Eur J Orthop Surg Traumatol (2014) 24:1597–1601
DOI 10.1007/s00590-013-1401-0

ORIGINAL ARTICLE

Reamed versus unreamed intramedullary locked nailing in tibial fractures

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Received: 2 December 2013 / Accepted: 22 December 2013 / Published online: 3 January 2014

Abstract The purpose of this prospective observational study is to identify whether or not reaming of tibial shaft fractures has benefits over unreamed intramedullary locked nailing. Eighty-four adult patients with recent open and closed tibial shaft fractures were treated with reamed or unreamed intramedullary locked nail fixation. We followed up for 12 months 39 of 43 patients in the unreamed and 38 of 41 patients in the reamed group, respectively. There were no significant differences between the two groups regarding the average time to healing for both clinical (3.2 vs 3.4 months, $p = 0.65$) and radiological (4.1 vs 4.5 months, $p = 0.43$) evaluations. The mean duration of surgery was shorter ($p = 0.025$) for the unreamed group 43 min (SD 18) compared to 55 (SD 27), but the main determinants were the fracture type and the surgeon's experience. We conclude that reamed nailing proved beneficial, but the impact on overall outcome is not superior to unreamed nailing.

Keywords Reamed · Unreamed · Intramedullary nailing · Tibia · Diaphyseal fracture

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Introduction

Tibial fractures are the most common long bone fractures in the human body [1]. The USA has reported an annual incidence of 492,000 fractures of the tibia and fibula [2]. Historically, there are multiple treatment methods for the tibial shaft fractures such as plating, reamed or unreamed intramedullary nailing, external fixation and functional bracing. Nowadays, most surgeons use as operative treatment for both open and closed tibial fractures the intramedullary nailing fixation [3].

The question about the intramedullary nailing fixation is whether or not it should be reamed. The advantage of reamed intramedullary nailing is that it will increase cortical blood flow, and it will offer better stability (larger diameter nails), but the disadvantages are multiple, such as damage of endosteal blood flow, longer operating time, compartment syndrome, bone necrosis and infection [4, 5]. The unreamed intramedullary nailing has the advantage of preserving the endosteal blood flow, but the biggest disadvantage is the poor biomechanical stability which may limit its use.

Initially, the trends have been favouring unreaming, but in the last decade, this has changed. One recent level I study has found a possible benefit for reaming closed fractures. This advantage has not been seen in open fractures, and with both approaches, many will consolidate after 6 months without reintervention [6].

The purpose of this prospective study is to identify whether or not reaming of tibial shaft fractures has benefits over unreamed intramedullary nailing fixation.

Materials and methods

We performed a prospective observational study on 84 patients with open and closed tibial shaft fractures that were

