Surgical Treatment of Talar Neck Fractures

Evaluation of Results

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Abstract

Background: Consideration of gravity of talar neck fractures and evaluation of the treatment results.

Patients and Methods: 22 patients suffering from talar neck fractures were retrospectively reviewed. There were ten type A, six type B, three type C, and three type D fractures according to the Hawkins classification modified by Canale & Kelly. All patients underwent open reduction and internal fixation.

Results: Excellent clinical results were observed in 45.4%, good in 27.2%, fair in 18.1%, and poor in 9.1% of the patients according to the Iowa Ankle Evaluation score. Two patients developed avascular necrosis (AVN) with body collapse, and tibiotalar fusion was required. Furthermore, five patients developed symptomatic subtalar arthritis but did not require subtalar fusion.

Conclusion: Accurate early open reduction is considered the treatment of choice for such types of fractures. AVN is associated with late management, while subtalar arthritis does not necessarily lead to subtalar fusion.

Key Words

Talar fractures · Avascular necrosis · Subtalar arthritis

Introduction

The incidence of talar fractures is between 3–6% of all foot fractures in the literature [1, 2]. Half of them are fractures of the talar neck [1]. The talus has a unique and delicate vascular pattern. Fractures may impair its vascularity thus leading to avascular necrosis (AVN). Other complications of talar fractures are mal- or nonunion, bony ankylosis, impaired joint mobility, tendon trapping, and late development of posttraumatic osteoarthritis, the latter being the most serious one [3–7]. In the past, this led surgeons to various therapeutic procedures including even talus excision or amputation [8, 9]. After the advent of principles of open reduction and internal fixation, early postoperative motion can be initiated, thus enhancing a better outcome. In this study, we present our experience with surgical treatment of talar neck fractures, which are the most common and challenging of talar fractures.

Patients and Methods

32 patients suffering 32 talar fractures were treated in our department in a 9-year period (1991–2000). 26 of them had talar neck fractures, and we were able to reexamine 22 of this group. Four patients were lost to follow-up. One had died from a reason not related to the talar fracture, two were living in remote villages but assured us on the phone that they were “satisfied” with the outcome, and the other did not return our phone calls.

There were 17 men and five women with a mean age of 34.14 years (range 16–64 years) included in this retrospective study. Twelve patients were car accident victims, and in the other ten, a fall from a height > 3 m was reported. Eight were multiply fractured patients: three with fractures of the spine, two with pelvic fractures, and three with fractures of the ipsilateral femur. Three of them were initially hospitalized in the intensive care unit (ICU) for 6–9 days. Nine patients (40.9%) suffered a concomitant fracture in an adjacent bone: four had fractures of the medial malleolus, two a pilon fracture, two a calcaneal fracture, and one fractures of the metatarsals. Two of the talar fractures were open.
Patients were classified according to the Hawkins classification modified by Canale & Kelly [12] in 1978. In this classification, type A refers to nondisplaced, nondislocated fractures, whose line is extended up to the subtalar articulation between the medial and posterior talar tubercle. Type B refers to displaced talar neck fractures with concomitant subtalar dislocation, type C to displaced fractures with concomitant subtalar and tibiotalar dislocation, and type D to fractures with further talar-navicular dislocation. Among our patients, there were ten type A, six type B, three type C, and three type D fractures.

On admission, almost all patients had a painful ankle, with bruising and swelling at the malleoli and midfoot. Radiographic examination included standard anteroposterior and lateral views (Figures 1 and 2). In several cases we obtained a CT scan of the region for more delicate depiction of the talus and better evaluation of its axis and the relationship of fragments with the adjacent bones (Figure 3). Intraarticular extension of the fracture line was not observed in any patient.

In all cases, a high-energy force was reported. The mechanism of injury was not clear in seven patients. In twelve cases, dorsiflexion of the ankle was mentioned, which resulted in collision of the talar neck on the anterior tibial lip. In the remaining three patients with concomitant medial malleolar fractures, extreme supination of the back of the foot with collision of the talar neck was reported as the mechanism of injury.

