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ORIGINAL PAPER

Intramedullary tibial nailing in distal third tibial fractures: distal locking screws and fracture non-union

Aso Mohammed · Ramaswamy Saravanan · Jason Zammit · Richard King

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Abstract Distal third tibial fractures are prone to non-union following tibial nail insertion. The purpose of this study was to assess the union of distal third tibial fractures in patients who have undergone intra-medullary (IM) tibial nailing with one versus two distal locking screws. Sixty-five patients who had intramedullary tibial nail fixation were retrospectively analysed. Our results showed that 80% of non-unions in distal third fractures had only one distal locking screw compared to 20% who had two distal locking screws. This is statistically significant ($p<0.01$). We therefore conclude that two distal locking screws are essential for distal third fractures.

Résumé Les fractures du tiers distal du tibia sont réputées entraîner des retards de consolidation après enclouage. Le propos de cette étude est d'étudier la consolidation de ce type de fracture chez les patients ayant bénéficié d'un enclouage centro médullaire avec une ou deux vis de verrouillage distal. 65 patients ont ainsi été analysés de manière rétrospective. Les résultats sont les suivants 80% des pseudarthroses avait une seule vis de verrouillage distal alors que seulement 20% des pseudarthroses sont survenues chez les patients ayant un verrouillage avec deux vis distales. Il existe une différence significative ($p<0.01$) entre ces deux techniques, le verrouillage distal avec deux vis est essentiel dans ce type de fracture.

A. Mohammed (✉)
Trauma and Orthopaedics, The Royal London Hospital,
London, UK
e-mail: asobm@hotmail.com

R. Saravanan
Homerton Hospital,
London, UK

J. Zammit
Trauma and Orthopaedics, Homerton Hospital,
London, UK

R. King
Trauma and Orthopaedics, Oldchurch Hospital,
London, UK

Introduction

The treatment of choice for the large majority of displaced tibial shaft fractures is IM nailing [2, 5, 11, 13, 16]. Distal locking screw insertion is the most difficult part of the operation and takes up to more than one third of the operation time [8]. The purpose of this retrospective study was to assess the fracture union outcome of distal third tibial fractures which were internally fixed using IM tibial nailing with one versus two distal locking screws.

Materials and methods

A retrospective study was conducted comparing one distal locking screw to two in tibial nail insertion. The study took place at three district general hospitals in London (Whipps Cross University Hospital, Oldchurch Hospital, Homerton University Hospital). Sixty-five patients who had IM nailing for tibial shaft fractures were followed up for this study. The study was carried out between 1999 and 2000. Patients were followed up to the tibial fracture union (12–36 months with a mean of 22 months). No patients were lost to follow-up. Distal locking screws were inserted by free-hand technique.

Results

The age of patients was 15–80 years with a mean of 42 years. Male to female ratio was 4:1 (52 males and 13 females). The most common mechanism of injury was road traffic accident (44%). Of the 65 cases 48 cases were closed injuries and 17 cases were open. Out of these 17 open injuries, five were Gustillo I, eight were grade II and four were grade III. 72% of the operations were performed by registrars and 28% by consultants. The average waiting time for surgery was 24–48 hours for closed injuries and 9–16 hours for open injuries. 34 cases (52%) had one distal locking screw and 31 cases (48%) had two. The tibia was reamed in 36 cases (54%) and un-reamed in 29 cases (46%). The fracture union rate was 76.9%. Complications resulting from tibial nailing in our study were superficial wound infection in seven cases, anterior knee pain in five patients, leg pain (four patients), pain at screw site (two cases), infection of the nail (one patient), wound dehiscence (one patient), ankle pain (one case), deep vein thrombosis (one case), compartment syndrome (one case) and distal screw breakage in one patient. The only case of distal screw breakage (0.9%) occurred in distal third fracture fixed with one distal locking screw. Out of the five cases of anterior knee pain three had nailing via a transtendinous approach and two via a paratendinous approach. Non-union occurred in 23.1% (15 cases) of tibial fractures treated with IM nailing. Of these, 12 cases (80%) had only one distal locking screw and the remaining 3 (20%) had two. This difference was statistically significant ($p<0.01$). Of these 15 cases, nine had reamed nail and six had un-reamed nailing. Closed fractures occurred in ten cases and open fracture in five cases. Out of these five cases of open fractures, two were Gustillo I, one was type II and two were Gustillo III. Out of the five cases of open injuries, four had one distal locking screw. Eight of the ten closed injuries had one distal locking screw (Table 1). Of the 15 cases both tibia and fibula were broken in ten cases and tibia alone in five cases. Of the 15 cases, two cases were caused by high velocity injury and three by a low velocity injury (Table 1).

