Severe Talar Neck Fractures. Analysis of Treatment in 20 Cases

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ABSTRACT

Introduction: Talar neck fractures are rare but present a high rate of complications and reoperations. The objective of this work was to analyze and describe the complications in the medium and long term in 20 patients with talar neck fracture. Our hypothesis was that, in severe injuries, ORIF presents a high rate of complications that will require new surgical interventions. **Materials and Methods:** We evaluated 20 patients with talar neck fracture: 6 Hawkins II (29%), 11 Hawkins III (52%), and 3 Hawkins IV (19%). The mean follow-up was 11 years. We analyzed the fracture pattern (simple or comminuted), the presence of associated injuries, complications, and the need to perform a new surgical procedure. **Results:** 11 (55%) had associated injuries and 14 (70%) had comminution in the fracture line. We presented complications in 15 patients (75%). 9 (45%) patients required a second intervention to treat the complication. **Discussion:** The factors most related to the development of complications and the need for a new intervention are: comminution in the fracture line, associated injuries in the ipsilateral lower limb, Hawkins type III and IV fractures, and exposed fractures. We believe that in severe talar neck injuries (Hawkins type III and IV) with one or more of these factors, primary arthrodesis reduces the risk of complications and new surgeries and shortens recovery time.

Key words: Talar neck fractures; treatment; outcomes.

Level of Evidence: IV

Fracturas graves del cuello del astrágalo. Análisis del tratamiento en 20 casos

RESUMEN

Introducción: Las fracturas del cuello del astrágalo son infrecuentes, pero la tasa de complicaciones y reintervenciones es alta. El objetivo de este estudio fue analizar y describir las complicaciones a mediano y largo plazo en 20 pacientes con fractura del cuello del astrágalo. Nuestra hipótesis fue que, en las lesiones graves, la reducción abierta y fijación interna genera una tasa alta de complicaciones que requerirán de nuevas intervenciones quirúrgicas. **Materiales y Métodos:** Se evaluó a 20 pacientes con fractura del cuello del astrágalo: 6 Hawkins II (29%), 11 Hawkins III (52%) y 3 Hawkins IV (19%). El seguimiento promedio fue de 11 años. Se analizaron el tipo de fractura (simple o conminuta), las lesiones asociadas, las complicaciones y la necesidad o no de un nuevo procedimiento quirúrgico. **Resultados:** Once pacientes (55%) tenían lesiones asociadas y 14 (70%), conminución en el trazo de fractura. Quince (75%) sufrieron complicaciones. Nueve (45%) requirieron una segunda intervención para tratar la complicación. **Conclusiones:** Los factores más relacionados con el desarrollo de complicaciones y la necesidad de una nueva intervención son: conminución en el trazo de fractura, lesiones asociadas en el miembro inferior homolateral, las fracturas tipos III y IV de Hawkins, y las fracturas expuestas. Creemos que, en las lesiones graves del cuello del astrágalo (tipos III y IV de Hawkins) con uno o más de estos factores, la artrodesis primaria podría disminuir el riesgo de complicaciones y de nuevas cirugías, y acortar el tiempo de recuperación de los pacientes.

Palabras clave: Fractura de cuello de astrágalo; tratamiento; resultados.

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INTRODUCTION

Talar fractures are uncommon, accounting for <1% of foot and ankle fractures, and approximately 50% of them occur at the level of the neck.[1] They are usually related to high-energy trauma and associated injuries to the foot or another region of the homolateral lower extremity are frequent, making their treatment a greater challenge.[2] Due to its particular anatomy, this bone plays a fundamental role in the biomechanics of the foot and ankle.[3] It lacks tendon and muscular insertions, and two-thirds of its surface are covered by articular cartilage leaving only the neck area and the posterior process for the contribution of periosteal irrigation.[4] This comes from the anastomotic network formed by the posterior tibial, anterior tibial, and fibular arteries. The arteries of the tarsal canal and sinus are primarily responsible for the irrigation of the neck and body. The anterior tibial artery provides irrigation to the head and dorsal area of the neck. Through the deltoid ligament, the branches of the posterior tibial artery nourish the posteromedial portion of the body.[5] These are some of the factors that determine the high rate of complications in these injuries.