Primary fusion was not performed in any of our patients. Autogenous cancellous grafts were used in two cases. Treatment was operative in all patients. Concomitant medial malleolar fractures were fixed with two screws or one screw and a Kirschner wire (K-wire), and pilon fractures were further stabilized with bridging transarticular external fixation. In fractures of the small bones of the foot, we used K-wires, while calcaneal fractures were treated conservatively. The talar fractures were stabilized with screws (cancellous or Herbert) and/or K-wires.

Eight type A fractures were treated with two screws. One patient suffering from type A (no. 6) and one suffering from type B (no. 14) talar neck fracture had a concomitant medial malleolar fracture and one (type A, no. 7) a pilon fracture. One of the two remaining type A fractures was treated with three K-wires (no. 5) and the other (no. 8) with two screws and two K-wires.

In group B, two patients were treated with two screws, one (no. 16) with two screws and two K-wires and internal fixation of a concomitant medial malleolar fracture, two with two screws and iliac bone graft, and one with two K-wires.

Two patients with type C fractures were treated with two screws and two K-wires and one patient with one screw and transarticular external fixation because of a concomitant pilon fracture.

Among the type D fractures, we used two screws in two patients and two K-wires in one.
Operative Technique

All patients except the three multiply fractured ones were operated within 8 h of admission. The other three underwent surgery between the 3rd and 6th day after admission. An anterolateral approach was used in six cases (two type B: nos. 11 and 13; one type A: no. 3; three type D: nos. 20, 21, and 22), if good visualization of subtalar articulation was necessary. The direction of screw or K-wire placement was from anterolateral to posteromedial in five patients. In one case (type A, no. 3), the screw was inserted from posterolateral to anteromedial through a small incision. In two of the aforementioned cases with type B fractures, autologous bone grafting was used [11].

In the remaining 16 patients, we used the anteromedial approach [3]. The incision was extended from the tip of the medial malleolus to the middle of the first sphenoid, between the anterior and posterior tibialis tendon. In no case did we need to proceed to medial malleolus osteotomy. The direction of screw placement was from anteromedial to posterolateral. In all cases, good alignment and reduction of the fragments were achieved. Screw position was regularly checked fluoroscopically before wound closure.

Aftertreatment

A below-knee plaster cast was applied for 6–8 weeks. During the 2nd postoperative week, patients were taught to remove the cast for several hours daily and exercise their ankle and foot joints. Radiographic follow-up of fracture healing was monitored with X-rays during the 3rd and 6th postoperative week (Figures 4 and 5) and then once a month until fracture consolidation. Appearance of “Hawkins sign” on the frontal X-ray between the 6th and 8th postoperative week is considered a good prognostic sign for talus vascularization. It was observed in 17 cases. In the other five cases, an MRI was obtained after the 3rd month for evaluation of talus vascularity.

Ankle motion was initiated after cast removal. Partial weight bearing was allowed after the 12th week, depending on the X-rays findings. In cases with AVN, weight bearing was postponed for > 6 months.

Results

Mean follow-up was 58 months (range 1–9 years). Patients were evaluated clinically, using the Iowa Ankle Evaluation score (0–100), and radiographically. This score evaluates function, pain during activities, presence of gait, and range of motion. Ten patients (45.4%) achieved excellent, six (27.2%) good, four (18.1%) fair, and two (9.1%) poor results.

Hawkins sign was found in 17 cases in our series. None of these patients developed osteoarthritis. In the other five patients, we could not identify the Hawkins sign and two of them developed AVN. These five cases were also examined with MRI, which confirmed AVN in the two aforementioned patients but showed no evidence of AVN in the other three.

The two patients with AVN (one type D: no. 21; one type C: no. 18) developed talar body collapse within 6 months and osteoarthritis, which was treated with tibiotalar fusion. Postoperative arthritis in the ankle, without AVN, developed in one (type A, no. 5) and subtalar arthritis in four patients (one type A: no. 4; two type B: nos. 12 and 14; one type C: no. 17).