Discussion

The treatment of distal metaphyseal tibial fractures remains controversial. Shortened IM nailing is an effective alternative for the treatment of distal metaphyseal tibial fractures [7, 10]. This involves removing approximately 1 cm just distal to the lowermost locking screw. It has been known for years now that one distal locking screw is insufficient and two are needed. Kneifel and Buckley [9] compared one distal locking screw to two in tibial fractures treated with un-reamed tibial nails. One distal locking screw failed (59.1%) significantly more often than two distal screws (5%). However, there was no significant difference between groups with respect to fracture union.

In our study, the complication rate regarding fracture non-union is high (23.1% or 15 out of the 65 patients). A majority of those (12 out of 15 cases) had only one distal locking screw. The other three (20%) had two locking screws. This difference was statistically significant ($p<0.01$) and we believe that insertion of one distal locking screw carries a higher complication rate. This is because intramedullary fixation entails a three-point fixation within the diaphysis. However, in the metaphysis, the intramedullary nail will not be able to maintain three-point fixation so that the use of transverse locking screws rather than one distal locking screw is necessary to maintain stabilisation of the fracture reconstruction.

In our study, high velocity injuries, open fractures with loss of soft tissue envelope, and patients with fractures of both tibia and fibula had higher risk of developing fracture non-union (Table 1). Among the 15 cases of fracture non-union, ten were closed injuries and five were open fractures (two Gustillo I, one Gustillo II, and two Gustillo III). Non-union rate was higher in the open fracture group (5 out of 17 or 29.5% compared to the closed injury group which

Table 1 Statistics of non-united fractures (15 cases)

Distal screws	One screw (12 cases)	Two screws (3 cases)
Mode of injury	High velocity – 10 patients	High velocity – 2 patients
	Low velocity – 2 patients	Low velocity – 1 patient
Type of injury	Closed – 8 patients	Closed – 2 patients
	Open – 4 patients	Open – 1 patient
Fracture pattern	Both bones – 8 patients	Both bones – 2
	Tibia only – 4 patients	Tibia only – 1
Procedure	Reamed – 7 patients	Reamed – 2 patients
	Un-reamed – 5 patients	Un-reamed – 1 patient
Treatment	Dynamization – 5 patients	Dynamization – 2 patients
	Exchange nail – 5 patients	Exchange nail – 1 patient
	Nail removal then plating of tibia – 2 patients	

was 21% or 10 out of 48 cases). The difference between open and closed injuries is that open fractures, especially grades II and III, are often caused by medium to high energy injuries with a moderate to severe crushing component and extensive soft tissue damage, including muscles, skin, and periosteum. This leads to a massive decrease in blood supply of the bone. In addition, wound contamination is highest with open fractures. All of these have negative effect on open fracture union.

The most common post-operative complication was superficial wound infection followed by anterior knee pain and leg pain. Complications with a single distal locking screw were knee pain in three patients, superficial wound infection in four patients, delayed wound healing in one patient, compartment syndrome (one case) and distal screw breakage in one patient. Complications with two distal screws were knee pain in two patients, leg pain in three, proximal nail prominence in two patients, superficial wound infection in three cases, and pain at the distal screw site (two patients). These differences were not statistically significant. Anterior knee pain occurred in 7.5% of cases. 60% of knee pain occurred in the transtendinous approach and 40% occurred in the paratendinous approach. No difference was found between transtendinous and paratendinous approaches in causing knee pain. Toivanen et al. found that, compared with a transpatellar tendon approach, a paratendinous approach for nailing insertion does not reduce the prevalence of chronic knee pain [3, 15]. Reaming was performed in nine cases of non-union and the nail was un-reamed in the other six patients, showing that reaming did not have a statistically significant effect on non-union rates of distal tibial fractures. Different methods have been described to treat non-unions. Court Brown and colleagues have done extensive work on tibia fractures and have successfully treated 33 fracture non-unions with exchange reamed nailing [4, 6, 14]. Dynamisation, the removal of locking screws at one end of the nail, is probably the most performed procedure to promote healing of delayed union [1, 12]. Of the 15 cases of non-union, seven cases were dynamised, while two cases had their tibia nail removed and replaced by plating and bone graft. Exchange reamed nailing was performed on the other six patients.

Conclusion

Our study showed that there was a high incidence of non-union in distal third tibia fractures treated with IM nailing when only one distal locking screw was used. Therefore, we recommend two distal locking screws in IM nail fixation of distal third tibia fractures. If two distal locking screw insertion is not possible due to the distal nature of the fracture, we would recommend an alternate form of fixation.

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