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Original article

Radiological outcome after extra-articular fracture of distal tibia treated with plating VS nailing

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Abstract:

Background: Traditionally, closure reduction and a cast have been used to treat closed tibial shaft fractures. The importance of anatomical reduction, soft tissue handling, early range of motion and weight bearing has opened the door for less invasive techniques for treating tibial diaphyseal fractures. This prospective study compared the radiographic outcomes of patients who underwent ORIF for unilateral unstable extra-articular closed or type I (Gustillo and Anderson) open extra-articular fractures of the distal tibial shaft to those who underwent closed reduction with IM nailing.

Material & method: This was a prospective, non-randomised, observational study carried out 2 years, 35 patients with a fracture of the distal tibia with or without fibula fracture received operative treatment. Trauma radiographs were used to determine the location and AO classification of the fractures in the selected patients. 26 patients met our inclusion criteria. All patients received treatment with ORIF plating or IM nailing depending on the surgeon's choice. 12 were treated with ORIF plating and 14 with IM nailing. 10 patients were matched for fracture type, age decade and gender

Observation & results: On Lateral radiograph 2 (20%) nailing patients had 5-degree posterior angulation as compared to 1 (10%) patient in the plating group who also had 5 degrees of angulation. (2). 4 patients from the nailing group had mal-alignment on AP radiograph (40%), out of 1 patient had 5 degrees valgus, 1 patient had 8-degree varus, 1 patient had 8 degrees valgus and one patient had 10-degree varus. 2 patients out of 10 (20%) of plating group had mal-alignment, one patient had 10 degrees valgus and one patient 15-degree varus. (3) Mean time for the radiological union for the nailing group is 19.1 weeks (16-24 weeks) (SD 2.6), and for plating, the group meantime 17.8 weeks (14-24 weeks) (SD 3.32). This was statistically non-significant. Using students test $t = 0.9734$, p-value $= 0.3432 > 0.05$

Conclusion: Radiologically nailing patients had more mal- alignment than plating patients but it was statistically non-significant.

Keywords: Extra-Articular Fracture Distal Tibia, Plating, Nailing, radiological, ap radiograph, lateral radiograph

Introduction:

The majority of study series on distal tibia fractures contain a percentage of fractures of the distal tibial metaphysis with no or minor extension into the joint[1,2]. These fractures differ from Pilon fractures in terms of injury mechanism and prognosis[3,4]. However, because of their close closeness to the ankle, the initial treatment is more difficult than with a tibial diaphysis fracture. This supports examining the epidemiology and prognosis of these injuries separately. [5]

Traditionally, closure reduction and a cast have been used to treat closed tibial shaft fractures. Since the late 1950s, open reduction and internal fixation (ORIF) have only been used when conventional methods failed to achieve or maintain an appropriate reduction. The substantial tissue dissection and devitalization required by ORIF frequently results in an environment that is less conducive to fracture union and more vulnerable to bone infection.

As a result, different, less invasive techniques for treating tibial diaphyseal fractures were created. It has been discovered that closed intramedullary (IM) nailing is the most efficient. Compared to closed reduction and fixation with a cast [6–8], there is less soft tissue damage, a faster time to union, and a shorter term of incapacity. In recent years, IM nails have significantly improved, and their indications for use have been expanded to include fractures closer to the ankle joint [9,10].

Placing has historically been the preferred implant for tibial Pilon fractures, and as a result, it has shown effective for extra-articular tibial fractures (AO/OTA type 1 Pilon Fracture). Which have improved over time as a result of a better understanding of the fragile soft tissue architecture of this location, better surgical technique with little exposure, and better fixation employing locking compression plates. Therefore, plating and nailing are the primary treatments for fractures in this region. However, neither a clear indication of a

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single modality's use nor its superiority over another has been established.

This prospective study compared the radiographic outcomes of patients who underwent ORIF for unilateral unstable extra-articular closed or type I (Gustillo and Anderson) open extra-articular fractures of the distal tibial shaft to those who underwent closed reduction with IM nailing.

Material & methods:

This was a prospective, non-randomised, observational study carried out 2 years, 35 patients with a fracture of the distal tibia with or without fibula fracture received operative treatment. Trauma radiographs were used to determine the location and AO classification of the fractures in the selected patients. 26 patients met our inclusion criteria of minimum 18-year age and Closed or type I open extra-articular fracture of the distal tibial diaphysis. (within 4 cm to 11 cm proximal to the distal tibial articular surface) AND Exclusion criteria were earlier fractures of the tibial shaft on the same side proximal or distal intra-articular fractures of the tibia, temporary treatment with an external fixator, fracture of the contralateral tibia or ipsilateral femur, pathological fracture and GA Type 2 and 3 open fracture. All patients received treatment with ORIF plating or IM nailing depending on the surgeon's choice. 12 were treated with ORIF plating and 14 with IM nailing. Of the patients treated 2 patients were lost to follow-up for various reasons. The remaining 10 patients treated with ORIF Plating were matched roughly to 10 patients treated with IM nailing based on gender, age decade, and the AO classification of the fracture after one year of follow-up.