There was no pseudarthrosis in our series.

Discussion

Various authors suggest that undisplaced talar neck fractures (type A according to Hawkins) should be treated conservatively and that open reduction and internal fixation should be reserved for displaced fractures, despite the fact that poor outcome is common and associated with various complications including AVN as well as subtalar and tibiotalar osteoarthritis [12–14]. Others, however, have pointed out that talar displacement may be
underestimated in the radiographs and favor anatomic reduction and stable internal fixation [12, 15, 16]. This is the reason why we treated all talar neck fractures operatively and allowed weight bearing during the 6th to 8th postoperative week, depending on fracture comminution. Since most of the patients came from rural areas and we had some doubts about their compliance, we applied a plaster cast and taught them to remove it for several hours each day to exercise their joints.

AVN may concern the whole talar body or a part of it [10, 19]. The incidence of AVN varies in the literature from 0 to 13% for type A fractures under the Hawkins classification and up to 80% for types C and D [12, 13, 17–19]. Hawkins sign, radiographically depicted between the 6th and 8th week, but potentially apparent between the 4th and 12th week, indicates satisfactory vascular supply to the talar body. Hawkins sign is regarded as very reliable in the literature [20], and this is supported by our findings. In our series, no patient with Hawkins sign developed AVN, while in the two patients with AVN diagnosed by MRI, Hawkins sign had not been identified in the radiographs. These findings have prompted us to use MRI in selected cases.

There is no doubt that CT scans are superior to plain radiographs both in the preoperative evaluation of talar fractures and in the diagnosis of talar AVN. However, the CT technicians in our hospital had busy schedules, and patients had to wait for hours. That obliged us to reduce preoperative CT scans to selected cases to avoid undue delay of surgery and to resort to plain radiographs in reexaminations.

The incidence of AVN in our series (two cases) was 9.1%. These results are substantially better than other reports in the literature and suggest that they possibly depend upon early (namely within 8 h of admission) accurate open reduction and stable internal fixation.

The two cases with AVN were classified in groups C and D. This is in accordance with the results of other authors who have found that the development of AVN is associated with the severity of fractures [21]. Both patients had multiple fractures and were initially admitted to the ICU. Therefore, delay in surgery could be a factor predisposing to osteoarthritis which resulted in tibio-talar fusion. It has been shown in the literature that AVN does not inevitably lead patients to require fusion, because some of them can tolerate AVN well; therefore,
further operative treatment is not mandatory [20, 22, 23]. However, that did not occur in our series. We did not find any correlation between Hawkins sign and the development of posttraumatic osteoarthritis in our series.

About 70% of the talar surface is covered by articular cartilage, providing a limited surface area for the entrance of nutrient vessels, and resulting in a high percentage of fractures to this bone being intraarticular [4, 15, 24]. This is coupled with the fact that more weight per unit area is borne by the talar dome than by any other joint in the body, thus leading to osteoarthritis [25]. The incidence of posttraumatic arthritis in such types of fractures varies but is about 30% in nondisplaced fractures [26].

In our series, we had seven cases (31.8%) with clinical and radiologic signs of posttraumatic osteoarthritis overall. These results are significantly better than others reported recently [27], but this should be attributed to the small number of severe fractures we had in our series. Two of our cases were observed along with AVN, while in five, no signs of AVN were found. It is interesting that tibiotalar osteoarthritis developed in a low-energy type A fracture. This implies that even in low-energy talar fractures, a lesion to the articular cartilage cannot be excluded. Subtalar arthritis developed in four cases with higher-energy fractures. In two cases (nos. 11 and 15) we used iliac grafting, an indication of the degree of comminution and the force applied. Since no intraarticular distortion was depicted, it is reasonable to suggest that in these cases, the articular cartilage was severely impacted at the collision. Subtalar arthritis is better tolerated than ankle arthritis. This probably explains why patients with ankle osteoarthritis ended in fusion, while those with subtalar arthritis refused any further treatment.