Open reduction and internal fixation (ORIF) is the standard treatment for displacement fractures. Even so, the rate of complications and reoperations is high. Hawkins,[6] Canale and Kelly[7] reported a high incidence of avascular necrosis (AVN). Likewise, some more recent studies reported an incidence rate between 30% and 100% in displaced fractures.[5,8] Similarly, the incidence rate of post-traumatic osteoarthritis ranges from 50% to 100%.[9-11]

Our hypothesis is that, in severe injuries, surgical treatment with ORIF causes a high rate of complications that may require further surgical interventions. The objective of this study was to analyze and describe medium- and long-term complications in 20 patients with talar neck fracture.

MATERIALS AND METHODS

Patients with fractures with large displacement (Hawkins types II, III and IV) were included. We retrospectively evaluated 20 patients (7 women and 13 men, mean age 35 years) with 20 talar neck fractures that were treated between 1980 and 2014. The minimum follow-up was 18 months and the maximum was 39 years (mean 11 years).

Six fractures were Hawkins type II (29%); 11, type III (52%): and three, type IV (19%). The Table shows the classification of these fractures according to the OTA *(Orthopaedics Trauma Association).* Ten (50%) were closed and 10 (50%) were exposed, and five of the latter were with exposure of the talar body.

Two were treated with plaster; two, with an external tutor; one, by arthrodesis with the Blair technique; and one, with primary talectomy. Eleven patients underwent ORIF. 10 of them underwent a double approach (anteromedial and anterolateral) and were stabilized with cannulated screws of 3.5 or 4 mm in diameter (8 cases) and with low profile plates (2 cases). In one patient, an anterior approach was performed and stabilized with cannulated screws. Three were treated with primary tibiotalocalcaneal arthrodesis using an anterior approach and stabilized with retrograde nail (2 cases) and 6.5 mm cannulated screws (1 case).

Patients were evaluated using anteroposterior and lateral foot and ankle radiographs and CT scans. An MRI was used only on suspicion of AVN that was not visualized on the radiograph. The type of fracture (simple or comminuted), the associated injuries, the complications and, finally, the need for a new surgical procedure were analyzed.

Injuries to the foot, ankle, or distal homolateral leg were considered associated injuries. AVN was defined on the basis of the presence of radiopacity in the talar dome on the anteroposterior ankle and lateral foot radiographs.

This study has been evaluated and approved by the Ethics Committee of our institution.

RESULTS

Eleven patients (55%) had associated injuries: five Hawkins type II, four type III and two type IV. Fourteen (70%) presented comminution: five Hawkins type II, seven type III and two type IV. Complications were detected in 15 patients (75%). Four out of six (66%) patients with Hawkins type II fracture had subtalar osteoarthritis; two (33%), partial AVN; one (16%), pseudarthrosis; and one (16%), varus malalignment. Of the 11 cases with Hawkins type III fracture, three (27%) had subtalar osteoarthritis; two (18%), tibiotalar osteoarthritis; three (27%), AVN (one with body collapse and 2 without collapse); one (9%), varus malalignment; and one (9%), infected pseudarthrosis. In the three cases of Hawkins type IV fractures, one (33%) had osteoarthritis of the subtalar, tibiotalar, and talonavicular joints, and AVN without collapse; one (33%), AVN without collapse; and one (33%), AVN with collapse.