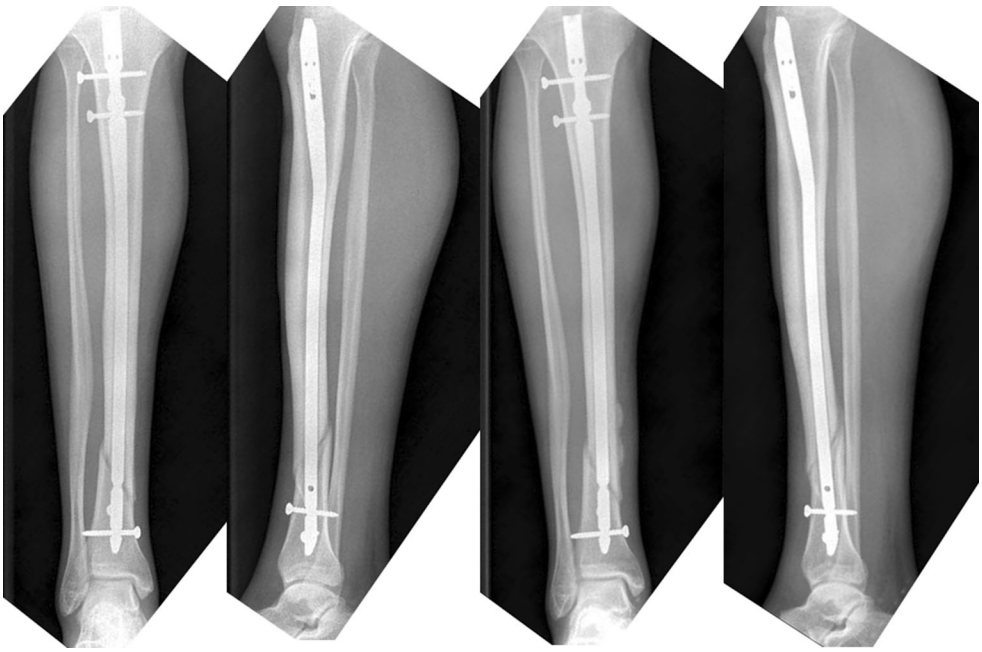

Fig. 1 Case 1 treated with unreamed IMLN (Synthes) AP and lateral X-rays at 2 and 8 weeks postoperatively

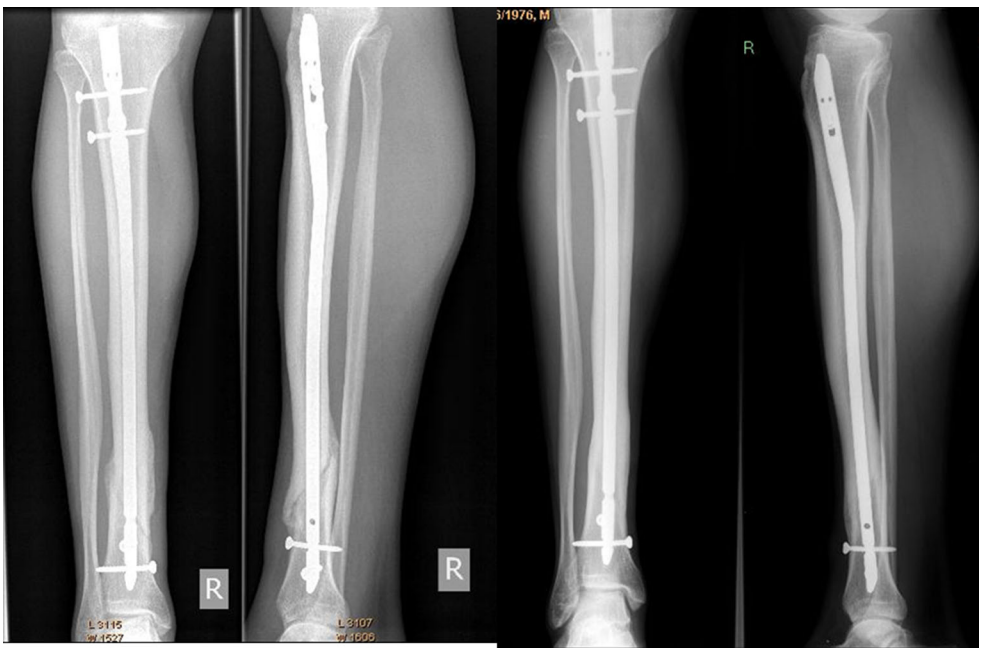

Fig. 2 Case 1 at 16 weeks and 12 months postoperatively

treated in our hospital over 5 years (Table 1). The surgeries were performed by six orthopaedic surgeons using intramedullary locked nailing (IMLN). The majority of the cases in the unreamed group (32 out of 43) were operated using Synthes titanium full nails. Most of the patients in the reamed group (35 out of 41) were operated using Stryker S2 and Synthes stainless steel hollow nails inserted over guide wire. These were the only implants used in the patients included for analysis. The reaming, when performed, was done in 0.5 mm increments up to 1 mm wider than the nail. All patients were operated using the transtendinous approach. Two screws were used for both proximal and distal locking.

