Abstract  In the last 10 years, traumatologists have become more aware of the importance of blood supply to fracture fragments for both the healing of fractures and prevention of infection. Due to our experience with fractures having severely disrupted periosteal blood supply, we are looking more critically at intramedullary reamed nailing as a treatment option. This research was a result of our increased knowledge of the interplay between periosteal and endosteal blood supply.

Key words  Unreamed nailing · Tibial fracture · Soft tissue damage

Introduction

Injuries with damaged soft tissue treated with plates have high complication rates [10, 29]. In the past, the only option available for a displaced fracture with a severe soft tissue injury was an external fixator. Without a doubt, the external fixator protects the periosteal and endosteal blood supply better than open reduction and internal fixation. However, the external fixator has many of its own complications, including pin-track infections, long healing time, and patient discomfort [1, 4, 5, 19, 26]. Furthermore, a pin-track infection makes early conversion to a plate osteosynthesis or a reamed nail difficult.

The unreamed tibia nail (UTN) was developed by Arbeitsgemeinschaft für Osteosynthesefragen/Association for the Study of Internal Fixation (AO/ASIF) in 1989 evolved after Küntscher's experience with nailing of shaft fractures and the later unreamed applications of tibial nails as described by Lottes in 1974 [15]. These nails were limited to stable fractures and did not have interlocking screws as an option. With interlocking techniques, the indications expanded to include metaphyseal and comminuted fractures. At first, unreamed nails were an alternative to external fixators prior to conversion to a "classically" reamed nail for fractures with severe soft tissue injury.

Early experience has shown that the UTN can be used as the definitive treatment in most of these fractures; however, the publications regarding these experiences studied only a small number of patients [10, 11, 12, 13, 14, 17, 19, 22, 23, 25, 30]. AOI has picked 11 international hospitals, led by Augsburg, to prospectively study UTNs to identify the indications, limits, complications, and contraindications for this technique. The following clinics took part in this multicenter study:

- Augsburg Central Hospital, Department of Trauma and Reconstruction Surgery, D-86156 Augsburg
- Basel Cantonal Hospital, Department of Surgery, CH-4031 Basel
- Berlin University, Rudolf-Virchow Hospital, Department of Trauma and Reconstruction Surgery, D-13353 Berlin
Materials and methods

The study took place over a 1-year period from 1 January 1992 until 31 December 1992. We included all tibia fractures suitable for interlocked nailing. Due to the aim of development for the UTN, fractures with high-grade soft-tissue damage (Gustilo type IIIA, B) should also be treated with the nail instead with the external fixator. The exclusion criteria were adolescent patients, osteomyelitis of the affected tibia, skeletal diseases, and immunosuppressive therapy.

All tibial nails involved in this study from the 11 centers were documented in a standardized fashion. For each implant, there are four computerized documentation sheets (nail and technique specification, epidemiology and clinical course during the hospitalization, concurrent fractures, and 2-year follow-up) containing 106 rows with 1193 bites of information.

The analysis of the sheets took place in the documentation center of the AO/ASIF in Davos, Switzerland. The follow-up rate of the documentation sheets was 100%. Also, in Davos, the radiographs of the involved tibial nails (after 6 weeks, 26 weeks, and 2 years) were digitized and graded by two independent observers. The 2-year follow-up rate for the analysis of the radiographs was 77%.

The complications we looked upon were osteomyelitis, nonunion (no fracture healing at 6 months after insertion of the nail), fracture malalignment (deviation greater than 5° from the anatomic axis), and implant breakage.

Results

Epidemiology

The average age of the 488 patients (with 496 fractures) was 34.8 years. There were 374 male patients (76.6%) with an average age of 33.4 years and 114 female patients (23.4%) with an average age of 39.5 years. Of all the patients, 80.3% were less than 50 years old (by decade: 68 patients from 10 years to 19 years, 168 patients from 20 years to 29 years, 96 patients from 30 years to 39 years and 60 patients from 40 years to 49 years; Fig. 1).

Mode of injury

The mechanism of injury was motor vehicle accident in 74.2%, sporting injury in 10.7%, work-related injury in 8.4%, and other in 6.8% (Fig. 2). There were 115 polytrauma patients (23.9%) and 40 of these patients had an injury severity score greater than 17.

Fracture classification

Using the AO/Mueller classification [21], there were 36.7% type-A fractures, 42.1% type-B fractures and 21.2% type-C fractures (Fig. 3). The closed soft tissue injury was graded using the Tscherne and Oestern classification [27]: 44.5% of the patients had closed injuries – 19.5% were type 0, 11.2% were type 1, 8.1% were type 2, and 5.7% were type 3.