Table. Sample description

Patient	Sex	Age	Hawkins Classification	OTA	Exposed	Comminution	Associated injuries	Treatment	Complications	2nd surgery
1	M	32	2	81.2.B	No	Yes	Skull fracture	ORIF	Pseudarthrosis	TTC Arthrodesis
2	M	49	2	81.2.B	GIIIa	No	Leg fracture	ORIF	Subtalar osteoarthritis	ST Arthrodesis
3	M	46	2	81.2.B	No	Yes	Calcaneal fracture	ORIF	Subtalar osteoarthritis and varus malalignment	No
4	F	22	2	81.2.B	No	Yes	Skull fracture	ORIF	Partial necrosis	No
5	M	22	2	81.2.B	No	Yes	Skull fracture	ORIF	Partial necrosis and ST osteoarthritis	No
6	F	38	2	81.2.B	No	Yes	No	Plaster	Subtalar osteoarthritis	No
7	M	63	3	81.2.C	No	No	No	Plaster	Subtalar osteoarthritis	ST Arthrodesis
8	F	56	3	81.2.C	GII	Yes	Tibial malleolus fracture	ORIF	Septic pseudarthrosis	Pantalar arthrodesis
9	M	42	3	81.2.C	GI	Yes	Tibial malleolus fracture	TTC Arthrodesis	No	No
10	F	19	3	81.2.C	GIIIa/E	Yes	Tibial malleolus fracture	TTC Arthrodesis	Varus malalignment	Valgizing osteotomy
11	M	32	3	81.2.C	GIIIa/E	Yes	No	Blair Technique	No	No
12	M	25	3	81.2.C	GIIIa/E	Yes	No	Talectomy	No	No
13	M	39	3	81.2.C	GIIIb	Yes	Tibial malleolus fracture	TTC Arthrodesis	No	No
14	M	51	3	81.2.C	No	No	No	ORIF	Necrosis with collapse	Modified Blair
15	F	23	3	81.2.C	GII	Yes	No	ORIF	Subtalar and tibiotalar osteoarthritis and necrosis without collapse	No
16	F	28	3	81.2.C	No	No	No	ORIF	No	No
17	M	24	3	81.2.C	GIIIa/E	No	No	External tutor	Subtalar and tibiotalar osteoarthritis and necrosis without collapse	TTC Arthrodesis
18	M	25	4	81.2.D	No	No	Body fracture	ORIF	Necrosis without collapse	No
19	M	30	4	81.2.D	No	Yes	Body fracture and Lisfranc injury	ORIF	Subtalar, tibiotalar, and talonavicular osteoarthritis, and necrosis without collapse	Pantalar arthrodesis
20	F	37	4	81.2.D	GIIIa	Yes	No	External tutor	Necrosis with collapse	Blair

M = male, F = female, OTA = *Orthopeadic Trauma Association* classification, ORIF = open reduction and internal fixation, TTC = tibiotalocalcaneal.

The patient who was treated with talectomy did not suffer any of the complications mentioned, but a shortening of 4.5 cm, inversion of the foot, and marked difficulty in walking.

Nine (45%) patients required a second surgery as treatment for the complication. Two of them initially had a Hawkins type II fracture; five, type III; and two, type IV (Table).

DISCUSSION

Talar neck fractures were defined by Inokuchi et al.[12] according to the line of the upper articular surface of the talus. Fractures located before the lateral process enter into the tarsal sinus and are therefore extra-articular neck fractures; those behind the lateral process involve the articular surface and are, therefore, intra-articular fractures of the body.

Penny and Davis[13] defined the mechanism of the injury well. Upon a force with dorsiflexion of the foot and ankle the posterior capsular ligaments of the subtalar joint break and the talar neck impacts against the anterior edge of the tibia and fractures. If there is associated inversion, the foot may subluxate or dislocate medially. As the force in dorsiflexion progresses, there is an additional rupture of the tibiotalar posterior capsular ligaments, the posterior talofibular ligament, and the superficial and deep bundles of the deltoid ligament. The body of the talus is posteriorly and medially dislocated and is located in the interval between the posterior side of the medial malleolus and the anterior side of the Achilles tendon (Figure 1).

Figure 1. Hawkins type III talar neck fracture.

In 1970, Hawkins published his classification for neck fractures which remains, to this day, the most widely used.[6] Group I injuries are non-displacement fractures, group II injuries represent displaced fractures with a dislocated or subluxated subtalar joint, and group III injuries present a dislocation of the subtalar and tibiotalar joints. In 1978, Canale and Kelly added group IV to the classification, which are those fractures with subluxation or dislocation of the talonavicular joint.[7]

The OTA classification also contemplates the presence of comminution in the fracture line.[14] In 2017, Casola et al.[15] proposed to modify Hawkins' original classification by subdividing type II into: A (simple line), B (comminution of the medial wall), and C (both medial and lateral comminution).

The two most frequent complications are AVN and post-traumatic osteoarthritis of the subtalar and tibiotalar joints. In our series, we observed eight AVNs (40%), two of them were partial and six were total. Despite this, there were only two cases of collapse of the talar body (Figure 2).