Fig. 3 Case 2 treated with reamed IMLN (Synthes) AP and lateral X-rays at 6 and 12 weeks postoperatively

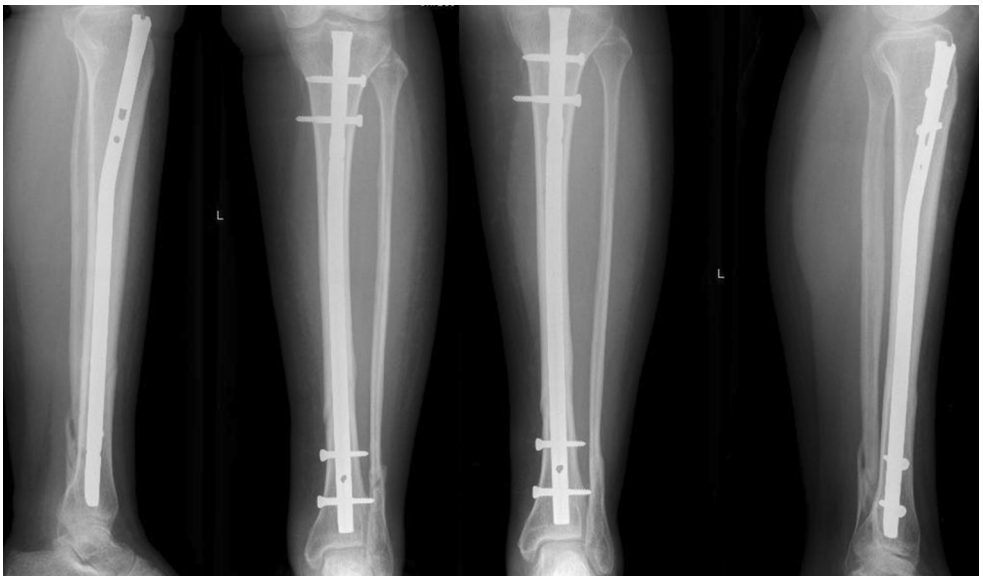

Fig. 4 Case 4 at 22 weeks and 12 months postoperatively

We created two groups of patients: 43 patients treated with unreamed IMLN and 41 patients treated with reamed IMLN. The healing evaluation was performed by an independent observer, blinded to the technique. There were 71 closed fractures and 13 open fractures. The closed fractures were described by Tscherne classification [7], and the open fractures were classified by the Gustilo and Anderson system [8]. We followed up 77 patients for 12 months, 93 % in the reamed and 91 % in the unreamed group, respectively, and we included these patients in the study (Table 1). One patient received concomitant oral bisphosphonate and Ca^{2+} and vitamin D supplements. All patients signed informed consents prior to surgery. *T* test was used to compare two means with statistical significance below 0.05 for 95 % confidence interval.

Evaluation of consolidation

Bone union was based on clinical and radiological healing. The first represents the absence of pain and restoration of gait, and the second presents as disintegration of fracture lines on three cortices on antero-posterior and lateral radiographic views.

Table 1 Characteristic of the fractures in the study

	Reamed group	Unreamed group
Number of patients	41 (22 females)	43 (19 females)
Tscherne grades 0;1;2 (closed)	28;5;2	22;9;4
Open fractures (GA I–II)	6	7
High energy	7	11
Present at follow-up till 12 months	38	39
Concomitant oral bisphosphonate treatment	1	0

Table 2 Comparison of the two group's results

	Reamed IMLN group (SD)	Unreamed IMLN group (SD)
Time to healing (clinical) $p = 0.65$	3.2 months (1.9)	3.4 months (2)
Time to healing (radiological) $p = 0.43$	4.1 months (2.3)	4.5 months (2.1)
Nail diameter	8.31 (0.26)	9.47 (0.55)
Reintervention for nonunion	1 patient	1 patient
Clinical without radiological healing	3 patients	4 patients
Proximal screw breakage	0 patients	3 patients

