Evaluation of clinical and functional outcome of internal fixation with intra medullary interlocking nailing with ‘Poller’ blocking screws in tibial metaphyseal fractures

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Abstract
Aim: To evaluate the Clinical and Functional Outcome of Closed Reduction/Open Reduction and Internal fixation with Intramedullary Inter Locking Nailing with “Poller” Blocking Screws” in Tibial Metaphyseal Fractures.

Materials and Methods: This is a prospective study of 20 cases of tibial metaphyseal fractures treated with open reduction/closed reduction with statically locked intra medullary nailing with ‘poller screws’ done in our Govt Theni Medical College Hospital, between August 2014 and September 2016. In our study, the test used for data analysis is ANOVA test.

Conclusion: We conclude that the surgical management of, open reduction/closed reduction with intra medullary interlocking nailing and poller screws in tibial metaphyseal fractures is effective in achieving the fracture alignment with poller screw acting as a reduction tool.

Keywords: Metaphyseal tibial fractures, medullary canal diameter, valgus deformity, varus deformity, recurvatum deformity, poller screw, Intramedullary inter locking nailing

Introduction
“Poller” screws derived their name from a traffic guiding device used in European cities as it guide and direct the nail in the centre of the medullary cavity. Originally they are 4.5 mm sized cortical screws.

Biomechanism: In proximal metaphyseal tibial fractures, the fracture is commonly oriented from distal anterior to proximal posterior. Nails used in proximal fractures are not forced anteriorly as occurred in case of mid shaft fractures. Further disparity in the medullary canal diameter between the fragments and the anatomy of metaphysis leads nail to go eccentrically causing malalignment of valgus/varus or and recurvatum/antevarvatum. In this situation poller screws having its role in reducing the diameter of medullary canal which inturn prevent the malposition of nail in the cavity. In valgus deformity the poller screw applied anteroposteriorly on the concave side of deformity reduce the medullary canal diameter and act as an subsitute for the laterl cortex guiding the nail. Thus it guide the nail when the nail is displaced laterally due to the shape of the medullary cavity and more medial entry of the nail. In the varus deformity with the screw applied on the concave side of the deformity, it act as substitute for the medial cortex thereby centralise the nail in the medullary cavity.

In antevarvatum deformity, mediolaterally placed poller blocking screw essentially functions as a substitute for anterior cortex, keeping the nail centrally in the medullary canal. Thus, the blocking screw placed in the anterior half of the proximal part of the tibia in the sagittal plane blocks the nail from passing anteriorly and abolishing the extension and translational forces in antevarvatum deformity. The reverse is applied for recurvatum deformity. Similarly, in distal metaphyseal fractures as the nail passing into the short distal fragment the disparity in the medullary canal diameter between the short distal fragment and the long proximal fragment leads nail to go eccentrically causing the malalignment. An anteroposterior poller screw placed laterally or medially decrease the medullary canal diameter and act as substitute for the lateral/medial cortex, keep the nail at midline, and prevent valgus/varus deformity.

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Inclusion and exclusion criteria

Adult patients more than 20 years of age. Either proximal or distal metaphyseal fractures. Adolescent patients <20yrs of age and Very minimally (or) undisplaced fractures are excluded from the study.

Materials: Intramedullary inter locking nail and 4.5 cortical screws as poller screws

Fig 1: Proximal metaphysic: In recurvatum deformity

Fig 2: The recurvatum deformity is corrected by the “poller” screw on the mediolateral plane posterior to the nail In valgus deformity:

Fig 3: The valgus deformity is corrected by the anteroposterior poller Scr.

Distal metaphyseal fractures

In valgus deformity: The anteroposterior “poller” screw is put on the lateral side of the nail, on the concave side of the deformity.

Operative Technique All the cases were taken up for surgery under spinal anaesthesia through the patellar tendon splitting approach. During nailing the tendency of the fragment towards which deformity is noted. The poller screw is inserted under the C-Arm guidance according to the deformity

Table 1: Proximal metaphyseal fractures

| Deformity    | Site of poller screw in short fragment |
|--------------|----------------------------------------|
| Antecurvatum | Anterior to the nail                    |
| Recurvatum   | Posterior to the nail                   |
| Valgus       | Lateral to the nail, at concave side.   |
| Varus        | Medial to the nail, concave side.       |

Table 2: Distal Metaphyseal fractures

| Deformity    | Site of poller screw in short fragment |
|--------------|----------------------------------------|
| Valgus Deformity | Lateral to the nail                      |
| Varus Deformity   | Medial to the nail                        |

Karlstrom-Olerud score

1. Residual angulation: (0 to 3 points)
   - 0° -- 0 point
   - 1 to 3° -- 1 points
   - 4 to 5° -- 2 points
   - >5° -- 3 points

2. Fracture healing: (0 to 3 points)
   - Union < 12 weeks -- 0 point
   - Delayed union >12 weeks -- 1 point
   - Delayed union requiring secondary procedures -- 2 points
   - Non-union > 6 months -- 3 points

3. Cast support: (0 to 1 point)
   - No cast support -- 0 point
   - Cast support -- 1 point
Outcome
- 0 & 1 Points - Excellent
- 2 & 3 Points - Good
- 4 Points - Satisfactory
- 5 Points - Fair
- 6 & 7 Points - Poor

Patients were evaluated clinically and Radiographically with the anteroposterior and lateral x rays according to the above Karlstorm-Olerud scoring system.

