Intramedullary nailing and functional bracing of tibial shaft fractures

167 cases followed for minimum 2 years

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We treated 167 diaphyseal tibial fractures without reaming and with intramedullary fixation, using an unlocked Küntscher nail. The patients were followed for a minimum of 2 years. The mean time to union was 16 weeks. There were no serious complications, but 1 case of nonunion, 1 case of deep infection and 2 cases of clinically relevant malalignment. Migration of the nail was observed in 11 cases. We conclude that this treatment is simple and gives satisfactory results in diaphyseal fractures after low- or mid-energy trauma.

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In closed, stable tibial shaft fractures, nonoperative treatment may give excellent results (Chárlez et al. 1995, Sarmiento et al. 1995). Unstable closed and grades I and II open (Gustilo and Anderson 1976) fractures of the tibial shaft are now commonly treated with locked intramedullary nails, with or without reaming (Alho et al. 1990, 1992, Court-Brown et al. 1990, Hooper et al. 1991, Weller 1993, Wiss and Stetson 1995). Although this fixation gives better stability, it is more difficult and time-consuming. There is an increased risk of intraoperative complications. Locking and reaming may not be necessary in simple fractures. We present our results using an unlocked Küntscher nail inserted without reaming.

Patients and methods

Between 1967 and 1994, 186 tibial fractures were treated with unreamed intramedullary nailing. 167 fractures were available for follow-up after a minimal period of 24 months. There were 122 men and 45 women. The mean age was 26 (14–70) years. Traffic accidents were the most frequent cause (82%). Transverse, closed or grade I open fractures were commonest (Table 1). The mid-third and the area between the mid- and distal-third of the shaft were affected in 97% of the cases, but 4 distal fractures were also treated. The operation was performed within the first 24 hours in 86% of the cases. The mean hospitalization time was 7 days.

The operative technique was simple. The patients were operated on in supine position on a standard table without traction (Figure 1). The same position was used for segmental fractures (Figure 2). A Küntscher nail between 8 and 11 mm in diameter was inserted through the patellar tendon without reaming. The nail was carefully hammered in and, if it got stuck, it was removed and a thinner one was inserted. An above-knee cast was used for 2 weeks. Then, the patients started progressive weight-bearing in a functional cast with free movement of the knee and ankle.

At follow-up, the criteria of Ekeland et al. (1988) were used. Malunion was defined as axial deformity or internal rotation of 10° or more, external rotation of more than 15°, or shortening of 2 cm or more and nonunion, as no evidence of healing, after 6 months.

Table 1. Distribution of fractures according to AO-ASIF and Gustilo and Anderson clasifications

Type	Closed	Open-I	Open-II	Total
A1	5	2	–	7
A2	22	10	3	35
A3	75	21	3	99
B1	–	–	–	–
B2	11	3	4	18
B3	–	–	–	–
C1	–	–	–	–
C2	8	–	–	8
C3	–	–	–	–
Total	121	36	10	167

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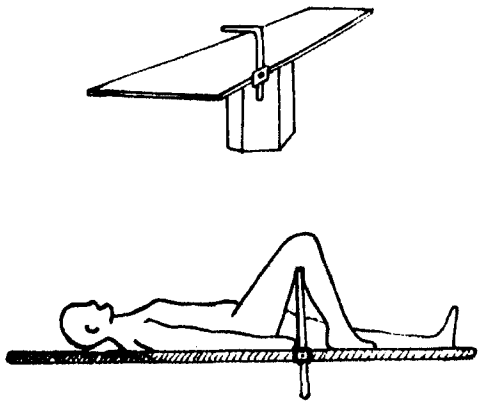

Figure 1. Patient's position on a radiotransparent conventional table.

Results

Healing occurred in all but 2 cases in a mean of 16 weeks. 1 aseptic nonunion needed exchange of the nail and autologous bone grafting. 1 open fracture became infected and was treated by changing the nail for an external fixator; then a successful transportation of a bone fragment was performed. Nail migration was observed in 11 patients, 8 of whom had to be reoperated on. 2 patients suffered deep venous thrombosis, without pulmonary embolism and there were 2 cases of transitory peroneal nerve palsy. Less than 5° of malalignment was seen in 14 fractures with unsatisfactory operative reduction; 1 had 7° varus and another one healed in 15° external rotation. 2 fractures consolidated with 1 cm of shortening. No patient developed ankle stiffness but 3 patients lost a mean of 12° of knee extension.

Discussion

Intramedullary nailing is at present the commonest treatment for diaphyseal tibial fractures (Weller 1993). Reaming and interlocking techniques give very stable fixation, but reaming can have undesirable effects. Peaks of intramedullary pressure lead to embolism of bone marrow in the femur (Pape et al. 1993, Wenda et al. 1993). In the tibia, the endosteal blood supply is destroyed and local embolism causes cortical infarction (Heim et al. 1993, Stürmer 1993), which may increase the risk of infection and delayed union (Whittle et al. 1992, O'Dwyer et al. 1994, Runkel et al. 1994). Good results (Table 2) have been reported with non-reamed nails such as the Ender

Figure 2. Segmental tibial fracture. Postoperative radiograph. Healing at 17 weeks.

