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Primary unreamed intramedullary nailing for open fractures of the tibia

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Abstract Forty-six open tibial fractures (42 patients) were treated by primary unreamed intramedullary nailing, with debridement of open wounds and treatment of soft tissue. According to Gustilo-Anderson classification there were 18 grade I cases, 18 grade II cases and 10 grade III cases. The incidence of infection was low with two cases of superficial infection and one of deep infection. The mean time for union was 21.9 weeks and the rate of nonunion was 10.8%. There was no significant difference in the mean time to union, infection rate and rate of nonunion with different site and grade of fracture, but there was a longer union time and a higher rate of nonunion in complex and comminuted fractures. Unreamed intramedullary nailing, with appropriate soft tissue treatment, gives good results in the treatment of open tibial fractures including grade III.

Résumé Quarante-six fractures ouvertes du tibia (18 grades I, 18 grades II et 10 grades III d'après Gustilo-Anderson) ont été traitées avec enclouage centro médullaire non verrouillé après parage de la plaie et traitement des parties molles. Il y avait deux cas d'infection superficielle et un cas d'infection profonde après un minimum d'observation de 12 mois. Le temps de consolidation moyen était 21.9 semaines, et cinq fractures n'ont pas consolidé. Un délai plus long de consolidation et un taux supérieur de pseudarthrose a été observé dans les fractures complexes et comminutives. Avec un traitement adapté des parties molles, l'enclouage centro médullaire non verrouillé peut être un traitement satisfaisant des fractures ouvertes du tibia, même pour celles de grade III.

Study conducted at Kyungpook National University Hospital, Taegu, Korea.

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Introduction

The optimum treatment for open fractures of the tibia remains controversial; treatment options include cast immobilisation, open reduction and plate fixation, external fixation and intramedullary nailing. External fixation is associated with a high incidence of complications including pin tract infection, malunion, delayed union and nonunion [6, 7]. Recently the use of unreamed tibial nails has gained acceptance with a low complication rate [14].

Patients and methods

Forty-six open fractures of the tibia were treated at this institution between November 1995 and December 1998 by primary stabilisation with an unreamed intramedullary locked nail. Unreamed nails (UTN, Syntes) of 8 or 9 mm diameter were used with 3.5 mm outer diameter locking screws. The fractures were graded according to the classification of Gustilo-Anderson [4] and classified according to the AO classification. Extensive irrigation and debridement of the associated wound was performed, and cover of exposed bone obtained for more severe open wounds (grade IIIB and IIIC) by either a local muscle flap or a distant flap. Patients with a grade I or II open fracture received intravenous cephalosporin therapy and patients with a grade III open fracture received a cephalosporin and an aminoglycoside. Early postoperative mobilisation was encouraged, when not contraindicated by other injuries, with a patellar bearing brace.

Superficial infection was defined as local erythema which resolved with antibiotic therapy. Deep infection was defined as continuing wound drainage or a positive bacteriological culture. Delayed union was defined as lack of union 6 months postoperatively. Radiographic evidence of union was defined by the presence of bridging callus, and clinical union by the ability to support body weight without walking aids. Statistical analysis (SAS 6.12) was used to evaluate the rate of union and the incidence of infection according to grade, type and site of fracture.

Results

The mean age of the patients was 32.4 years (15–62 years) and there were 33 men and 9 women (4 bilateral cases). The mean follow-up was 19 months with a minimum of

Fig. 1 **A** Preoperative radiographs and illustrations show the comminuted fracture of the distal tibia with extensive exposure of bone (grade IIIb). **B** Immediate unreamed locked nailing was performed with debridement of the open wound and a soleus flap. **C** There was no infection with well-healed soft tissue, but bone-grafting was performed for nonunion with bony loss laterally at the fracture site

Table 1 Union time and infection according to the open grade – Gustilo-Anderson classification system (S superficial infection, D deep infection)

