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Evaluation of talus fractures treated with fixation- correlation of functional outcome with the fracture type and wound condition

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ABSTRACT

Background: Fractures of talus are one of the most difficult ones to treat owing to the problems of complicated fracture patterns, wound problems, risk of osteonecrosis etc. This study aims to evaluate the relation of the fracture type and wound with the functional outcome after open reduction and fixation.
Methods: The study was conducted in Sir J. J. Group of Hospitals from June 2014 to March 2018. A consecutive series of 28 patients with displaced fractures of talus were selected after approval from ethical committee. All patients were operated and evaluated at average of 6 months after surgery.
Results: The Hawkins score was used to evaluate the functional outcome. 60% of patients of type II gained good to very good score as compared to 40% of patients of type III and 30% of type IV. With increase in severity of the fracture, percentage of score decreased.
Conclusions: Most precise method of restoring and maintaining the anatomy of talus fracture is open reduction and internal fixation to allow early motion. Surgery for displaced fractures consists of anatomically correct reconstruction to avoid articular surface incongruence and angular deformity as well as preservation and rapid restoration of talar blood supply. This will ensure early mobilization and satisfactory outcome. Open fractures have worse functional outcome than closed fractures owing to lower union rates, higher osteonecrosis rates and higher re-operation and infection rates.

Keywords: Talus, Fractures, Hawkins, Osteonecrosis

INTRODUCTION

Fractures and dislocations around the talus, although rare can be very challenging to treat. The incidence of these fractures is 0.1–2.5%.[1,2] and half of these are fractures of the talar neck.[3,4] These fractures occur following high energy trauma and are almost always intra-articular. Talar fractures can be classified loosely, based on the location of the fracture line, into head, neck, body or lateral/posterior process fractures. Undisplaced fractures can be conserved in a cast but a majority of these fractures are displaced or may be associated with per-talar dislocation, which requires surgical treatment in form of open reduction and internal fixation. The options for fixation include 4 mm cannulated cancellous screws, k wires and mini fragment plated. However, in spite of untiring efforts to accurately fix these fractures, the management is complicated by incidence of avascular necrosis, non union and post traumatic arthritis of tibio - talar joint.[5]

This study aims to evaluate the functional outcome of fixation of talus fractures and its relation to the fracture

type, wound and the time lag between onset of trauma and fixation of fracture.

METHODS

A consecutive series of 28 patients who sustained displaced talar fractures and required open reduction and fixation, were selected for the study which was conducted in Grant Government Medical College and Sir J. J. Group of Hospitals from June 2014 to March 2018.These patients were studied prospectively after getting approval from the ethical committee of our institution. The cases were included for the study based on the following criteria.

Inclusion criteria

All patients with radiologically proven displaced fracture talus irrespective of age and sex.

Exclusion criteria

Talus fractures with other fractures (including fractures of other tarsal bones), undisplaced fractures of the talus, patients who were medically unfit for surgery were excluded from the study.

All patients with suspected fracture were given initial treatment in the form of below knee plaster of Paris splint with strict limb elevation, active toe movements, anti-inflammatory medications and analgesics. The patients were evaluated based on following:

Clinical evaluation

Proper history of trauma as well as other relevant history was elicited from each patient. All patients had visible swelling of the ankle with tenderness and inability to move the ankle and bear weight on affected limb. Patients with suspected dislocations had deformity of the ankle. In all patients, neuro vascular status was assessed carefully.

Radiological evaluation

All patients were subjected to standard plain radiographs of the ankle in antero- posterior, lateral and Mortise views. CT scans were also done to see the pattern and extent of fracture, degree of communition as well as to aid in treatment. Fractures were classified as per the Marti and Webers classification (Figure 1, Table 1).[6]

Initial treatment

All patients with suspected fracture talus were admitted, thoroughly evaluated for chest, abdomen, pelvis or head injuries and treated for same. Meanwhile all patients for fracture talus were immobilized with below knee plaster slab.

Table 1: Marti and Weber classification of talus fractures.[6]

Type I	Peripheral fracture - Processus fibularies - Processus posterior - Distal neck - Head	Circulation intact	No necrosis
Type II	Central fracture without displacement - Proximal neck - Body	Circulation mainly intact	Seldom necrosis
Type III	Central fracture with displacement - Proximal neck - Body	Intra-osseous circulation interrupted, auxiliary circulation intact	Often necrosis
Type IV	Dislocation fracture - Proximal neck - Body dislocated in the ankle and/or subtalar joint	Intra-osseous and auxiliary circulation interrupted	Nearly always necrosis

Non–operative management

Undisplaced fractures were generally managed with the application of non-weight bearing below knee cast in planter flexion for 8-12 weeks. Non weight bearing was continued for additional 4-6 weeks after cast removal and mobilization of ankle was encouraged.

