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Talar Neck Fractures Treated Using a Highly Selective Incision: A Case-Control Study and Review of the Literature

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ABSTRACT

We describe a highly selective incision combined with percutaneous manipulation for reduction and internal fixation of talar neck fractures. We retrospectively investigated the clinical data from 29 cases of talar neck fractures treated from January 2009 to June 2013. Fifteen patients (study group) were treated using a 1- to 2-cm limited incision placed on the anteromedial or anterolateral side of the talus, followed by percutaneous reduction and fixation. Another 14 patients (control group) underwent open reduction and internal fixation through a conventional anteromedial or anterolateral approach. All cases were fixed with Herbert screws or cannulated titanium screws. All the patients were followed up for a minimum of 18 (median 24) months. All the fractures displayed bony union at or before the final follow-up visit. The mean American Orthopaedic Foot and Ankle Society ankle scale score in the study group was 75.3 ± 17.7, 9 patients (60%) had good or excellent results, and 3 (20%) developed talar avascular necrosis. The mean ankle scale score in the control group was 78.9 ± 15.2, 9 patients (64.3%) had good to excellent results, and 6 (42.9%) developed avascular necrosis. No statistically significant differences were found in the American Orthopaedic Foot and Ankle Society score, the number of good to excellent outcomes, or the incidence of complications between the incision groups. A highly selective incision combined with percutaneous reduction and internal fixation can be used to treat fractures of the neck of the talus satisfactorily.

The talus is an important tarsal bone in the human body. For anatomic purposes, it can be divided into a head, body, neck, lateral process, and posterior process. The shape of the talus consists of 6 articular surfaces and is wider in the front than at the back, providing greater stability in dorsiflexion. About 70% of its surface is covered by articular cartilage without muscle attachment. In addition, the talus lacks independent nutritional vessels and its blood supply is primarily through the thickened ligaments and joint capsules distributed in the talus. Talar fractures are relatively uncommon, accounting for only 0.6% of all fractures (1). The cause of talar fractures can be a forceful plantarflexion, with the talar neck striking the anterior edge of the tibia, resulting in a fracture line vertical to the talar neck. Other investigators believe that such fractures are caused by mutual impact of the talus with the tibia and calcaneus (2,3).

Fractures of the talar neck account for about 48% of all talar fractures (1). The Hawkins classification is commonly applied to talar neck fractures. Type I fractures are nondisplaced fractures of the talar neck without dislocation. Type II fractures are displaced fractures of the talar neck with subluxation or dislocation of the subtalar joint. Type III fractures are displaced fractures of the talar neck with subluxation or dislocation of the tibiotalar joint and the subtalar joint. Finally, type IV fractures are displaced fractures of the talar neck with subluxation or dislocation of the subtalar joint, tibiotalar joint, and talonavicular joint (1,2). Fractures of the talar body are uncommon, constituting 13% to 23% of all talar fractures reported in published studies, and 40% of the talar body fractures are often associated with talar neck fractures (4,5).

Post-traumatic arthritis and avascular necrosis of the talus can occur as sequelae to certain talar neck fractures owing to its unique anatomic structure and blood supply and have been the subject of wide-ranging research. Previously, the talar blood supply was

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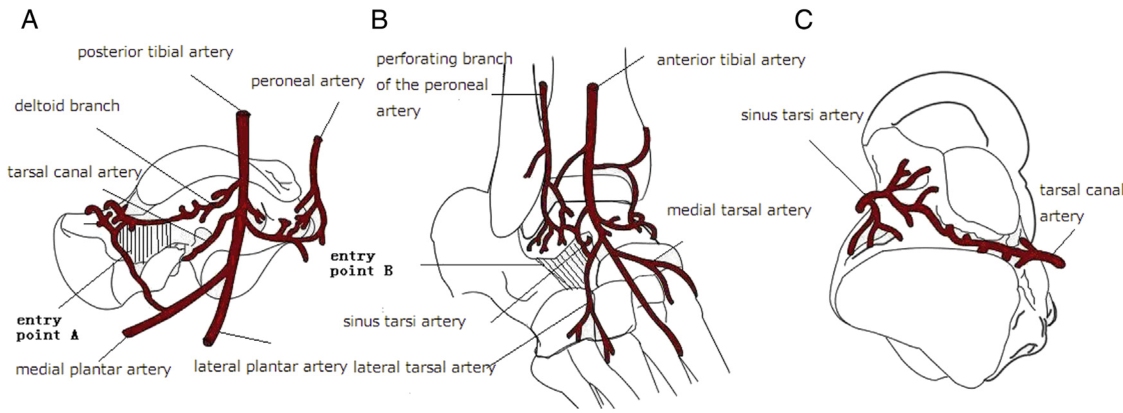

Fig. 1. (*A*) The medial body of the talus is mostly supplied by the tarsal canal artery and deltoid branch. Branches of the peroneal artery mainly supply the posterior process. Shaded area indicates the entry point at the anteromedial area. (*B*) The perforating peroneal artery and branches of the anterior tibial artery form the tarsal sinus artery supply to the lateral talus. Shaded area indicates the entry point at the anterolateral area. (*C*) The tarsal sinus artery anastomoses with the tarsal canal artery.

considered poor; however, subsequent studies have shown that multiple blood vessels form a rich vascular network around the talus (1,6–8). Among the arterial branches that supply the talus, the tarsal canal artery, deltoid branches, and tarsal sinus artery play important roles (Fig. 1). If they were all injured, the blood supply to the talus would be seriously disturbed.

