment. This can be solved by the use of intramedullary interlocking nail in combination with blocking screws or Poller screws. A series of 20 cases of proximal diaphysis-metaphyseal fracture of tibia treated with intramedullary interlocking nail in combination with poller screw and were followed up regularly till 6 months and evaluated using Modified Karlstrom-Olerud Score. Most patients had Excellent score at 6th month follow-up. Our study suggests intramedullary interlocking nail in combination with poller screws is an effective management of proximal diaphysis-metaphyseal fracture of tibia.

Keywords: Proximal diaphysis-metaphyseal fracture of tibia, Poller screws, blocking screws, intramedullary interlocking nail

Introduction

Proximal tibial fractures considered a more challenging injury. With the increasing number and the advent of high velocity transport system, there is an alarming increase in RTA with increased morbidity and mortality. Amongst every 10-15 trauma cases, there is one fracture shaft tibia. Non-articular fractures of the proximal third of the tibia account for 5 to 11% of tibial shaft injuries. The goals of treating these fractures are: achieving bony union, restoring soft tissue vitality, preventing infection and instituting early joint motion and muscle rehabilitation. A wide variety of nonsurgical and surgical methods of treatment are available. Intramedullary nail passes from one end of the bone to another end in the medullary canal, it acts as an internal splint. It allows the axial forces to be transmitted to the opposite end of the fragment. Intramedullary nailing for metaphyseal tibial fractures is associated with an increased risk of frontal and sagittal plane malalignment (procurvatum). This may be attributed to an inaccurate entry site or both displacing muscular forces and residual instability. The large difference between the size of the implant and the metaphyseal diameter increases the risk of malalignment. This can be solved by the use of blocking screws or Poller screws. Poller screws decrease the width of the medullary cavity, guide and block the nail in the centre of the widened metaphyseal area, and increase the mechanical stiffness of the bone implant construct. The aim of this study was to evaluate the functional outcome of Proximal diaphysis-metaphyseal fracture of tibia with Intramedullary interlocking nailing and Poller screws.

Materials & Methods

The study was conducted on 20 patients above 18 years were enrolled after detailed clinical and appropriate radiological evaluation in Department of Orthopedics, Mahadevappa Rampure Medical College, Kalaburagi and other Private Hospitals in Kalaburagi. It was conducted between June 2018 to March 2020. Modified Karlstrom-Olerud Score was used to evaluate the functional outcome.

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Inclusion criteria

1. Age >18yrs with clinically and radiologically diagnosed closed fractures of proximal diaphysis-metaphyseal tibia.
2. Type I, II and IIIA open fractures of proximal diaphysis-metaphyseal tibia.

Exclusion criteria

1. Unstable comminuted fractures
2. Type III B and C open fractures of proximal diaphysis-metaphyseal tibia

Surgical Technique

- Under Spinal Anesthesia, patient in supine position on a radiolucent table.
- The knee positioned in 90-degree flexion. A longitudinal incision about 4 cm was made from the inferior pole of the patella, patellar tendon was splitted in midline to expose proximal tibial ridge.
- The entry point of nail at articular ridge opened using a curved Awl.

- The fracture was manipulated manually or by using percutaneous clamp to achieve reduction.
- Poller screws were placed percutaneously at the junction of posterior 2/3rd and anterior 1/3rd of tibia metaphysis above the Herzog bend or proximal to fracture medial to lateral direction
- Guide-wire passed through medullary canal down to level of the fracture site, then was directed toward the distal fragment and its position was checked again radiographically for further confirmation.
- The chosen nail attached to insertion jig and driven over the guide wire through the medullary canal
- Proximal and distal locking was done.
- Incision was closed in layers & pressure dressing applied.

Physiotherapy protocol included Knee isometric exercises, Quadriceps strengthening exercises and Knee ROM exercises & non weight bearing for 6 weeks and weight-bearing was increased gradually, depending on the absence of pain and radiographic evidence of bone union.



Fig 1: Pre-op X-ray



Fig 2: Immediate Post-op X-ray



Fig 3: 6 months Post-op X-ray

Results

The patients were followed up postoperatively at 4 weeks, 3 months, 6 months. The results of the study had been evaluated through: union of fracture, ranges of motion of both knee and ankle joints, alignment of fracture, occurrence of infection, degree of knee pain, walking capacity, extension lag and stability of the knee joint. All cases had been united.