Case No: 1

Fig 6: Valgus deformity

Fig 7: Valgus deformity corrected with anteroposterior poller screw at the concave side of the deformity, lateral to the nail

Case No: 2

Fig 8: Valgus deformity of the proximal metaphysis

Fig 9: Valgus deformity corrected with anteroposterior poller screw on concave side of the deformity lateral to the nail

Result - analysis
In our study, the test used for data analysis is ANOVA test. In this method, repeated measures designs allow their own subject to act as control. In our study there was no control group. So the ANNOVA test is chosen for our study. Multiple measurements are made on the same individual at different point of times [24].

I. Residual angulation

Table 3: Antecurvatum / Recurvatum (7 legs having the deformity)

|                     | N | Mean | SD  | 95% LCL | 95% UCL |
|---------------------|---|------|-----|---------|---------|
| Pre-operative       | 7 | 5    | 2.31| 4.75    | 5.26    |
| Post-operative      | 7 | 1    | 1.92| 0.95    | 1.05    |
| At Union            | 7 | 0.43 | 1.13| 0.41    | 0.45    |

Post-operative mean residual antecurvatum/recurvatum alignment is 1(one) degree (95% LCL is 0.95 degrees, 95% UCL is 1.05 degrees) when compare to the preoperative mean value of 5 degree (95% LCL 4.75degrees, 95% UCL is 5.26 degrees). The P value was 0.04 which was (< 0.05) statistically significant.

Fig 10: 12 weeks follow up with bone union

Fig 11: Mean degree

Table 4: Varus/Valgus angulation: (18 legs having the deformity)

|                     | N | Mean | SD  | 95% LCL | 95% UCL |
|---------------------|---|------|-----|---------|---------|
| Pre-operative       | 18| 9.89 | 6.16| 9.39    | 10.41   |
| Post-operative      | 18| 2.78 | 3.65| 2.64    | 2.93    |
| At Union            | 18| 1.61 | 2.38| 1.53    | 1.69    |

Post-operative residual mean varus/valgus alignment is 2.78 degree (95% LCL is 2.64 degrees, 95% UCL is 2.93 degrees)
when compared to the preoperative mean value of 9.89 degree (95% LCL 9.39 degrees, 95% UCL is 10.41 degrees). The P value is 0.02 (<0.05) which is statistically significant.

![Graph showing mean degree preoperative, postoperative, and at union.](image)

**Fig 12:** Valgus-varus

| Time for union | No. of cases | Percentage |
|----------------|--------------|------------|
| < 15 weeks     | 12           | 60         |
| 15 – 20 weeks  | 7            | 35         |
| > 20 weeks     | 1            | 5          |
| Total          | 20           | 100        |

**Table 5:** Time taken for fracture union

![Graph showing time for union.](image)

**Fig 13:** Time for union

| Score | No. of cases | Percentage | Remarks |
|-------|--------------|------------|---------|
| 0, 1  | 12           | 60         | Excellent |
| 2, 3  | 6            | 30         | Good     |
| 4     | 0            | 0          | Satisfactory |
| 5     | 1            | 5          | Fair     |
| 6     | 1            | 5          | Poor     |

**Table 6:** Karlstrom-Olerud Scoring

The disparity between the diameters of medullary canal at the level of isthmus (i.e. maximum possible nail size) and at the fracture site in all cases. We found that there was a significant p value <0.001 (p< 0.5) which is significant in comparing the diameter. We found that the mean diameter of medullary canal at the level of isthmus was 9.90 mm compared to 18.25.2mm at the level of fracture site. This mismatch in the medullary canal diameter is the cause for the malalignment in intramedullary nailing. We emphasized that the use of poller screw as reduction tool was proved in our study by the repeated measures ANOVA test with 95% of Excellent to satisfactory outcome which is better the values given by the C. Krettek et al. The C. Krettek et al. showed the result of 94% excellent to satisfactory outcome. In our study, the mean postoperative mean varus-valgus angulation is 2.78 degrees in comparing to the mean preoperative varus/varus of the 9.89 degrees and postoperative mean antevertum/recurvatum deformity is 1 degree (one) in comparing to the preoperative value of the 5 degrees. The poller screws usually applied in anteroposterior direction as the coronal plane malalignment is more prone to occur than the sagittal plane. In case sagittal plane deformities is expected to occur mediolateral screw also was inserted, even in single patient. In one patient we have applied both antero posterior and mediolateral screws to prevent both the varus and recurvatum deformity. In another patient with varus deformity two screw were inserted. The reduction was ensured in two planes with C-Arm after placing the poller screws and before applying the locking screw. We had excellent to satisfactory outcome in 95% of patients by Karlstrom-Olerud scoring which is better than the results of C. Krettek et al. with 94% excellent.

**Conclusion**

Poller screws

- Are effective in achieving the fracture alignment with poller screw acting as a reduction tool
- Give improved stability of the bone – implant construct, with the poller screw functionally reducing the medullary width.

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