Concomitant fractures did not seem to play a significant role in the outcome in general. However, calcaneal fractures were associated with less than optimal results (case no. 8 fair and case no. 17 good). A retrospective careful examination of the preoperative calcaneal lateral and axial radiographs revealed that operative treatment of these fractures could have yielded better results. In one case (no. 19), the poor outcome could not be attributed exclusively to the concomitant pilon fracture, because the patient had been hospitalized in the ICU with multiple fractures.

We used the anteromedial approach with anteromedial to posterolateral direction of the implants in 16 patients, since it is considered the best approach for successful reduction of talar neck fractures, even though visualization of subtalar joints is not satisfactory. We did not include calcaneal fractures in the analysis, as they were associated with less than optimal results (case no. 8 fair and case no. 17 good). A retrospective careful examination of the preoperative calcaneal lateral and axial radiographs revealed that operative treatment of these fractures could have yielded better results. In one case (no. 19), the poor outcome could not be attributed exclusively to the concomitant pilon fracture, because the patient had been hospitalized in the ICU with multiple fractures.

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<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Fracture type</th>
<th>Treatment</th>
<th>AVN</th>
<th>DJD</th>
<th>Ankle</th>
<th>Arthrodesis</th>
<th>Concomitant fractures</th>
<th>Iowa score</th>
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<tr>
<td>1</td>
<td>A</td>
<td>2 screws</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<td>A</td>
<td>2 screws</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Excellent</td>
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<tr>
<td>3</td>
<td>A</td>
<td>2 screws</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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</tr>
<tr>
<td>4</td>
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<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Fair</td>
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<tr>
<td>5</td>
<td>A</td>
<td>3 K-wires</td>
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<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>Fair</td>
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<tr>
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<td>2 screws</td>
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<td>Pilon</td>
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<td>–</td>
<td>–</td>
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<td>–</td>
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<td>Excellent</td>
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<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Excellent</td>
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<tr>
<td>16</td>
<td>B</td>
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<td>–</td>
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<td>–</td>
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<td>Malleolus</td>
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<tr>
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<td>C</td>
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<td>+</td>
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<td>–</td>
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<tr>
<td>18</td>
<td>C</td>
<td>2 screws</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Tibiotalar ICU</td>
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<td>19</td>
<td>C</td>
<td>1 screw</td>
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<td>–</td>
<td>Pilon ICU</td>
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<td>D</td>
<td>2 screws</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Malleolus</td>
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<tr>
<td>21</td>
<td>D</td>
<td>K-wires</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>Tibiotalar ICU</td>
</tr>
<tr>
<td>22</td>
<td>D</td>
<td>2 screws</td>
<td>–</td>
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<td>–</td>
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</table>
not use it in fracture-dislocation (type D, three cases), because with this procedure, the remaining vascular supply was at risk. In these three type D cases, along with three others, we preferred the anterolateral approach with anterolateral to posteromedial direction of the implants. In two of them (type B), a bone graft was used in order to avoid varus displacement after internal fixation [28]. The placement of screws by a posterior small incision (no. 3) with direction from posterolateral to anteromedial is considered more stable biomechanically and does not affect talar body vascularity [29]. However, this approach does not allow good visualization of subtalar articulation and use of fluoroscopy is mandatory for proper placement of screws in the talar neck.

Fayazi et al. [30] have recently proposed percutaneous pinning of talar neck fractures with two partially threaded cannulated screws placed in opposite directions and parallel to each other in cases where closed reduction was feasible intraoperatively. Their results are encouraging, thus leaving open reduction for cases with irreducible fractures and/or necessary bone graft insertion. However, as the authors state, a prospective study is required.

**Conclusion**
Talar neck fractures are associated with serious complications. Good knowledge of the anatomy, early anatomical reduction and internal fixation are the cornerstones for a successful outcome. Proper surgical approach – according to the fracture pattern – is essential to achieve good results. AVN is associated with late treatment. Patients with subtalar posttraumatic osteoarthritis can usually tolerate symptoms well and do not necessarily end in subtalar fusion.

**References**

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