Type II fracture with subluxation or dislocation of subtalar joint is most likely to be successful with knee flexed and the foot plantarward flexed. Any varus or valgus malalignment should be corrected.

In type III, in rare cases it may be possible to replace talar body into ankle mortise. This requires planter flexion and varus positioning of foot. In some cases, closed reduction can be aided by use of transverse Steinman pin through calcaneum to apply traction. However this also increases soft tissue damage and skin necrosis owing to degree of direct pressure required to reduce.

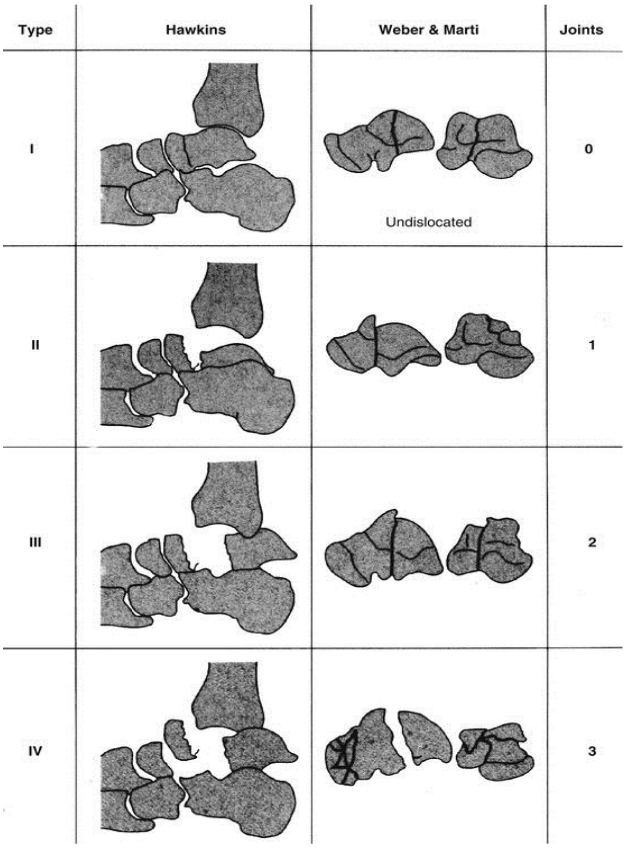

Figure 1: Marti and Weber classification.[6]

Operative management

Many patients require open reduction and fixation. The indications are

1. Attempted closed reduction does not result satisfactory opposition of fragments.
2. If an initial close reduction was satisfactory but follow up roentgenogram evaluation showing loss of reduction.
3. Compound injury associated with fracture.
4. Associated fracture of medial malleolus with interposition of soft tissue.

Management of open or compound fracture

Few of type I, type II and majority of type III, type IV fracture neck talus are compound fractures. All of them require initial debridement and local care of wound with primary or secondary skin suturing or skin grafting and antibiotics.

Technique of open reduction and fixation

Surgical approaches

1. Anteromedial approach
2. Anterolateral approach
3. Posterior approach
4. Combined approach

1. Anteromedial approach

Position of patient:- Patient is kept supine with flexion 50 degrees abduction 30 degrees and external rotation 20 degrees at hip joint and flexion at knee 70 degrees.

This brings medial side of the ankle joint upward while lateral side remain in contact with operating table.

Incision of 7.5 to 10 cm long beginning just proximal to anterior surface of medial malleolus curving distally plantarward towards foot sole and ending on medial side of the body of navicular is to be made. Deep dissection is medial to anterior tibial tendon. The retinaculum over tibialis posterior is incised to retract posterior tibial tendon. If a medial malleolus osteotomy contemplated, medial malleolus is predrilled.

This approach can be used to assess talar neck or body fracture. Saphenous vein and nerve lie superficial and are easily damaged.

2. Anterolateral approach

This approach uses a curvilinear skin incision that begins 2cm anterior to tip of fibula and extends to base of 4th metatarsal. Deep dissection is carried out through extensor retinaculum and lateral to extensor tendons.

This allows access to the sinus tarsi, lateral talar body and neck. The artery of tarsal sinus may be jeopardized.