Table: Distribution of cases

Parameter	Total number of cases (20)	
	Number	Percentage
Age Distribution (years)		
18-35	5	25%
36-55	10	50%
>55	5	25%
Sex distribution		
Male	16	80%
Female	4	20%
Side Distribution		
Right	18	90%
Left	2	10%
Mode of Injury		
Road Traffic Accidents	18	90%
Fall/Trauma	2	10%

According to Modified Karlstrom-Olerud Score, out of 20 patients, 12 had excellent results, 5 had good results, 2 had satisfactory result & 1 had poor result.

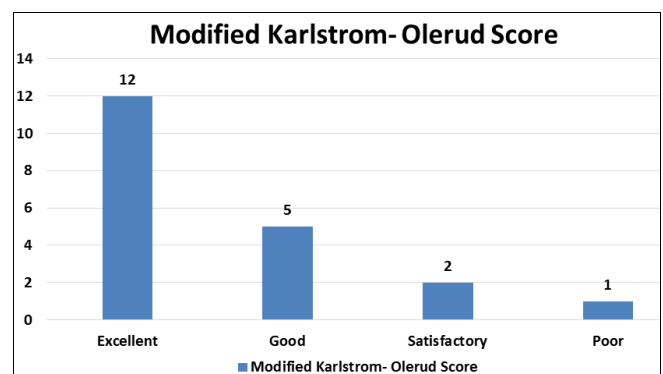


Fig 4: Final outcome

In our series, 1 patient had delayed union, 2 patients had varus mal-alignment & 2 patients developed superficial skin infection and treated with antibiotics. No case of implant failure developed.

Discussion

Controversy still remains regarding the use of IMN as a definitive management of proximal third tibial fractures. Historically, these injuries have been notoriously difficult to fix and maintain without early failure in some reported series. Malunion rates have been reported to be high and several earlier series offered high rates of fixation failure, typically into an apex anterior and valgus position.

The natural bony anatomy and muscular attachments of the

proximal tibia offers the perfect set up for a number of common deformities after fracture with subsequent malalignment during IMN placement. These are due to muscular stresses via tendinous attachments. The dynamic forces of the patellar tendon pull the proximal fragment into an apex anterior angulation, whereas the attachment of the pes anserinus causes varus stress on the same fragment. These forces; in addition to the capacious medullary canal at this level, create the potential for improper reduction and suboptimal nail placement during nailing with conventional techniques for IMN of proximal third tibial fractures with the knee hyper flexed.

The use of Poller screws to supplement intramedullary nailing for metaphyseal proximal tibial fractures enable control of angular deformity and increases stability of fixation.

Poller screws act via a 3-point fixation principle to nullify the forces of muscle and ligament pull and narrow the metaphysis play. Additional Poller screws in the concave side can nullify tissue tension when they are placed close to the centre of rotation of angulation (CORA), adjacent to the nail track, and perpendicular to the deformity plane. Precautions should be taken not to apply the Poller screws away from the CORA or on the convex side.

The guidelines include: (1) taking a high entry point (if a low entry point is taken, a proximal Poller screw will have to be added); (2) using a proper size high bend unreamed nail; (3) placing the nail co-axially with the long axis of tibia; (4) accounting for the nail bend distance; and (5) applying a second screw to avoid posterior translation. Poller screws are not just blocking screws but tools of reduction.

In a review by Freedman et al of 133 tibial fractures treated within intramedullary nails, proximal third fractures resulted in a significantly higher rate of tibial malalignment than middle or distal third fractures. This was due to the lack of a sufficiently long posterior cortex in the proximal fragment. A neutral to slightly lateral entrance angle for nail insertion should be used for proximal third tibial fractures.

Conclusion

We strongly recommend that the surgical management of open reduction/closed reduction with intra medullary interlocking nailing and poller screws in proximal tibial metaphyseal fractures -

- Is effective in achieving the fracture alignment with poller screw acting as a reduction tool.
- Gives improved stability of the bone – implant construct, with the poller screw functionally reducing the medullary width.
- Maintains the fracture alignment till union, preventing loss of initial reduction with poller blocking screw in situ.

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