

A Comparison between Unreamed Locked Intramedullary Nailing and Plate-Screw Fixation in the Treatment of Tibial Diaphyseal Fractures

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Abstract

Background: Tibial diaphyseal fracture is the most common fracture of long bones. In Iran plating and unreamed tibial nailing (UTN) are the most commonly used methods and because of paucity of equipments such as c-arm and reaming sets, the reamed method is rarely used. This study compares these two methods.

Methods: In a randomized clinical trial study including 100 patients (78 males, 22 females; mean age=24 years; range=16-50 years) undergoing UTN and plate-screw in the treatment of uncomminuted closed tibial shaft fractures (50 patients in each group) were compared regarding the union time and complications after a mean follow up of 16 months (12- 20 months).

Results: the mean time to union was 16 weeks with UTN and 14.3 weeks with plate-screw fixation. There was 4 (8%) and 3 (6%) non unions after UTN and plating respectively. Plain radiographs in both groups showed angulation in 3 patients; all in distal third and in varus (6%). There was not any infection after UTN but one case of superficial and one case of deep infection were noticed after osteosynthesis with plate and screw (4%). Four patients after UTN and 4 patients after fixation with plate-screw required reoperation (8%).

Conclusion: plate-screw osteosynthesis yielded satisfactory results in uncomminuted closed fractures of the tibial shaft comparable with UTN results.

Keywords: Close fracture; Tibial diaphysis; Undreamed tibial nailing; Plate; Screw

Introduction

Tibial diaphyseal fracture is the most common fracture of long bones.¹ There are different methods of treatment according to the type of fracture. Closed treatment with casting and functional bracing are effective methods for low energy, stable and minimally displaced fractures, but this group includes only a small percentage of fractures. Plate fixation has been considered as an optimal method since the AO group developed compression plating techniques. Locked intramedullary nailing (reamed) is the preferred method of internal fixation in the majority of orthopedic centers.

Nowadays, internal fixation is the main method of treatment for fractures that are unsuitable for non-operative managements (high energy, unstable, severely displaced, comminuted and the majority of open fractures).^{1,2}

On the other hand, locked intramedullary nailing was introduced for the first time as an unreamed method in Iran which is currently used. Based on this background and also paucity of equipments such as c-arm and reamed intramedullary nailing sets, plating and UTN are still the primary methods of internal fixation in the majority of orthopedic centers in the country. Each of these two methods has advantages and disadvantages and the best treatment is still a matter of debate.^{2,3}

This study was conducted to compare the two most commonly used methods in Iran: plate-screw and UTN. The results of both methods are inferior to

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reamed intramedullary nailing according to orthopedic references.^{1,2,4}

Materials and Methods

In a randomized clinical trial study, 100 patients who were admitted for closed tibial fracture were randomly divided into two groups (In each group every three days with regard to the admission day in the Emergency Department) according to the following exclusion criteria during a 2 years period: i) Systemic diseases such as diabetes mellitus, immunosuppressive conditions or systemic bone diseases, ii) Pathologic fractures, iii) Comminuted fractures: type B₃ and C orthopaedics trauma association (OTA) classification and iv) Previous deformity in tibia.

All of selected patients were operated during the first week after trauma by one of the two methods of UTN or plating with dynamic compressive plate (DCP). All patients received IV cefazoline (0.5 hour before operation) and cefazoline and gentamicine (for two days after operation). All intramedullary nails (nail diameter was measured equal to the narrowest diameter of the medulla in lateral x-ray and nail length was measured equal to the distance from tibial tuberosity to medial malleolus) were locked with two screws proximally and 2 screws distally and 4 screws (8 cortices) proximal and distal to the fracture line that were placed in all plates. We advised all patients to be non-weight bearing for at least 6 weeks.

All patients were evaluated with regard to the union and complications (nonunion, malunion, infection) after a mean follow up of 16 months (12-20 months) in two groups: UTN and plating each including 50 patients (78 males, 22 females; mean age=24 years; range=16-50 years) (Table 1).

We followed the patients at 2, 4, 8 and 16 weeks, 6 months and 1 year after surgery by clinical examination and radiographic assessment. More than 6 months after surgery, absence of clinical and radiographic union was accepted as non-union and more than 5 degrees angulations in anterior posterior or lateral radiographs was accepted as mal-union. Some patients required another operation during the follow up

period because of complications or plate or nail fractures. The mean follow up was 16 months. Results were analyzed statistically using SPSS software (version 15, Chicago, IL, USA) applying independent t-test.

