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Avulsion fracture of the posterosuperior tuberosity of the calcaneus managed with lag screw fixation[☆]

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ABSTRACT

Background: To review the efficacy of lag screw fixation in management of avulsion fracture of the posterosuperior tuberosity of the calcaneus.

Methods: Since 2002, thirteen patients with displaced fracture of the posterior tuberosity of the calcaneus were treated with emergency reduction of the fracture and lag screw fixation. The medical records and radiographs of the patients were reviewed and the patients were assessed according to the Kerr calcaneal fracture scoring system during the latest follow up.

Results: There was no skin necrosis, but one wound dehiscence in a patient with unstable diabetes and hypothyroidism. All fractures healed, but two had separation of the fracture fragments after the plaster was removed, both of them were elderly osteoporotic patients. The overall average calcaneal score was 93 (range, 77–100). The average calcaneal score of the patients with closed reduction was 91 (range, 77–100). The average calcaneal score of the patients with open reduction was 94 (range, 79–100). Complications occurred in seven patients (54%).

Conclusions: Percutaneous or open reduction of the avulsion fracture of the posterosuperior tuberosity of the calcaneus together with lag screw fixation and equinus short leg cast immobilization can provide good results without skin necrosis. The surgeon should pay attention of the details of the operation and the rehabilitation program in order to minimize the complications.

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1. Introduction

Avulsion fracture of the posterosuperior tuberosity of the calcaneus can be classified into four types [1,2]. Type I fracture is a 'simple extra-articular avulsion' fracture. Type II is the 'beak' fracture in which there is an oblique fracture line running posterior from just behind Bohler's angle. Type III is the infrabursal avulsed fracture by superficial fibers from the middle third of the posterior tuberosity. In the type IV fracture there is the 'beak', but a small triangular fragment is separated by deep fibers only from the upper border of the tuberosity [1–3]. It is an orthopaedic emergency as the fragment may impinge on the fragile skin of the posterior heel (Fig. 1) [4]. Even if the skin is not jeopardized, open reduction and internal fixation of a displaced fracture of the posterosuperior tuberosity of the calcaneus is usually recommended otherwise the push of triceps surae will be significantly weakened [1–3,5–15]. We retrospectively reviewed the clinical presentation and outcome of a consecutive series of thirteen

patients with displaced fracture of the posterior tuberosity of the calcaneus.

2. Materials and methods

Since 2002, thirteen patients (eight males, five females) with displaced fracture of the posterior tuberosity of the calcaneus were admitted to our department. All are Beavis type II fractures [1,2] and were treated operatively (Table 1). The mean age at the time of injury was 52 years (range, 29–85 years). Left foot was involved in eight patients and right side was involved in five patients. Same day emergency operation was performed in all of them.

2.1. Description of technique

The patient was put on lateral or prone position depended on surgeon's preference. A thigh tourniquet was applied in case of open reduction. The patient of Case 11 was put on supine position because of her age and chest problem.

In case of open reduction, a posteromedial incision was made on the medial side of Achilles insertion. The fracture was reduced and held with a reduction clamp. Satisfactory reduction was

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Fig. 1. Case 6. (A) X rays showed the extra-articular avulsion fracture of the posterosuperior tuberosity of the calcaneus with shape posterior edge. (B) Clinical photos showed the skin impinged by the fragment.

confirmed with fluoroscopy and fixed with two 7.3 mm cannulated screws with washers. Posterolateral incision was used in the patient of Case 5 because failed percutaneous reduction and the posterolateral stab wounds were extended for open reduction (Fig. 2). Partial tear of the Achilles tendon close to its insertion was noticed in Case 6. Reattachment of the tendon to the calcaneus was performed by means of a radiolucent suture anchor.

In case of closed reduction, the fracture was reduced by flexing the knee and plantarflexing the ankle. Sometimes, the fragment needed to be disengaged from the impinged skin with a small periosteal elevator before the fracture can be reduced. The fracture was held with a reduction clamp. Two 7.3 mm cannulated screws were inserted percutaneously (Fig. 3). The fracture cannot be reduced by manipulating the ankle and knee in Case 2 because of the perched fracture end. The perched fracture site was disimpacted by a small periosteal elevator in order to reduce the fracture.