Grade	No. of cases (%)	Union time (weeks)	Infection
I	18 (39.1)	23.6	–
II	18 (39.1)	19.7	1(S)
IIIA	5 (10.9)	23.2	–
IIIB	4 (8.7)		1(D)
IIIC	1 (2.2)		1(S)
Total	46 (100)	21.9	3

Table 2 Union time and nonunion according to AO classification

Types	No. of cases (%)	Union time (weeks)	Nonunion
A (22) (simple)	3 (6.4) 10 (21.5) 9 (19.4)	19.1	1 ^a
B (18) (wedge)	0 (0) 14 (30.3) 4 (8.5)	23.6	1 ^b
C (6) (complex)	2 (4.3) 2 (4.3) 2 (4.3)	29	3 ^a
Total	46 (100)	21.9	5

^aNonunion with bone graft^bDelayed union without bone graft

12 months. According to the classification of Gustilo-Anderson, there were 18 grade I cases, 18 grade II cases, 5 grade IIIa cases, 4 grade IIIb cases and 1 grade IIIc case. One fracture was within the proximal third of the tibia, 32 within the middle third and 13 within the distal third of the tibia. There were 22 type A fractures, 18 type B fractures and 6 type C fractures according to the AO classification. Forty-one fractures united within 6 months with a mean period to union of 21.9 weeks. There were five nonunions, four were treated with bone grafting, and one case in which union was delayed for more than 6 months (Fig. 1). According to the severity of grade the mean time to union of grade I fractures was 23.6 weeks, that of grade II fractures was 19.7 weeks and grade III fractures at 23.2 weeks. There was thus no correlation between severity of the open fracture and the time to union (Table 1). The mean time to union according to the AO classification was 19.1 weeks with type A fractures, 23.6 weeks with type B fractures and 29 weeks with type C fractures (Table 2). Thus the union time was longer in more complex high energy fractures ($P=0.02$). There were two superficial infections, one in a grade II fracture and one in a grade IIIc fracture, successfully treated with antibiotic therapy. There was one deep infection associated with a grade IIIb fracture which resolved after serial debridement and antibiotic treatment. There were three cases of malunion, defined as a rotational deformity of more than 10° or an angulation deformity of more than 10° or shortening by more than 10 mm. Locking screws broke in six cases; no nails broke. There were no complications requiring removal of implant or amputation.

Discussion

The complications of treating open fractures of the tibia include nonunion, infection and malunion [1]. The complication rate has been reduced following improvement in techniques to obtain primary soft tissue cover and wound healing, and improvement in techniques of fixation. External fixation for the treatment of unstable open fractures is associated with significant pin loosening, nonunion and late angular deformity [6]. Earlier methods of unreamed intramedullary fixation using Ender's nails and Lotte's nails produced good results when compared with external fixation but with problems of axial control [5, 9, 10]. Recent reports of the unreamed locked nailing technique have drawn attention to the fact that rigid fixation may be obtained without damage to the periosteum and with maintenance of intramedullary blood flow [3, 6]. The mean time to union in this series, excluding the case of delayed union, was 21.9 weeks, which is similar to that in other series [7]. The time to union correlated with the severity of the fracture as classified by the AO system but not with the severity of the injury as judged by the Gustilo-Anderson classification. There were five cases of nonunion; the overall rate of union compares favourably with that of other studies [14, 15]; and we suggest that early weight bearing contributes to the satisfactory rate of union compared with studies using external fixation [12, 14]. There are, however, relatively few grade III fractures in this study. Fixation with an unreamed intramedullary nail even in cases with extensive local soft tissue loss and damage may produce good results. There was a low rate of infection in this series. This may partially be due to the fact that the technique is associated with minimal damage to the blood supply of cortical bone locally [8, 11]. Other authors have reported an incidence of infection varying from 2–4% to 11.6% [2, 15]. The incidence of malunion was also low, occurring in three patients only, and this also compared favourably with other series [6, 13].

In conclusion, open fractures of the tibia with extensive associated soft tissue damage may be treated by an unreamed intramedullary locked nailing technique with a satisfactory rate of union and low complication rate.

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