Table 2. Some reports about tibial fractures

Series	Nailing method [a]	Healing weeks	Nonunion %	Infection %	Malunion %
Wiss (1995)	LR	28	1.5	7.4	3.7
Alho (1990)	LR	16	2.1	3.2	15
C Brown (1990)	LR	17	1.6	1.6	2.5
Meseguer (1995)	FU	17	2.1	0	6.5
Jahnke (1992)	FU	16	2.5	1.8	8.7
Howard (1992)	RU	19	6	2	7
Present	RU	16	1.2	0.6	0.6

[a] LR locked reamed, FU flexible unreamed, and RU rigid unreamed nailing.

type (Jahnke et al. 1992, Meseguer et al. 1995, García et al. 1996), Rush-pins (Önnerfält 1978), Küntscher nail (Queipo de Llano and Queipo de Llano 1967) or Lottes' triflange nail (Lottes 1974, Howard et al. 1992). These types of nail have been blamed for producing high rates of nonunion, malunion and nail migration. The use of a cast postoperatively has also been regarded as a disadvantage. However, 2 weeks of immobilization and then functional treatment do not jeopardize the clinical result and our results, as regards union and infection rate, compare well with those of reamed, locked nails (Table 2). The operation is easier and quicker, which is an advantage in patients with multiple injuries (Figure 3). Reoperations for nail migration (5%) are easily accepted since locked nails also need secondary surgery for broken screws and dynamization (Duwelius et al. 1995, Hutson et al. 1995).

This technique cannot be used in fractures of the distal third (Figure 4) or in comminuted fractures, but in epidemiologic studies (Court-Brown and McBirnie 1995) at least half of the tibial shaft fractures can be treated with this type of nail. Being thicker than a 6 mm Rush-pin, a Küntscher nail gives better stability and fills the medullary cavity adequately, with less shortening in the case of an oblique fracture.

Figure 3. Floating knee in a multitrauma patient: easy, safe and definitive solution with unreamed technique.

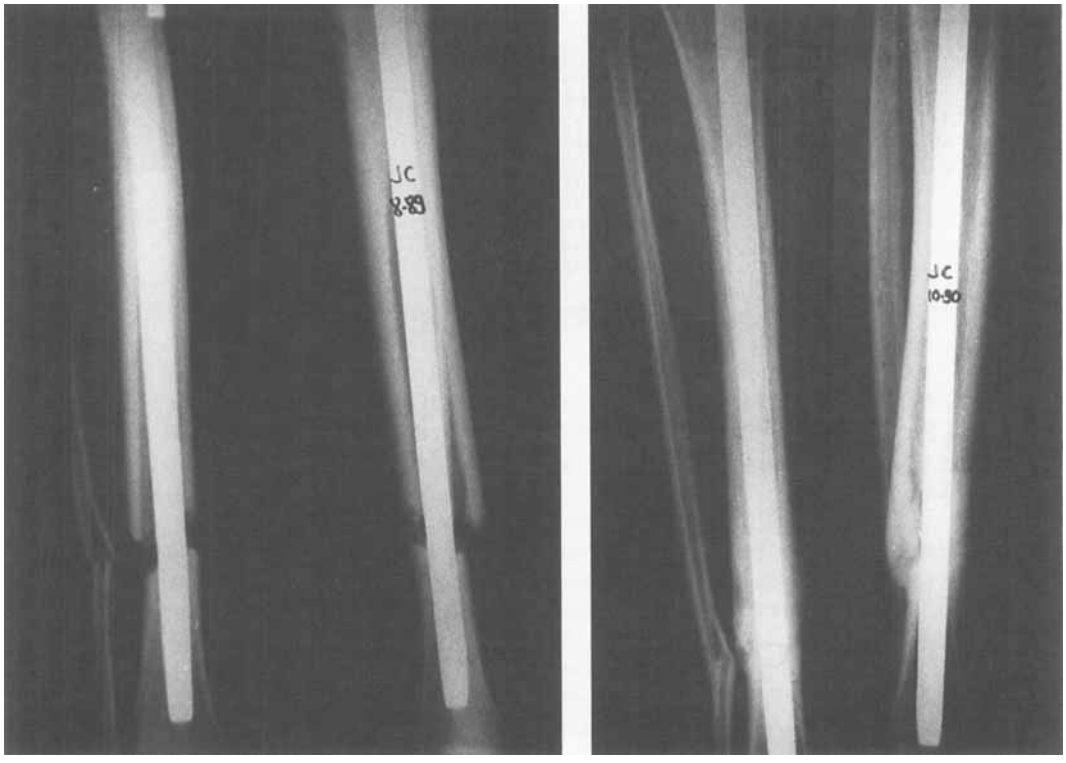

Figure 4. Unlocked nail is not a good choice for distal tibial fractures. This case had an excellent outcome.

Alho A, Ekeland A, Strömsoöe K, Folleras G, Thoresen B. Locked intramedullary nailing for displaced tibial shaft fractures. J Bone Joint Surg (Br) 1990; 72: 805-9.

