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Posterior fragment in ankle fractures: anteroposterior vs posteroanterior fixation

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KEYWORDS

ankle fracture
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lag screw
posterolateral approach
indirect reduction

ABSTRACT

Introduction: The aim of this study was to compare reduction quality and functional outcome of posterior malleolus fractures treated with indirect reduction and anteroposterior (AP) fixation or with direct reduction via a posterolateral approach and posteroanterior (PA) fixation.
Methods: Forty-eight patients with trimalleolar fracture were enrolled in the study. Patients were randomised in two groups: indirect reduction and AP fixation (AP group) and direct reduction and PA fixation (PA group). Inclusion criteria were: posterior fragment involving more than 25% of the articular surface, displacement over 2 mm and ankle instability. The quality of reduction was evaluated using postoperative plain radiographs. Residual displacement of the posterior fragment, articular step-off and/or articular surface gap were analysed. The reduction was considered excellent (<1 mm), good (1–2 mm) or poor (>2 mm). Range of motion (ROM) was measured bilaterally, and the difference in dorsiflexion between the injured and uninjured side was considered as dorsiflexion restriction. Demographic data (age, sex), type of fracture (AO/ASIF classification) and complications were noted.
Results: Forty-six patients completed all follow-up examinations. There was no statistically significant difference in age ($p = 0.41$), sex ($p = 0.29$) or specific type of fracture ($p = 0.83$) distribution between the AP and PA groups. All fractures completely healed within 3 months. The overall complication rate was 8.7%. There was no statistically significant difference in complication rate between the two groups ($p = 0.71$). Radiological evaluation of the ankle showed there was significantly better quality of reduction with direct reduction via a posterolateral approach in the PA group. Excellent reduction was achieved in 79.2% and 45.5% of the PA and AP groups, respectively. The quality of reduction was significantly higher in the PA group compared with the AP group ($p = 0.04$). The mean restriction of dorsiflexion was lower in the PA group (5.96 ± 0.65°) compared with the AP group (6.45 ± 1.06°), but this difference did not reach statistical significance ($p = 0.07$).
Conclusions: The direct reduction technique via a posterolateral approach and PA fixation enables higher quality of reduction and better functional outcome in the management of the posterior fragment compared with indirect reduction and percutaneous AP fixation.

Introduction

Fracture of the posterior malleolus, also known as Volkmann's triangle, is seen in up to 46% of AO/ASIF type B and C fractures [1]. Displaced fractures of the posterior malleolus in ankle fractures remain an important issue because of the lack of consensus among surgeons regarding the most appropriate treatment. Despite recent advances in understanding about these injuries, the optimal management of posterior malleolus fractures remains controversial, and opinions differ on the type of approach, reduction and fixation. There are no definitive management guidelines regarding optimal treatment for displaced posterior malleolus fracture. So far, the size of the fragment has been considered to be the main indication for the internal fixation.

Most of the papers published on the treatment of displaced posterior malleolar fractures reported a fragment size larger than 25% of the joint surface to be an indication for internal fixation [2,3]. Posterior malleolus enables stability and load distribution through the ankle. However, different biomechanical studies reported equivocal results. Harper *et al.* concluded that resection of 50% of the posterior

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articular surface does not significantly influence stability [4]. On the other hand, Gardner *et al.* found that posterior fragment fixation provides more stability than the syndesmotic screw [5]. Bartonicek *et al*. stated that involvement of the posterior tubercule and the fibular notch is probably the most important factor of stability [6]. Standard diagnostic tools include AP, latero-lateral (LL) and mortise radiographic views. Nevertheless, the precise fracture geometry can be obtained only by CT scan. Surgical management of displaced posterior malleolar fractures includes two basic techniques: indirect reduction and anteroposterior (AP) fixation or direct reduction and posteroanterior (PA) fixation. Indirect reduction and AP fixation with lag screws was developed first and still has many proponents among surgeons. Reduction is achieved percutaneously and fixation is performed with 3.5-mm partially-threaded cancellous lag screws. However, there are some concerns about the routine use of this technique in patients with posterior malleolus fracture, including precision of the indirect reduction. Furthermore, it can sometimes be difficult to achieve interfragmentary compression with AP fixation if the threaded portion of the screw is not completely accommodated within small or medium-sized fragments [5]. Direct reduction and PA fixation enables direct reduction via a posterolateral or posteromedial approach, disimpaction of smaller osteochondral fragments and definitive fixation with two lag screws or buttress plate if necessary. Internal fixation of the fibula is possible via the same posterolateral approach with the antiglide-plate principle [7]. Different authors published favourable functional results using this technique [5,8]. Most of the authors suggest using a single, long, posterolateral incision for fixation of posterior fragment and fibula fracture. Nevertheless, it is possible to use separate incisions for the approach to malleolar fractures as well. The present study compares the results of indirect reduction and AP fixation with those of direct reduction and PA fixation.

Fig. 1. AP radiograph of trimalleolar fracture.

Materials and methods

Between January 2014 and May 2017, a total of 48 patients with displaced trimalleolar fractures and medium-to-large-sized posterior fragment were prospectively enrolled in the study. Inclusion criteria were: posterior fragment involving more than 25% of the articular surface, displacement over 2 mm and ankle instability. Patients were randomised with a computer programme and allocated into two groups using a sealed envelope: one group was treated with indirect reduction and percutaneous AP fixation (AP group) and the other with direct reduction and PA fixation (PA group). The study comprised 48 patients, with 23 in the AP group and 25 in the PA group. Two patients (one from each group) were lost to follow-up. The final study comprised 46 patients who completed all the follow-up examinations, 22 in the AP group and 24 in the PA group. Institutional review board approval was obtained, and all patients provided informed consent to participate in the study. All fractures were assessed on standard radiographs and with CT scan, thus we could address exact fracture geometry, such as number of fragments and relation with the fibular notch (Figure 1–4). All procedures were performed by four surgeons experienced in ankle surgery with the assistance of surgical residents. All patients received three doses of Cefazolin perioperatively. Patients in the AP group were in supine position with the tourniquet around the thigh. A standard posterolateral approach to fibular fracture was performed. After reduction and fixation with one-third tubular plate, dorsiflexion of the foot was performed to enable indirect reduction of the posterior fragment to be achieved. The posterior fragment was temporarily held by pointed forceps between the anterolateral and posterolateral tubercule of the tibia. Definitive fixation was achieved with 3.5-mm partially-threaded cancellous screw via a small stab incision in the AP direction. Patients in the PA group were placed in prone position with a thigh tourniquet. The anterolateral approach was used for reduction of the fibular fracture, followed by a posterolateral

Fig. 2. Lateral radiograph of trimalleolar fracture.