Open Tibial Fractures Treated with Hoffmann External Fixation

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Summary. Thirty-two open fractures of the tibial shaft were treated with external fixation between 1973 and 1981. Early amputation was necessary in one patient. In the remainder, including 14 with extensive soft-tissue lesions, wound healing was obtained within 18 weeks, and the median time until full weight bearing without pain was 32 weeks (range 8–60 weeks). Two deep infections healed during the observation period. Among 26 patients examined 1–9 years after the injury, the result was excellent in six, good in 11, fair in four, and poor in five patients (including the amputation). One fracture had not united during the observation period. Four poor results were due to the stiffness of the ankle and foot after compartment syndrome. In conclusion, alertness for early fasciotomy is necessary even in severe open tibial fractures. The external fixation should not be continued longer than the soft tissue and bone reconstruction make it necessary.

During the past 20 years, external fixation has gained widespread acceptance as a safe method for the initial treatment of open and complex tibial fractures [2, 4, 7–9, 11, 13, 17, 19, 21, 30]. However, there is still much controversy as to which of many available external fixation devices is optimal with regard to the configuration, the rigidity, and the appropriate fixation time.

External fixation of open tibial fractures was introduced in our department in 1973, as our previous treatment policy of rigid internal fixation of these fractures gave less satisfactory results [28].

The present study was aimed at analyzing our results and scrutinizing whether any changes in the policy were warranted.

Patients and Methods

From 1973 to 1981, 44 compound fractures of the tibia were treated with external fixation. Nine patients with fractures in the adjacent joints and three patients transferred to other hospitals after a short stay were excluded. Thus, 32 patients, 25 men and seven women, with a compound lower leg fracture were left for the study. Their median age was 26 years (range 13–83 years).

Twenty patients were injured in traffic accidents, two in falls from heights, and ten in other accidents. The soft-tissue lesions were graded from 1 to 3 after Rittmann et al. [24] (Table 1) (Fig. 1). The fractures were classified according to Bauer et al. [3] (Table 2) (Fig. 2). Primary suture of the wound was performed within 8 h of injury in 19 patients, while the wound was left open in the remaining 13 patients. Four patients needed extensive plastic surgical procedures later. All but five patients received prophylactic antibiotics (cephalotin or cloxacillin). Eleven patients had other major injuries, including six with femoral fractures and three with contralateral ankle fracture. These injuries did not influence the treatment or outcome of the tibial fracture.

On admission, five patients demonstrated a compartment syndrome, and a four-compartment fasciotomy through a long medial and lateral skin incision was done immediately. In another four patients, the compartment syndrome was recognized 1, 2, 2, and 6 days after admission, respectively, and the fasciotomy was then done. Two injuries of the fibular nerve and one of the tibial nerve were diagnosed on admission, but no surgery was warranted. The Hoffmann external fixator was applied immediately after admission in 26 patients. Acceptable reduction was achieved in 22 cases, whereas four patients needed extensive plastic surgical procedures later.

Table 1. Soft-tissue lesions in 32 patients with open tibial fractures (modified after Rittmann et al. [24])

<table>
<thead>
<tr>
<th>Classification</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1: Compounded from within, lesion &lt; 5 cm</td>
<td>13</td>
</tr>
<tr>
<td>Grade 2: Compounded from within, lesion &gt; 5 cm, or compounded from without, moderate contusion</td>
<td>4</td>
</tr>
<tr>
<td>Grade 3: Compounded from without, with severe contusion and/or laceration</td>
<td>15</td>
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Table 2. Fracture classification in 32 patients with open tibial fractures (from Bauer et al. [3])

<table>
<thead>
<tr>
<th>Classification</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1: Spiral and long oblique fracture (low energy)</td>
<td>5</td>
</tr>
<tr>
<td>Grade 2: Transverse and short oblique fracture, with or without a small intermediate fragment (medium-energy)</td>
<td>10</td>
</tr>
<tr>
<td>Grade 3: Comminuted fracture (high-energy)*</td>
<td>17</td>
</tr>
</tbody>
</table>

* Nine of 17 comminuted fractures were segmental (two-stage) fractures. In three comminuted fractures substantial bone defects were revealed after reduction.

needed another reduction during the first week. Six patients were treated with reduction and plaster cast initially. The external fixator was applied within 2 weeks in five cases and at 5 weeks in one patient. In 29 patients a Vidal-Adrey double frame [1] was used, while a single frame was used in two patients. One patient had half-pins only; he was later reoperated on with intramedullary nailing. The pins were inserted with manual drilling from the lateral side, dislocating the anterior muscles posteriorly. The pintrack care consisted of daily swabbing with chlorhexidine. Ten bone graftings were performed between 3 and 25 weeks after the injury (median 16 weeks). The external fixator was generally used until fracture healing was evident in clinical testing. After removal of the fixator, a PTB walking plaster cast was applied, usually for 4 weeks.

Twenty-six patients participated in a follow-up investigation from 1 to 9 years after the injury (median 4 years). Two patients had died of unrelated causes and four patients lived too far away to appear for the examination.

The two-tailed Mann-Whitney U-test was used in the statistical analysis.

Results

Wound healing was obtained in all patients between 1 and 18 weeks (median 5 weeks; Fig. 3).

The external fixator was generally used until fracture healing was evident in clinical testing, and the definition of healing was that the leg should support full weight without pain. The median in-frame time was 16 weeks (range 8–51).

The grade-1 and -2 fractures according to the classification of Bauer et al. [3] healed a median of 24 weeks after the injury (range 8–56 weeks) (Fig. 4). Seven grade-3 fractures healed after 36 weeks (range 22–60 weeks), while seven grade-3 segmental fractures healed after 42 weeks (range 24–48 weeks), and one fracture remained ununited during an observation time of 5 years.

Two patients had lesions of major blood vessels. One 80-year-old woman who had sustained extensive soft-tissue lesions of the leg and lesions of both the femoral artery and vein underwent an above-knee amputation after 2 weeks in external fixation.

Two patients developed pain immediately after the period of weight-bearing in plaster. In both cases an angulation was observed on radiographs without obvious refracture. Both patients were operated on with internal fixation, after which the fractures healed. Two refractures were experienced 24 weeks and 50 weeks after the primary fracture. Both healed...