Figure 2. Avascular necrosis of the body without collapse.

The different publications show a AVN rate of 0-24% in Hawkins type I fractures, 0-50% in type II, and 33-100% in types III and IV.[16-18] Although the published rates are very variable, it is clear that it is more frequent in talar neck fractures with great displacement. Vallier et al.[19] reported 12 cases of talar dome collapse in 39 AVNs (31%). There is no evidence that justifies avoiding weight-bearing in case of AVN with the aim of preventing collapse.

Eight of our patients (40%) presented post-traumatic osteoarthritis, and the subtalar joint was the most affected (Figure 3).

Figure 3. Evolution of a Hawkins' type III talar neck fracture at age 39. Subtalar arthrodesis due to post-traumatic osteoarthritis and secondary tibiotalar osteoarthritis.

Joint damage is caused by the same injury produced at the moment of trauma and by progressive damage secondary to reduction defects that alter the biomechanics of the foot and ankle. Talar neck fractures types III and IV are the most likely to develop it and the published incidence rate ranges from 56% to 100%.[20,21] This rate increases as the follow-up of patients continues, which makes us think that all will develop osteoarthritis in the medium or long term.

In the preoperative evaluation, 14 patients (70%) had comminution in the fracture line: five Hawkins type II, seven type III, and two type IV. This finding is a factor of poor prognosis. The reported rates of AVN and post-traumatic osteoarthritis are usually higher in those fractures with comminution.[19] Evaluating by means of a computed tomography whether or not there is comminution in the medial and lateral wall of the neck will help us define the surgical approach, the method of fixation, and the prognosis of the injury.[15]

Talar neck fractures are usually caused by high-energy trauma and it is common to find associated injuries. Eleven (55%) of our patients suffered an associated injury. This modifies not only the therapeutic approach, but also the complication rate and prognosis. In a series of 50 patients, Pajenda et al.[22] described 23 complex foot injuries and 29 leg and ankle fractures. Sander et al.[8] reported 41 associated injuries in the homolateral lower limb in 70 patients (59%).

On the other hand, there is no relationship between the time elapsed from the time of injury and surgery with the development of AVN.[19,20] Vallier et al. found no significant differences in AVN between two groups of talar neck fractures in which definitive fixation was performed at 10.1 h and 10.6 days.[19] Age and sex, number of approaches, use of bone grafting, and direction of screws also do not appear to be related to complications.[8]

The high rate of complications means that many of these patients require new interventions. In our series, five (45.5%) of the 11 patients treated with ORIF underwent arthrodesis to treat complications. But only one of those treated with primary arthrodesis underwent a new surgery that consisted of a valgizing osteotomy of the calcaneus to correct the varus malalignment in the position of the arthrodesis.

In their series of 70 cases of ORIF, Sanders et al.[8] reported a second procedure rate of 24% during the first year, 32% at two years, 38% at five years, and 48% at 10 years. It should be noted that 24% of patients with Type II Hawkins fractures, 36% with Type III fractures, and 62.5% with Type IV fractures required a second surgery. The factors most related to the need for a new intervention are: comminution in the fracture line, associated injuries in the homolateral lower limb, Hawkins type III and IV fractures, and exposed fractures.[8,19,21] The most common cause of new interventions is post-traumatic osteoarthritis, mainly of the subtalar joint.[8]

We believe it is important to consider arthrodesis as an initial treatment in patients with severe talar neck injuries with associated injuries and comminution in the fracture line. Even more so if there is body exposure. Blair's technique for tibiotalocalcaneal arthrodesis is a good option to decrease shortening and prevent collapse of the internal column.[23-25]

The limitations of this study are that it is based on a series of only 20 patients and that they were treated in different ways. The strength is the 11-year follow-up that allows long-term outcomes to be evaluated.

CONCLUSIONS

Talar neck fractures are high-morbidity injuries with a high rate of complications in the medium and long term. Among them, osteoarthritis of the neighboring joints is the most frequent. While the treatment of choice is ORIF, considering arthrodesis as an initial treatment could decrease the rate of complications and second interventions.

Conflict of interests: The authors declare they do not have any conflict of interests.

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