Alho A, Benterud J, Hogevold H, Ekeland A, Strömsöe K. Comparison of functional bracing and locked intramedulary nailing in the treatment of displaced tibial shaft fractures. Clin Orthop 1992; 277: 243-50.

Court-Brown C, McBirnie J. The epidemiology of tibial fractures. J Bone Joint Surg (Br) 1995; 77: 417-21.

Court-Brown C, Christie J, McQueen M. Closed intramedullary tibial nailing. Its use in closed and type I open fractures. J Bone Joint Surg 1990; 72: 605-11.

Chárlez A, Pallisé F, Gómez A, Cardona J M, Fernández J J. Tratamient™o ortopédico versus tratamiento quirúrgico de las fracturas diafisarias de tibia. Avances Traumatol 1995; 25/1: 19-22.

Duwelius P, Schmidt A, Rubinstein R, Green J. Nonreamed interlocked intramedullary tibial nailing. Clin Orthop 1995, 315: 104-13.

Ekeland A, Thoresen B O, Alho A, Strömsöe K, Folleras G, Haukebö A. Interlocking intramedullary nailing in the treatment of tibial fractures: a report of 45 cases. Clin Orthop 1988; 231: 205-15.

García López A, Marfil Romero M, Herrainz Hidalgo R, Morales Buljan L, Abad Rico J I. Enclavado centro-medular con clavos de Ender en fracturas de tibia. Presentación de 440 casos. Rev Ort Traumatol 1996; 40: 339-43.

Gustilo R B, Anderson J T. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones. J Bone Joint Surg (Am) 1976; 58: 453-8.

Heim D, Schlegel U, Perren S M. Intramedullary pressure in reamed and unreamed nailing of the femur and tibia, an in vitro study in intact, human bones. Injury 1993; 24 (3): 56-63.

Hooper G, Keddell R, Penny Y. Conservative management or closed nailing for tibial shaft fractures. A randomised prospective trial. J Bone Joint Surg (Br) 1991; 73: 83-5.

Howard M, Zinar D, Stryker W. The use of the Lottes nail in the treatment of closed and open tibial shaft fractures. Clin Orthop 1992; 279: 246-53.

Hutson J, Zych G, Cole D, Johnson K, Ostermann P, Milne E, Latta L. Mechanical failures of intramedullary tibial nails applied without reaming. Clin Orthop 1995; 315: 129-37.

Jahnke A, Fry J, Swanson K, Watson R, Tapper E. Treatment of unstable tibial shaft fractures by closed intramedullary nailing with flexible (Ender-type) pins. Clin Orthop1992; 276: 267-71.

Lottes J O. Medullary nailing of the tibia with the triflange nail. Clin Orthop 1974; 105: 253.

Meseguer Olmo L R, Galián Cánovas A, Melendreras Montesinos E. Tratamiento de las fracturas de la tibia con enclavado elástico de Ender y PTB asociado. Resultados en una serie de 92 casos. Rev Ortop Traumatol 1995; 39: 150-6.

O'Dwyer K J, Chakravarty R D, Esler C N. Intramedullary nailing technique and its effect on union rates of tibial shaft fractures. Injury 1994; 25 (7): 461-4.

Önnerfält R. Fracture of the tibial shaft treated by primary operation and early weight-bearing. Acta Orthop Scand (Suppl 171) 1978: 1-63.

Pape H C, Regel G, Dwenger A, Sturm J A, Tscherne H. Influence of thoracic trauma and primary femoral intramedullary nailing on the incidence of ARDS in multiple trauma patients. Injury1993; 24 (3): 82-103.

Queipo de Llano Jiménez E, Queipo de Llano Jiménez A. Tratamiento de las fracturas de tibia, por enclavijamiento cerrado con clavo de Küntscher. Rev Ortop Traumatol 1967; 11: 409-26.

Runkel M, Wenda K, Stelzig A, Rahn B A, Storkel S, Ritter G. Bone remodeling after reamed and unreamed intramedullary nailing. A histomorphometric study. Unfallchirurg 1994; 97 (8): 385-90.

Sarmiento A, Sharpe F E, Ebramzadeh E, Normand P, Shankwiler J. Factors influencing the outcome of closed tibial fractures treated with functional bracing. Clin Orthop 1995; 315: 8-24.

Stürmer K M. Measurement of intramedullary pressure in an animal experiment and propositions to reduce the pressure increase. Injury 1993; 24 (3): 7-21.

Weller S. Internal fixation of fractures by intramedullary nailing. Introduction, historical review and present status. Injury 1993; 24 (3): 1-6.

Wenda K, Runkel M, Degreif J, Ritter G. Pathogenesis and clinical relevance of bone marrow embolism in medullary nailing. Demonstrated by intraoperative echocardiography. Injury 1993; 24 (3): 73-81.

Whittle A P, Russell T A, Taylor C, Lavelle D G. Treatment of open fractures of the tibial shaft with the use of interlocking nailing without reaming. J Bone Joint Surg (Am) 1992; 74: 1162-71.

Wiss D, Stetson W B. Unstable fractures of the tibia treated with a reamed intramedullary interlocking nail. Clin Orthop1995; 315: 56-63.