Results

The location of the tibial shaft fractures was as follows: Five (10%) in proximal one third in both groups, 30 (60%) and 34 (68%) in middle one third and 15 (30%) and 11 (22%) in distal one third in intramedullary nailing and plating group respectively. These were 4 nonunion (8%) in intramedullary nailing group while 2 of them were associated with nail fracture. Ten patients in this group started weight bearing earlier than they were allowed.

In plating group, there were 3 (6%) nonunion, one of them was associated with plate Fracture. Eight patients in this group began weight bearing earlier than they were permitted and all of nonunions were observed in these 8 patients. There was no significant difference between the two groups with regard to union time (14.3 weeks in plating group and 16 weeks in UTN group) and nonunion ($p>0.05$). In intramedullary nailing group, 3 (6%) lateral (all varus) angulation and in the plating group, 2 lateral (varus) and one lateral and anterior-posterior (varus and anterior) mal union (6%) were noticed. All of these malunions occurred in the distal one third fractures. In plating group, 2 cases (4%) of infection were observed, a superficial one that was treated by IV antibiotics and another deep one that was associated with skin sloughing and required debridment and skin flap.

Four patients in the intramedullary nailing group required reoperation, all due to nonunion. Two patients were treated by dynamization and 2 required renailing because of nail fracture.

In the plating group, 4 patients needed reoperation, 3 due to nonunion and plate failure and another one due to skin sloughing. Among patients who required reoperation due to nonunion, two patients were treated with intramedullary nailing and one with replating and bone graft. Another patient required debridment and skin flap because of infection and skin slough (Table 1).

Table 1: The results of plating and UTN of closed Tibial Fractures

	No.	Male/female	Nonunion%	Malunion%	Infection%	Reoperation%
UTN	50	34/16	8	6	0	8
Plate-screw (DCP)	50	44/6	6	6	4	8

Discussion

Fixation with plate-screw has been introduced as a method of treatment for tibial fracture since 1880 and different types of plates were used since that time. The most commonly used plate is now dynamic compressive plate (DCP). We used this type of plate in our study.

Ruedi *et al.*⁵ in a study of closed tibial fractures treated with DCP, reported 98.1% good or excellent results with a complication rate of 7% for infection and nonunion cases. Later studies however were not able to confirm these results. Denouter *et al.*⁶ reported a 54% nonunion, 3.2% infection and 6.6% malunion rate in 68 open or closed fractures of tibia. In another study in 2004, Bombachi *et al.*⁷ recommended fixation with plate-screw for uncomminuted diaphyseal fractures and intramedullary nailing for comminuted fractures. This study showed that plating had equal or superior results in simple closed shaft fractures regardless of infection rates. Bilat *et al.*⁸ reported infection (as the most important complication of plating) in 1.7% and malunion in 6.8% of closed tibial fractures following fixation with plate and screw. They reported 94% good or excellent results. In our study, union rate was more and complications were less than previous studies, probably because of strict patient selection and also uncomminuted fractures.

It seems that fixation with plate screw had better results for proximal or distal diaphyseal fractures than UTN. In Janssen *et al.*'s study,⁹ plating had superior results than UTN for distal one-third tibial fractures because there were lower rates of malunion with plating but the union time, infection and nonunion rates were identical.

There are numerous studies about locked intramedullary nailing too. Reamed IMN in comparison to UTN Resulted into shorter union time and lower rates

of nonunion.^{1,3,10} Williams *et al.*¹¹ reported a 98% union rate with reamed IMN but malunion occurred in 37% of patients and 18% required reoperation due to nonunion or malunion. In our study, we achieved a 92% union rate. This low rate may be due to undreamed IMN in our study. Gregorg and Sanders¹² reported union time of 23.3 weeks and 5.2% infection rate and 11% nonunion and 3% malunion after undreamed IMN.

We did not find any comparative clinical trial to compare these two methods in the treatment of closed tibial shaft fractures in literature. Gross and Chad² reviewed all studies between 1966 and 1988 on closed tibial fractures but they failed to show a definite superiority for one of these two methods. They reported 2.6% and 16.7% delayed union, non- and 11.8% malunion, 9% and 0.5% infection after plating and UTN respectively. They reported 4.7% and 23.1% reoperation after plating and UTN respectively; however reoperations after UTN included removal of screws for dynamization and screw prominence. In our study, we required 4 reoperations (8%) in both groups but we did not include screw removal for screw prominence in UTN group and we did not follow malunions in longer time for a need to reoperation.

Our results showed that plate-screw osteosynthesis yielded satisfactory results in uncomminuted fractures of the tibial diaphysis and it may have better results in comparison to undreamed IMN.

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