3. Posterior approach

The patient is placed in a true lateral position. Incision of 3 cm vertical is made 1 cm lateral to achilles tendon. Identify and developed the interval between peroneus brevis and flexor hallucis longus tendon. Open posterior capsule exposing the talus posterior.

Advantage of posterior approach

a. Talonavicular joint is protected.
b. Screws are more likely to be perpendicular to fracture plane.
c. Anterior vascular structures are protected.

Fixation option

Fracture fragment fixation can be done in following ways

a. Screw osteosynthesis
   - Cortical lag screw (3.5 mm)
   - Cannulated lag screw (4.5 mm)
   - Cancellous screw (4 mm, 6.5 mm)
b. K wire osteosynthesis
c. Minifragment T plate
d. K wires + External fixation

Post-operative treatment

- During first 48 hours post operation, the leg is elevated, movements of the toes and the whole leg with flexion extension in the knee joint is encouraged.
- In type I and type II, a below knee walking cast applied for another 4 weeks. Partial weight bearing of 10– 20 kg is allowed with crutches.
- In type III and type IV, a weight relieving caliper is applied after removal of sutures. Full weight bearing is allowed if there is no evidence of necrosis.
- Usually after dislocation fracture, the treated area become necrotic or relatively dense and sclerotic radiologically. If the roentgenogram shows a subchondral translucency as a result of vascularity of the bone (Hawkin's sign), full weight bearing can be safely allowed.

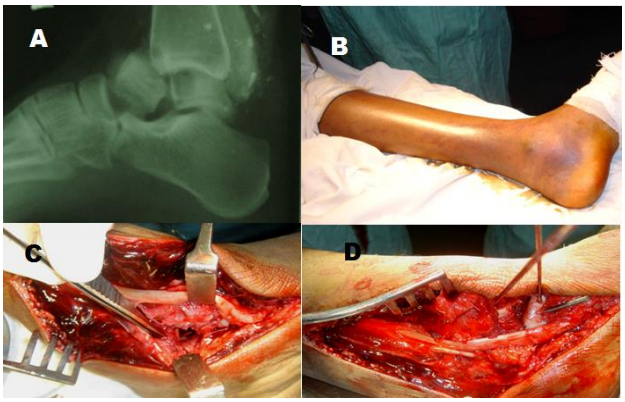

Figure 2: (A) 38 year old male patient with type III closed fracture of talus; (B) position of limb for anteromedial approach with medial malleolus oteotomy; (C) tibialis anterior and tibialis posterior tendons retracted and fracture site exposed; (D) 'K' wires used as joystick.

Figure 3: (A and B) postoperative radiographs of patient; (C and D) full plantarflexion and dorsiflexion respectively at 6 months follow-up.

Follow up

The average postoperative follow up was 6 months (4 months to 8 months). All the patients underwent a standardized clinical follow up examination. Patients were asked about persistent accident related complaints and the effects on their professional careers. Radiographs of the ankle joint were done in two projections, anteroposterior and lateral view.

Table 2: Hawkin's score.

Pain	No pain	6
	Pain only after fatigue	3
	Pain on walking	0
Limping	No limping	0
	Limping	3
Ankle and subtalar range of motion	Full motion	3
	Partial motion	2
	Fusion	1
	Fixed deformity	0
The quantitative sum of all above was made and results interpreted as		
Very good	13 to 15	
Good	10 to 12	
Fair	7 to 9	
Poor	6 or less	

The Hawkin's score based on pain, presence of limping and range of motion at ankle and subtalar joint was used for the final assessment of the treatment.[7]

RESULTS

This study is based on 28 patients who sustained talus fractures and were treated at our institute during June 2014 to March 2018.

All patients were followed up clinically and radiologically for an average period of 6 months, limits being 4 months to 8 months.

The following observations were made after analyzing data collected.

Age and sex incidence

Age group ranged from 15 to 56 years, but 75% were in 25–44 years age. There was a definite male preponderance. In the study group 86% were males.

Table 3: Age distribution.

Age in years	No. of patients	Percentage (%)
15–24	05	18
25–34	13	46
35–44	08	29
45 and above	02	07

Table 4: Sex distribution.

Sex	No. of patients	Percentage (%)
Male	24	86
Female	04	14

Type of fracture

The distribution of study materials according to Marti and Webers classification is as below (Table 5).

Table 5: Distribution of cases as per type of fracture.

Type of fracture	No. of patients	Percentage (%)
Type I	01	04
Type II	10	36
Type III	10	35
Type IV	07	25

Mode of trauma

Table 6: Distribution as per mode of trauma.

