ABSTRACT

Purpose. To compare the outcome after early versus late surgery for closed ankle fractures in terms of the length of hospital stay and infection rate.

Methods. Records of 95 men and 119 women aged 14 to 92 (mean, 46) years who underwent open reduction and internal fixation for ankle fractures during three 6-month periods in 2004, 2007, and 2010 were reviewed. 82 and 132 patients underwent surgery <24 hours and >24 hours after presentation, respectively. The most common reason for delayed surgery was unavailability of the operation theatre, followed by delayed admission to the fracture clinic and excess soft tissue swelling.

Results. Patient and injury characteristics of the 3 study periods were comparable (p=0.399). The early and late surgery groups were comparable in proportions of various fracture patterns but not in patient age (40 vs. 49 years, p=0.002). The mean postoperative length of hospital stay was shorter in the early surgery group (2.9 vs. 5.5 days, p=0.009). The 2 groups did not differ significantly in the infection rate (7% vs. 11%, p=0.589) or the need for additional surgery (3.7% vs. 5.3%, p=0.63).

Conclusion. Patients with delayed surgery for ankle fracture had a longer postoperative length of hospital stay. Surgery should be performed within 24 hours of injury to minimise the length of hospital stay.

Key words: ankle fractures; length of stay; time-to-treatment

INTRODUCTION

The incidence of ankle fractures is approximately 0.01% per year.\textsuperscript{1,2} Indications for surgical fixation include severe displacement and unstable fracture pattern.\textsuperscript{3} The treatment goal is to maintain accurate reduction for bone healing. Restoration of fibular length and rotation together with accurate reduction of the ankle mortise prevents abnormal contact pressure and early post-traumatic degeneration.\textsuperscript{4,5} Despite advances in treatment techniques, most patients still experience persistent functional limitation.\textsuperscript{6}
The timing of surgery affects recovery. Although this has little effect on functional outcome,\(^6\) it may result in soft tissue complications and prolong the length of hospital stay.\(^7\) Timely surgical intervention is advocated to minimise peri-operative soft tissue envelope problems and postoperative risks of infective and soft tissue complications.\(^7,8\)

Early surgery to stabilise the fracture and restore normal anatomy achieves optimal outcome. Nonetheless, surgery can be delayed by soft tissue swelling and fracture blisters around the ankle.\(^9\) Skin can become threatened, particularly in the presence of a severely displaced fracture or fracture-dislocation. Immediate closed reduction, plaster immobilisation, and elevation can minimise swelling, but swelling usually continues to increase during the first 48 hours.\(^10\) The degree of swelling determines the timing of surgery. Surgery should be performed within 7 to 24 hours of injury or up to 12 days after injury until soft tissue swelling has settled.\(^10\) This study compared the outcome after early versus late surgery for closed ankle fractures in terms of the length of hospital stay and infection rate.

**MATERIALS AND METHODS**

Records of 275 patients who underwent open reduction and internal fixation for ankle fractures during February to July in 2004, 2007, and 2010 were reviewed. 61 patients were excluded because they had open, pilon, physeal, or talar fractures, polytrauma, external fixation, incomplete follow-up, or transferred from other hospitals. The remaining 95 men and 119 women aged 14 to 92 (mean, 46) years were analysed.

Fractures were classified jointly by 2 assessors according to the number of malleoli fractured, the Danis-Weber classification, and the AO classification (Table 1). For the high C fracture of the Danis-Weber classification, the syndesmosis was stabilised but separate fixation for the fibular fracture was deemed not necessary.

The time of presentation was used as a surrogate for the time of injury. The time of surgery and discharge was determined by the surgical team. Protocols for immobilisation, non-weight bearing, and antibiotic prophylaxis were similar in all patients.

82 and 132 patients underwent surgery <24 hours and >24 hours after presentation, respectively. The most common reason for delayed surgery was unavailability of the operation theatre (53.7%), followed by delayed admission to the fracture clinic (22%) and excess soft tissue swelling (18.2%) [Table 2]. Reasons for delayed surgery were not associated with fracture classification (p=0.258, Fisher’s exact test, Table 1).

The early and late surgery groups were compared using the Chi-squared test, Fisher’s exact test, or Mann-Whitney \(U\) test, as appropriate. A \(p\) value of <0.05 was considered statistically significant.

**RESULTS**

Patient and injury characteristics of the 3 study periods were comparable (\(p=0.399\), Kruskal-Wallis test). The early and late surgery groups were comparable in proportions of various fracture patterns (Table 1) but not in patient age (40 vs. 49 years, \(p=0.002\)).