A major complication of talar fractures is avascular necrosis of the talus. A high-energy injury with damage to the blood supply and dislocation are the major reasons for avascular necrosis. The incidence of necrosis after talar neck fractures is 14% for Hawkins type I fractures, 20% to 50% for type II, 80% to 100% for type III, and ≤100% for type IV fractures (1,3,8,9). Moreover, the incidence of avascular necrosis of talar body fractures is 25% to 50% (3,8,9). Therefore, the treatment of talar fractures poses a great challenge for orthopedic surgeons.

Some researchers have applied closed reduction and percutaneous internal fixation for nondisplaced fractures, which effectively reduces the damage to the soft tissue and the disturbance to the blood supply (10). In addition, an inclination exists to apply open reduction and internal fixation for displaced fractures; however, such treatment could further damage the residual blood vessels iatrogenically. The use of highly selective incisions and minimally invasive techniques has been shown to have superior results in managing fractures in various scenarios. Applying these techniques in managing talar fractures could also possibly minimize the damage to the soft tissue and the disturbance to the blood supply, increasing the fracture healing rate and reducing the incidence of avascular necrosis. Thus, we investigated the outcomes of talar neck fracture surgery with the use of a highly selective incision combined with percutaneous Kirschner wire prying reduction.

Patients and Methods

The present study was designed as a retrospective investigation of the data from 15 consecutive patients treated for talar neck fracture at our department from November 2011 to December 2013 (study group). In addition, 14 patients with talar neck fractures who had undergone conventional open reduction and internal fixation from January 2009 to August 2011 were enrolled as the control group. All the patients were collected by the senior authors (J.T., Q.W.). The study group included 12 male and 3 female patients, and their mean age at diagnosis was 40.0 years. The control group included 8 males and 6 females, with a mean age of 41.6 years. The primary cause of injury included 16 cases (55.2%) of a fall from a height, 9 (31.0%) of traffic accidents, and 4 (13.8%) crush injuries. According to the Hawkins classification, in the study group, 1 case (6.7%) was type I, 8 (53.3%) were type II, and 6 (40%) were type III. In the control group, 2 cases (14.3%) were type I, 6 (42.9%) were type II, and 6 (42.9%) were type III. Of the 29 cases, 3 (20%) in the study group were Gustilo type I or type II open fractures, and 2 (14.3%) in the control group were Gustilo type I or type II open fractures. Hawkins Type IV fractures will often present as Gustilo type III open injuries with a dislocated talus. The incidence of talar necrosis with this type of fracture has been 100% (1); therefore, these cases were excluded from the present study. The exclusion criteria also included multiple fractures of the ipsilateral limb, a follow-up period of <12 months, previous ankle injuries and deformities, age <16 years, and pregnancy. The data from all 29 patients are listed in Table 1.

All trauma patients were comprehensively evaluated in the emergency room. Those patients with obvious talar dislocations or gross displacement underwent manual reduction under anesthesia, and a plaster slab or external fixation was applied to provide temporary stability. Nine patients underwent fixation with a single-arm external fixator, and the Schanz pins were placed in the proximal part of the tibia and the calcaneus. (6 [40%] in the study group and 3 [21.4%] in the control group). External fixation was performed to prevent the fragments from compressing the skin and forming tension blisters and to help ease the stretching of the surrounding vascular network. Conventional preoperative 3-dimensional (3D) computed tomography (CT) scans were analyzed to classify the fractures and clarify the positions of the major fragments and comminution.

The timing of surgery was determined according to the nature and time of the injury. For every patient, surgery was performed as quickly as possible. For open bone fractures, the patient underwent emergency surgery within 2 to 8 hours after the injury, and an attempt was made to immediately reduce and stabilize the fracture. For patients with poor soft tissue conditions, open reduction and internal fixation was performed within 7 to 10 days after injury.

A preoperative plan was formulated in accordance with the findings from the CT and radiographic images. All the surgical procedures were performed by 5 experienced surgeons (K.W., Z.Z., J.T., J.H., and J.L.) in our department. In the study group, we placed 1- to 2-cm incisions at the anteromedial and/or anterolateral shaded areas (Fig. 1*A* and *B*). After creating sharp skin incisions, the fascia was bluntly dissected. The medial incision was placed such that the tarsal canal and the deltoid branch arteries were preserved, and the lateral incision was created to avoid injuring branches of the tarsal sinus artery. Under the guidance of C-arm fluoroscopy, 2.0- to 3.0-mm Kirschner wires were used for the prying and reduction of the fragments, and cannulated screw guide pins were applied to temporarily fix the fragments. The entry points are shown in Fig. 2. If exposure of the talar body was required, a 2- to 3-cm incision was placed at the medial malleolus, and care was taken to ensure that the dissection protected and preserved the vascularity of the soft tissues. Only 3 cases (20%) required an osteotomy of the medial malleolus for exposure. After the osteotomy, the medial malleolus, together with the deltoid ligament, was reflected distally to ensure exposure of the medial and superior surface of the talar body. Incisions at the posterior side of the medial malleolus were avoided, and attention was given to protect the posterior tibial tendon and blood vessels

Table 1
Clinical data of the 2 groups (N = 29 feet in 29 patients)

Group	Patients (n)	Gender (male/female)	Age (y)	Surgical Timing (d)	Duration (min)	Follow-Up (wk)	Healing Time (wk)
Study group	15	12/3	40.0 ± 10.7	5.47 ± 2.26	82.3 ± 12.5	23.9 ± 4.27	15.1 ± 3.94
Control group	14	8/6	41.6 ± 11.4	5.29 ± 2.23	75.9 ± 7.27	24.1 ± 4.86	16.6 ± 4.11
Total	29	20/9	40.8 ± 10.9	5.38 ± 2.21	79.2 ± 10.2	24.0 ± 4.48	13.7 ± 2.72
p value			.914	.922	.022	.815	.851