Mode of trauma	Type					
	I	II	III	IV	Total	%
Vehicular accident	01	05	07	04	17	60
Fall from height	00	04	02	02	08	29
Fall of heavy objects	00	01	01	01	03	11

Status of the wound

Table 7: Distribution of cases as per wound status.

Status of the wound	No. of patients	Percentage (%)
Closed	23	82
Open grade I	00	00
Open grade II	03	11
Open grade III	02	07

5 patients had open fractures.

Hawkins score

Functional outcome with respect to type of fracture varies as per Table 8.

Final functional outcome correlated with type of fracture at the initiation of injury. 60% of patients of type II gained good to very good score as compared to 40% of patients of type III and 30% of type IV. With increase in severity of the fracture, percentage of score decreased.

Functional outcome with respect to status of wound (Table 9).

Functional outcome with respect to timing of surgery (Table 10).

Functional outcome with respect to age (Table 11).

Table 8: Functional outcome as per Hawkin's score in various types of fracture.

	Very good (%)	Good (%)	Fair (%)	Poor (%)	Total
Type I	1 (100)	-	-	-	01
Type II	2 (20)	4 (40)	3 (30)	1 (10)	10
Type III	1 (10)	3 (30)	5 (50)	1 (10)	10
Type IV	1 (15)	1 (15)	2 (28)	3 (42)	07

Table 9: Functional outcome and status of wound.

Status of wound	Very good (%)	Good (%)	Fair (%)	Poor (%)	Total
closed	5 (21)	8 (35)	8 (35)	2 (09)	23
Open grade I	-	-	-	-	-
Open grade II	-	-	2 (67)	1 (33)	03
Open grade III	-	-	-	2 (100)	02

Table 10: Relation between functional outcome and time lag for surgery.

Time lag between injury and surgery (hrs)	Very good (%)	Good (%)	Fair (%)	Poor (%)	Total
0–12	-	3 (30)	4 (40)	3 (30)	10
13-24	-	1 (25)	2 (50)	1 (25)	04
24 and above	4 (34)	3 (25)	4 (34)	1 (07)	12

Table 11: Relation of functional outcome to age.

Age group	Very good (%)	Good (%)	Fair (%)	Poor (%)	Total
15–24	1 (20)	-	2 (40)	2 (40)	05
25–34	4 (31)	3 (23)	3 (23)	3 (23)	13
35–44	-	4 (50)	4 (50)	-	08
45 and above	-	1 (50)	1 (50)	-	02

Table 12: Complications in various types (C=close ; O=open).

complication	Type I		Type II		Type III		Type IV		Total
	c	o	C	O	c	o	c	o	
Superficial necrosis	-	-	2	-	1	1	-	2	06
Infection	-	-	-	-	1	1	-	3	05
Avascular necrosis	-	-	1	-	1	-	2	2	06
Ankle arthritis	-	-	2	-	2	-	1	2	07
Subtalar arthritis	-	-	3	-	2	-	1	2	08

DISCUSSION

High energy nature of majority of talar factures produce not only fracture displacement and comminution but also severe soft tissue damage, frequently in association with open wounds[8]. These characteristics often predict a poor prognosis. Functional outcome of talar fractures is dependent on development of complications. Early complications such as skin necrosis (22%), infection (18%) and late complications such as osteonecrosis (22%), post traumatic arthritis (53%) have occurred in our series. Treatment strategies have evolved from closed reduction and immobilization to open reduction and internal fixation. Surgery for displaced fractures consists of anatomically correct reconstruction to avoid articular surface incongruence and angular deformity as well as preservation and rapid restoration of talar blood supply.[9,10]

Marti Weber type I and type II fractures of the talus generally have a good prognosis. They are usually treated conservatively. However, undisplaced talar neck fractures can also be treated with percutaneous screw fixation. Osteosynthesis permits early mobilization of the joint. The results of the fractures of type III and type IV are often unpredictable because of incidence of osteonecrosis and post traumatic arthritis.[11] Hawkins (1970) reported prevalence of osteonecrosis of 53%, Canale and Kelly reported 52% of prevalence of osteonecrosis.[7,12] More than half of the patients in above two studies were treated non-operatively. In our study, we found overall prevalence of osteonecrosis to be 22%. The low rates of secondary talar necrosis are probably due to majority of cases in our study treated operatively to achieve and maintain anatomical reduction. However, as the numbers in present study were small, it is difficult to derive a conclusion.