Methodology:

1. **Mal-alignment on AP and Lateral Radiograph:**

For alignment measurement anteroposterior and lateral radiographs of the full-length tibia on a single film were examined after one year of follow-up.

The angle between the distal part and the proximal part of the tibia was determined by measuring the angle between the line through the centre of the tibial plateau down the middle of the proximal shaft, and the line from the centre of the ankle up the middle of the distal shaft. Thereafter, the angle between the distal part and the proximal part of the consolidated tibia was measured.

This was done in two directions, on anteroposterior and lateral radiographs. The difference between these angles was considered to be anterior/ recurvatum and varus /valgus mal-alignment respectively.

We only determined mal-alignment in degrees, we did not define malunion because many surgeons have defined malunion ranging from 5 degrees to 25 degrees. [11] The difficulty of measuring the exact midpoint of the tibial shaft is due to

- S-shaped medullary canal
- Individual variation of shape of tibial shaft
- Taking a true AP or Lat radiograph of ankle and knee in one frame.

Shortening: we did not consider shortening because of the non-uniformity of fibular fracture and the effect of its fixation on the length of the healing tibia.

2. **Radiological union**: Despite a large number of studies of tibial fractures which have used healing as an outcome measure, there is disagreement on the precise definition of a radiological union. Many non-specific criteria are described such as the formation of callus or the absence of a fracture gap, for healing on follow-up radiographs. [12–15] we used the criteria of a radiological union as the presence of bridging callus on at least two orthogonal views. [16–18]

Statistical analysis:

Mean and SD of measurable characteristics were seen and comparison is conducted using student's 't' test. Also, countable quality is analysed and described the variable in the percentages. 5% level of significance is adopted to distinguish the significant differences.

RESULTS:

1. Mal-alignment on lateral radiograph - 2 (20%) nailing patients had 5-degree post angulation as compared to 1 (10%) patient in plating group who also had 5 degree of post angulation (Graph 1).

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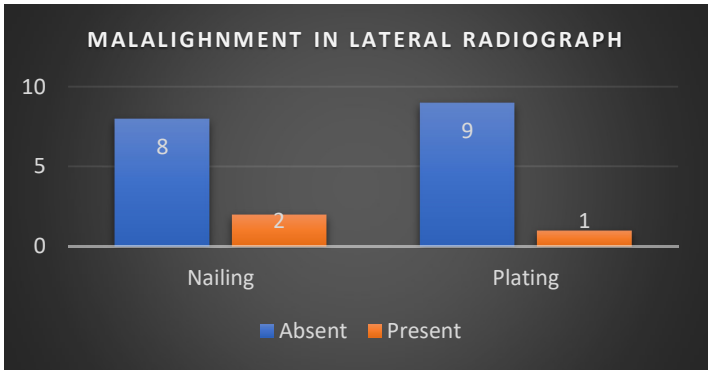
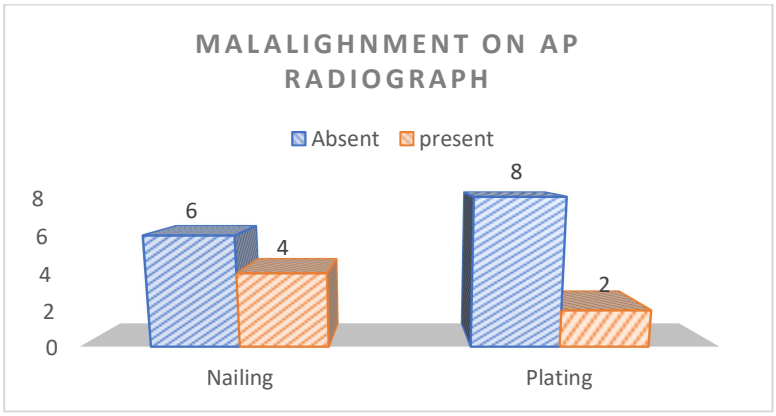


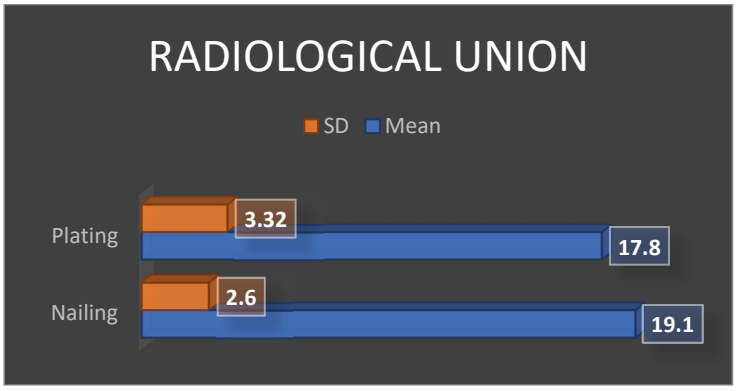
Graph 1: Mal-alignment on lateral radiograph