Results

There was no significant difference in union rate and healing time based on clinical healing between the reamed IMLN group (average of 3.2 months) and the unreamed IMLN group (average of 3.4 months). Two example cases, one from each group, are depicted in figures 1 to 4. The time of radiological healing was slightly higher in the unreamed IMLN (average of 4.5 months) compared to the reamed IMLN (average of 4.1 months) (Table 2). There were two cases of nonunion, one in each group, treated by exchange nailing and autologous bone grafting. None of the patients developed compartment syndrome or deep infection (osteomielitis). Seven patients presented clinical healing without radiological healing.

The mean duration of surgery was shorter ($p = 0.025$) for the unreamed group 43 min (SD 18) compared to 55 (SD 27), but the main determinants were the fracture type and the surgeon's experience. None of the patients were dynamised which led to the screw breakages, all three in the unreamed, titanium nails. Sixteen patients had their nails removed. The main complaint (ten patients) was lateral ankle pain due to distal screw impingement.

Discussion

Intramedullary nailing proved a successful treatment for both open and closed tibial shaft fractures. The strong point of our study was that it provided a regional centre experience in consensus with the literature. There are randomised controlled trials with large number of patients showing a small advantage for tibial reaming in comparison with tibial unreaming. A study on 152 patients described that was a higher prevalence of delayed union and breakage of screws after unreamed intramedullary nailing [9]. Furthermore, other studies found a significant difference in union time during the first 4 postoperative months was in favour of reamed intramedullary nails [10]. Others have found higher rates of nonunions in the unreamed group [11].

One of the most feared complications is the postoperative infection. It has been demonstrated that there is no significant difference about incidence of infection between reamed and unreamed intramedullary nails in open tibial fractures [10]. In our study, there was no patient with compartment syndrome. A study on 48 patients with 49 fractures treated with reamed or unreamed intramedullary nailing of displaced, closed tibial shaft fractures reported that no patient had compartment syndrome [12]. A meta-analysis revealed a statistically significant difference in nonunion and implant failures for reamed intramedullary nailing in comparison with unreamed intramedullary nailing in closed tibial fractures. The same study showed that there was no difference in risk of infection and compartment syndrome between reamed and unreamed intramedullary nailing in closed tibial fractures [13]. A more recent meta-analysis of 11 randomised clinical trials and over 2,000 participants found no difference regarding the rates of major re-operations, nonunion, pain, deep infection, malunion and compartment syndrome, para versus transtendinous approach and locking using two or three screws [14].

The differences that we encountered in the time to union are shared by other studies in the literature [15]. These authors also identified a 66 % relative reduction risk of nonunion with unreaming and a 33 % relative reduction in reoperation due to autodynamisation for closed reaming, respectively. The trend in German countries has also shifted over the last years. Before 2000, nearly all recommended unreamed as more being more biological, but now isolated femur and tibia fractures should be reamed [16].

There are also several limitations in our study. The SPRINT trial has identified several negative prognostic factors that we did not adjust for: high-energy mechanism of injury, a stainless steel compared with a titanium nail, a fracture gap and full weight-bearing status after surgery [17]. In addition, our sample size was small, and this has been proved to alter the significance of the results [18].

Also, our radiological healing assessment was based on disintegration of fracture lines which has less reliability compared to more recently developed scores such as Radiographic Union Score for Tibial fractures (RUST) [19].

In conclusion, our study reveals that reamed nailing proved beneficial, but the impact on overall outcome is not superior to unreamed nailing. There was no statistical difference in healing time between reamed and unreamed intramedullary nails in open and closed tibial fractures.

Conflict of interest This research received no specific Grant from any funding agency in the public, commercial, or not-for-profit sectors. All named authors hereby declare that they have no conflicts of interest to disclose.

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