Post-operatively, the patients were put on equinus short leg cast for 3 weeks and then changed to neutral cast for another 3 weeks. The patients were advised on non-weight bearing walking for 6 weeks and partial weight bearing for another 6 weeks before full weight walking.

The medical records and radiographs of the patients were reviewed and the patients were assessed according to the Kerr calcaneal fracture scoring system [16] during the latest follow up.

2.2. Statistical analysis

The significance of the calcaneal score of those patients after closed reduction and those after open reduction was determined with the Mann Whitney test using the SPSS 18. The level of statistical significance was set at $p < 0.05$.

3. Results

The fractures were extra-articular in eleven patients and the posterior calcaneal facet was involved in two patients. Skin impingement by the fragment occurred in seven of the thirteen patients (54%). Open reduction was performed in seven patients and closed reduction was performed in six patients.

The average follow up after the key operation was 61 months (range, 19–112 months). No skin necrosis was noticed in all patients. All the fractures healed. The overall average calcaneal score was 93 (range, 77–100). The average calcaneal score of the patients with closed reduction was 91 (range, 77–100). The average

calcaneal score of the patients with open reduction was 94 (range, 79–100).

Complications occurred in seven patients (54%) and were summarized in Table 1. These included a case of flexor hallucis longus (FHL) tethering (Case 2), one case of screw head irritation and retrocalcaneal bursitis (Case 3), one case of breakage of the fragment by the screw (Case 5) (Fig. 4), wound dishiscence and infection in one patient (Case 6), partial separation of the fragments in two patients (Case 8 and 11) (Figs. 5 and 6) and hypertrophic scars in two patients (Case 8 and 13).

There was no statistical significance between the calcaneal scores of those patients after open reduction and those after closed reduction (p value = 0.366).

4. Discussion

The avulsion fracture of the posterosuperior tuberosity of the calcaneus typically occurs in osteoporosis and in the elderly and it separates the upper part of the tuberosity through a fracture line that is transverse or semicoronal [5–7,17]. The fracture exits the posterior tuberosity in variable planes with the fracture line parallel to the trabecular patterns as the “path of least resistance” [18]. The pull of the Achilles tendon results in superior displacement of the superior fragment to varying degrees. In some cases, this can lead to threatened soft tissues overlying this displaced fragment [4]. This can be caused by tenting of the overlying skin or direct pressure of the displaced fracture fragment which is related to the degree of the tuberosity displacement [4]. However, soft tissue compromise can also occur in case of lesser degree of the tuberosity displacement by direct skin impingement by the sharp edge of the fragment [4].

Emergency reduction to relieve tented skin has been recommended [4] and we followed the same protocol. Similar to the result of Gardner et al.’s study [4], none of our patients progressed to posterior skin breakdown.

Both closed reduction and open reduction methods have been utilized to reduce the fracture and there was no statistically significant difference of the clinical outcome. However, FHL tethering was observed in one patient with close reduction of the fracture (Case 2). We believed that it was due to the damage of the tendon by the periosteal elevator during disimpaction of the fracture which was close to the FHL tendon. This led to scarring around the FHL tendon posterior to the ankle and resulted in the tethering. Moreover, two cases of hypertrophic scar were observed and can be the result of irritation of the wound edge by the instruments during the manipulation of the fracture or screw insertion. Partial Achilles tendon tear was noted during open reduction in Case 6. This is an advantage of the open approach to detect associated Achilles tendon injury. The wound complication of this patient was related to her multiple comorbidity including poorly controlled diabetes mellitus and hypothyroidism. Therefore, we preferred open approach especially when there is perching of the fracture at its anterior end. Although some authors proposed the use of a transverse posterior calcaneal incision for reduction and fixation of the fracture and suggested that this approach allowed adequate exposure to the underlying target structures, orientation of the scar in line with relaxed skin tension lines, which minimizes scar formation, and avoidance of dissection of the Achilles tendon [15], we preferred the posteromedial incision. Posteromedial incision allows the use of local sural flap in case of skin breakdown over the Achilles tendon.

There is no consensus which is the best option of fixation. Screw and plate fixation [9], twinfix suture anchors fixation [11], external fixator [12], K wires and tension band wiring [14] and even excision of the fragment together with reattachment of the Achilles tendon with suture anchor [13]. Lag screw fixation supplemented by

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