The mean postoperative length of hospital stay was shorter in the early surgery group (2.9 vs. 5.5 days, \(p=0.009\), Mann-Whitney \(U\) test) after excluding 2 patients with exceptionally long stay unrelated to ankle fracture. One patient in the early surgery group

<table>
<thead>
<tr>
<th>No. of Malleoli fractured</th>
<th>Danis-Weber classification</th>
<th>AO classification</th>
<th>No. (%) of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Early surgery group (&lt;24 hours after presentation) [n=82]</td>
</tr>
<tr>
<td>1</td>
<td>B</td>
<td>44-B1</td>
<td>19 (23.2)</td>
</tr>
<tr>
<td>1</td>
<td>C</td>
<td>44-C1</td>
<td>6 (7.3)</td>
</tr>
<tr>
<td>1</td>
<td>High C</td>
<td>44-C3</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1</td>
<td>Isolated medial side</td>
<td>Not described</td>
<td>0 (0)</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>44-B2</td>
<td>19 (23.2)</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>Not described</td>
<td>7 (8.5)</td>
</tr>
<tr>
<td>2</td>
<td>High C</td>
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<td>4 (4.9)</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
<td>44-B3</td>
<td>22 (26.8)</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>44-C2</td>
<td>4 (4.9)</td>
</tr>
<tr>
<td>3</td>
<td>High C</td>
<td>Not described</td>
<td>1 (1.2)</td>
</tr>
</tbody>
</table>

Table 1

Ankle fracture classification for 214 patients
had multiple sclerosis and deteriorated respiratory function and was hospitalised for 104 days. Another patient in the late surgery group had an uneventful recovery but was hospitalised for 74 days owing to social difficulties.

In total, 34 patients developed complications, including infection (n=21), hardware prominence/irritation necessitating removal (n=5), revision for surgical reason (n=2), complex regional pain syndrome (n=1), deep vein thrombosis (n=1), blisters (n=1), temporary tibial nerve irritation caused by the plaster (n=1), and non-union of the medial malleolus (n=1). The 2 groups did not differ significantly in the infection rate (6/82 [7%] vs. 15/132 [11%], p=0.589, Chi squared test).

10 patients underwent additional surgery to resolve the infection by washout/debridement (n=2), implant removal (n=7), or ankle fusion (n=1). The 2 groups did not differ significantly in the need for additional surgery (3/82 [3.7%] vs. 7/132 [5.3%], p=0.63, Fisher exact test, Table 3).

**DISCUSSION**

Surgical management for unstable ankle fractures is recommended for most patients. The degree of articular damage and anatomic reduction are determinants of satisfactory outcome. The optimal management for soft tissue is prompt reduction and stabilisation. Nonetheless, immediate definitive fixation may not always be feasible. The timing of surgery affects the time to bone union. Delayed surgery secondary to delayed presentation of 5 to 8 days results in slower bone healing at 6 weeks and therefore prolonged immobilisation and non-weight bearing status, although the range of ankle motion at late follow-up is not affected.

Soft tissue swelling is not a contraindication to early surgery (6–12 hours after injury); there is less danger of disturbing the micro-circulation in wound margins due to oedema during surgery.

Postoperative infection is more common in patients with delayed (up to 2 weeks) than early (<24 hours) surgery for Danis-Weber type B ankle fractures (12.9% vs. 3.6%). In our study, the infection rate of the early and late surgery groups was nevertheless comparable.

The total mean length of hospital stay has been reported to be 8 (range, 1–18) days: 4.5 days preoperatively and 3.5 days postoperatively. The mean length of hospital stay has been reported to be 5.4 days for early surgery (<24 hours) and 9.5 days for late surgery (>24 hours). In our study, the longer postoperative length of hospital stay could be explained by the slower progress in physiotherapy secondary to a longer period of preoperative immobility. The length of hospital stay is usually shorter after early (<24 hours) than delayed surgery. Nonetheless, the postoperative length of hospital stay is longer after early (<48 hours) than late surgery (6.98 vs. 4.93 days), because of different thresholds for surgery and peri-operative protocols. The length of hospital stay can be shortened in delayed surgery, because patients are discharged initially if significant ankle swelling or blistering has precluded early surgery, and semi-elective re-admission for surgical fixation is arranged. Semi-elective readmission is a cost-effective alternative to in-patient admission. During our study, there was no protocol for discharge.
and semi-elective readmission, but it is now a standard practice to reduce total hospital stay. In the UK, the estimated cost of an acute hospital bed per day is £225. To maximise cost-effectiveness, shortening the length of hospital stay is important. Based on the 2.52-day increase in postoperative length of hospital stay in our patients with delayed surgery, the estimated increased cost per patient was £567.

There were limitations to our study. The relatively low rate of infection and complications may have been underpowered to evaluate the impact of timing of surgery. In addition, the role of comorbidity (particularly diabetes and other immunosuppression) and smoking status on the complication rate was not assessed. These 2 factors may be significant variables for the complication rate. Further study is needed to correlate the reasons for delayed surgery with its associated complications (unavailability of operation theatre vs. soft tissue complications). Patients in the late surgery group were older probably because the elderly are more susceptible to soft tissue swelling following ankle fracture or have medical comorbidities that preclude immediate or early surgery.

CONCLUSION

Patients with delayed surgery for ankle fracture had a longer postoperative length of hospital stay. Surgery should be performed within 24 hours of injury to minimise the length of hospital stay.

DISCLOSURE

No conflicts of interest were declared by the authors.

REFERENCES