Treatment of pilon fractures using anterior locking plate
– review of current literature and preliminary results in 22 patients in Helsinki University Central Hospital

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Pilon fractures are severe distal tibial injuries, a combination of soft tissue injuries and often highly comminuted intra-articular fractures. These injuries are difficult to treat by any method and a uniformly accepted optimal treatment does not exist. The initial favourable results using plate osteosynthesis were published by Rüedi and Allgöwer already 1969. Since then many reports have been published concerning complications resulting from open reduction and internal fixations. We review the current literature and our series of 22 patients treated with anterior locking plate.

Introduction
Pilon fracture is a severe distal tibial injury. Fracture etiology is either low energy injury like a fall on the same level or high-energy trauma caused by falls from heights or motor vehicle accidents. In these high-energy traumas there is typically remarkable comminution and impactation of the joint surface (figure 1). It has been evaluated that up to 20 % of these fractures are open fractures and they are frequently associated with additional trauma in other areas of the body (1-3). These fractures are estimated to comprise 3 to 10 % of all tibia fractures and less than 1% of lower extremity fractures (1-3).

Several treatment methods have been recommended for the treatment of pilon injuries including variations of external fixations, plate fixation with a recent emphasis on minimally invasive techniques (4-12). In the past 50 years, no studies have reported on conservative management with cast immobilization. Rüedi and Allgöwer (12) published their encouraging results using plate fixation. Since then there have been unconvincing results with soft tissue problems especially with open fractures (13-16). On the other hand in properly selected patients good results with plate osteosynthesis concerning both radiological results and soft tissue status have been reported (17-20).

Our treatment protocol has been reported previously (18,20,21). In the late of 2003 we started to treat patients with anterior locking plate (LCP Pilon plate - Synthes). Our aim was to assess preliminary results after locking plate fixation in patients with pilon fractures with special reference to radiological status and soft tissue complications and refer these results to current literature.
Materials and methods

This study is a retrospective follow-up study. Data were collected from medical records and from the information obtained during the follow-up visits between December 2003 and December 2005 in the Töölö Hospital, Department of Orthopaedics and Traumatology, Helsinki University Central Hospital. We review 22 consecutive pilon fracture patients treated with anterior or locking plates. Patients with severe open fracture or comminution, which was not able to treat with plate osteosynthesis were treated with limited open reduction and screw or wire fixation combined with bridging external fixation (figure 2).

The average age of the patients at the time of injury was 44 years (range from 20 to 67 years). There were 3 (14%) female and 19 (86%) male. All together 7 (32%) patients had social problems (alcoholic, drug addict, mental illness). Half of the patients were physical workers, 5/22 unemployed, 5/22 pensioned. Thirteen (60%) injuries were high-energy trauma and 9 (40%) low-energy trauma. Most common trauma mechanism was fall from height. Fractures were graded according to AO/ASIF classification (22) as follows: 14/22 C3, 3/22 C2, 4/22 C1 and 1/22 B3 (25). Five patients had open fracture: 2/5 gr 2, 1/5 gr 3B, and 2/5 gr 3A.

Surgery was performed in two steps. Preliminary external fixation over the ankle joint was performed immediately as well as surgical debridement in case of open fracture. Definite treatment with plate fixation was performed after initial posttraumatic oedema had resolved, mean 11 days (range from 5 to 26 days). We used antero-medial approach. Fibula plating was used if the fibular fracture was located at the malleolar region. Bone grafting was used in 12 patients and synthetic bone substitutes in three patients. Surgery was performed by 8 different consultant orthopaedic surgeons and by 1 senior registrar.

Radiological reduction results (anteroposterior AP and lateral plain radiographs) were graded according to Burwell-Charnley (13).

Results

The mean time to bony union was 6 months. Primary radiological result was either excellent or good in every patient, except one. However, in two patients a varus deformity at the metaphyseal level was found in the post-operative x-ray. Two patients had loss of reduction soon after the definitive operation due to weight-bearing problems. There were two non-unions and with one of these patients the plate was broken at the metaphyseal level (figure 3). Two other patients had malunion with 10° of varus angulations, which was noted in the post-operative x-rays as well.

Soft tissue reconstruction (gracilis flap) as a part of the primary treatment was used in two patients, one of these patients had an open fracture. Three patients required additional soft tissue reconstruction (2 gracilis flap, 1 latissimus dorsi flap). Three patients had deep infection, which led to below knee amputation in two patients. All the complications cumulated to patients with social and co-operation problems and heavy smokers. Complications per patients are presented in table 1.

Discussion

Pilon fractures are difficult to treat with success. There are many factors, which worsen the prognosis. This
injury seems to cumulate to the patients with social problems. They are difficult to treat by any method. Although there is no consensus regarding the optimal treatment of these injuries, most clinicians advocate either ORIF or external fixation. Plate osteosynthesis has been used with various results (4,17,18,20). The “internal ex-fix” design of locking plates has as an advantage that screw insertion does not draw the bony fragments to the plate and hence, the precise contouring of the plate is less important in achieving accurate reduction and the pressure to extra-osseous blood supply is less. This factor is however less important with comminuted pilon fracture while open reduction is necessary to reconstruct the articular surface and minimal invasive plate osteosynthesis is seldom possible.

In this series, we confirm that good early results can be obtained with this technique when definitive procedure is made with good preoperative planning, proper patient selection, careful soft tissue preparation and after the soft tissue swelling has subsided. (figure 4). Plate osteosynthesis is also possible with open fractures when early wound covering is done immediately with free flap. However, patients with severe social problems, diabetes, uremia, etc. especially with open fracture should be treated with external fixation.

What ever the definitive treatment implant is, these fractures are difficult to treat (20). Plastic surgical consultation should be available and co-operation with orthopaedic surgeon and plastic surgeon is essential from the very beginning. This goal is best achieved by treating these fractures in few centers with good experience.

Figure 4. 37 years old construction worker had C3 type fracture, which was treated with anterior locking plate. After 10 months of follow-up a good clinical and radiological result was noted.

<table>
<thead>
<tr>
<th>Pt</th>
<th>trauma-energy</th>
<th>open fr</th>
<th>Type of fr</th>
<th>Complications, procedures and end-result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
<td>No</td>
<td>C3</td>
<td>Loss of reduction, infection, free flap, TC arthrodesis, metaphyseal late fracture, pseudoarthrosis</td>
</tr>
<tr>
<td>2</td>
<td>High</td>
<td>Yes</td>
<td>C3</td>
<td>Non-union revision with ring frame, infected free flap, deep infection, amputation</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td>Yes</td>
<td>C3</td>
<td>Loss of reduction, infection, free flap, re-reduction, loss of reduction and deep infection, amputation</td>
</tr>
<tr>
<td>4</td>
<td>High</td>
<td>No</td>
<td>C2</td>
<td>Early wound problems, gracilis flap, bony union without further soft tissue problems</td>
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</tbody>
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Table I. Complications