2. Mal- alignment in AP radiograph – 4 (40%) patients from nailing group had mal-alignment on AP radiograph , out of 1 patient had 5 degree valgus, 1 patient 8 degree varus , 1 patient 8 degree valgus and one patient 10 degree varus. 2 patient out of 10 (20%) of plating group had mal-alignment ,one patient had 10 degree valgus and one patient 15 degree varus.(Graph 2)



Graph 2: Malalignment on AP Radiograph

3. Radiological union - Mean time for radiological union for nailing group is 19.1 weeks (16-24 weeks)(SD 2.6), and for plating group mean time 17.8 weeks (14-24 weeks)(SD 3.32).This was statistically non-significant .Using students test $t = 0.9734$, p value = $0.3432 > 0.05$ (Graph 3)



Graph 3: Radiological Union

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Discussion:

Distal non-articular fracture of the tibia (located 4cm to 11cm of tibial plafond)[19] are complex injuries to manage. Particularly when associated with open injury or soft tissue damage.

We compared two primary modalities of treatment of closed or GA type 1 open injury, intramedullary nailing and open reduction and internal fixation with plate and screw.

We tried to match 10 patients in the nailing group with 10 patients in the plating group in terms of age, sex and AO classification.

Alignment on Lateral radiograph: 2 (20%) nailing patients had 5 degrees post angulation as compared to 1 (10%) patient in the plating group who also had 5 degrees of post angulation (procurvatum)(Graph 1) . Heather et al found 11 patients out of 111 had mal-alignment on the lateral radiograph. None of the plating patients had procurvatum. 1 patient from the nailing group had 5-9 degrees and 2 >10 degrees. 2 patients from the plating group had recurvatum of 5-9 degrees so did 4 patients from the nailing group. 2 patients from the nailing group had >10 degrees recurvatum deformity[19]. Kasper[20] et al found 2 patients from the nailing group had mal-alignment on lateral radiograph 5-10 degrees but none in the plating group.

Alignment on AP radiograph: 4 (40%) patients from the nailing group had mal-alignment on AP radiograph, out of 1 patient had 5 degrees valgus, 1 patient had 8-degree varus, 1 patient had 8 degrees valgus and one patient had 10-degree varus. 2 (20%) patient out of 10 of plating group had mal-alignment, one patient had 10 degrees valgus and one patient 15-degree varus (Graph 2).

Heather et al[19] noted Twenty-four fractures (21%) healed with 5 degrees or more angulation. Eight of these (7.1%) had 10 or more degrees of angular deformity. Valgus was the most frequent deformity, occurring in 16 patients. Nine patients had multiplanar deformities. Malunions were more common after treatment with a nail (n = 22, 29%) versus a plate (n = 2, 5.4%; P = 0.003). All of these fractures were initially stabilized in a mal-aligned position.

In GI[21] noted average angulation in the nailing group was 2.8 degrees and in the plating group 0.9 degrees. p = 071.

Vallier et al[22] noted Primary angular malalignment was identified in 17 patients (16.3%). This included four patients treated with tibial plating (8.3%) and 13 patients treated with nails (23%, P = 0.02). Eight of these (7.7% of all patients) had malalignment between 6 and 10 degrees of angulation. Valgus was the most common deformity, accounting for 70% of cases. Eleven of the 13 tibia fractures that were nailed in a mal-aligned position (85%) did not have fixation of their associated distal fibula fractures, whereas eight patients had open reduction and internal fixation of the distal fibula and did not develop malalignment. The rates of primary malalignment of the tibia were 20% after open reduction and internal fixation of the fibula and 28.9% when the distal fibula fracture was not stabilized (P = 0.30).

Kasper et al[20] found none of the patients from the plating group had varus or valgus mal-alignment of > 5 degrees. While 2 patients (16.7%) in nailing had mal-alignment.

Time to radiological union: Mean time for the radiological union for the nailing group is 19.1 weeks (16-24 weeks), and for plating, the group meantime 17.8 weeks (14-24 weeks). This was statistically non-significant (Graph 3). This was also our meantime for follow-up as we followed up till the radiological union of the fracture.

Heather et al[19] found mean time to tibia fracture union for all patients wasv4.7 months (2.5–14). A total of 10 patients (8.8%) had delayed unions or non-union, nine of which occurred after nailing Four patients had delayed unions after nailing (5.3% of all nails). All underwent dynamization of their nails after a mean of 5.3 months (4–6) and one patient had iliac crest bone grafting concurrently.

In GA[21] noted 18 weeks for fracture union for the nailing group and 20 weeks for the plating group. (p=0.001)

Kasper et al found (115) that the mean time to radiographic union was 19 weeks (range 14–32 weeks) for the ORIF group versus 21 weeks (range 13–28 weeks) for the IM nailing group (p=0.44). Delayed union occurred in 2 patients (16.7%) managed with ORIF and in 3 patients (25%) who had IM nailing.

The difference in time to the union may be due to different criteria under consideration for the radiological union.

Conclusion

1. Radiologically nailing patients had more mal-alignment than plating patients but it was statistically non-significant.
2. The treatment modalities stand on the same ground for their use in distal extra-articular tibial fractures and more research is needed to throw light on demarcating the indications of both.
3. If soft tissue condition is good ORIF with minimal exposure is better for radiological alignment.

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