Talar fractures are treated urgently to reduce the risk of osteonecrosis because urgent reduction of dislocation may help to preserve any remaining blood supply. Although the numbers in present study are small, no correlation was found between timing of surgery and functional outcome of fracture. Delay in surgery does not necessarily result in adverse outcome. Also in some cases internal fixation cannot be safely undertaken on urgent basis because of life threatening trauma or because of severe soft tissue damage and swelling of ankle and foot. Surgical delay will allow improvement in associated soft tissue injury and will decrease rates of wound complications and infections.[13]

Weber recommended primary arthrodesis in fracture dislocations, which sacrifices the ankle and subtalar joints.[14] We and other authors (Beck, David et al, Schulze et al) do not agree this approach.[15-17] In our series we have 2 cases primarily treated with arthrodesis (1 case with type III comminuted, 1 case with type IV). Both have fair to good functional outcome during follow up study. Though the number of cases in our study is small, it can be recommended that primary arthrodesis can be done in severely communicated fractures which preclude acceptable internal fixation of fracture fragments.

In our study 57% (13 out of 23) of closed fractures scored very good to good score as compared to 100% of open fractures scoring fair to poor results. Overall, the open fracture in our series fared much worse than did the closed fractures with a higher osteonecrosis rate, infection rate and arthritis prevalence rate.

Hawkins in his initial study of 57 talar neck fractures, reported an overall prevalence of osteonecrosis of 53%.[7] Canale and Kelly in study of 71 talar neck fractures reported 52% prevalence of osteonecrosis.[12] Penny and Devis reported 48% prevalence of osteonecrosis.[18] Grob

et al reported 16% osteonecrosis rate in a series in which 28 of 41 talar fractures were fixed surgically within 8 hours after injury.[19] They have attributed the low osteonecrosis rates to early fixation. In our study, prevalence of osteonecrosis was 22% (4% in type II, 4% in type III and 14% in type IV). As the severity of fractures increased, rate of osteonecrosis increased. The rate of osteonecrosis was not related to timing of fixation; but rather to the initial degree of fracture displacement and presence of an open injury.

Szyszkowitz et al reported prevalence of subtalar arthritis 74% and ankle arthritis 52%.[20] Grob et al reported 37% of prevalence of post traumatic arthritis.[19] Elgafy et al found 53% prevalence of subtalar arthritis.[21] In our study, prevalence of overall post traumatic arthritis was 53% (ankle arthritis 25%, subtalar arthritis 28%). The observations in recent studies more closely parallel the finding in our study, in which post traumatic arthritis was twice as common as osteonecrosis. Functional outcomes were worse when talar body fractures were followed by development of arthritis or osteonecrosis with collapse.

Closed radiological follow up study of all talar fractures is important to detect the subtle changes of density manifested by those fractures with normal healing and those undergoing avascular necrosis. It is necessary to follow serial anteroposterior and lateral roentgenograms of talar dome monthly during atleast 3–4 months with comparable contralateral normal roentgenogram. subchondral atrophy of the dome, appearing usually 6 – 8 weeks following fracture dislocation (Hawkins sign) indicates intact blood supply to fragment, which is usually sufficient to prevent avascular necrosis.

CONCLUSION

Most precise method of restoring and maintaining the anatomy of talus fracture is open reduction and internal fixation to allow early motion. Surgery for displaced fractures consists of anatomically correct reconstruction to avoid articular surface incongruence and angular deformity as well as preservation and rapid restoration of talar blood supply. This will ensure early mobilization and satisfactory outcome. Primary arthrodesis can be acceptable mode of treatment in severely comminuted fracture of talus which preclude acceptable internal fixation of fracture fragments. Open fractures have worse functional outcome than closed fractures owing to lower union rates, higher osteonecrosis rates and higher re-operation and infection rates. Osteonecrosis is related to initial degree of displacement of fragments (severity of fracture type) at the time of injury and / or the associated open injury. Post traumatic arthritis, particularly affecting subtalar joint appears to be more common than osteonecrosis.

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REFERENCES

1. Fortin PT, Balazsy JE. Talus Fractures: Evaluation and Treatment. J Am Acad Orthop Surg. 2001;9:114-27.
2. Stirton JB, Ebraheim NA, Ramineni SK. Medial peritalar fracture dislocation of the talar body. Trauma Case Reports. 2015;1(3):32-7.
3. Santavirta S, Seitsalo S, Kiviluoto O, Myllynen P. Fractures of the talus. J Trauma. 1984;24:986.
4. Vallier HA. Fractures of the Talus: State of the Art. J Orthop Trauma. 2015;29:385.
5. Haverkort JJM, Leenen LPH, van Wessem KJP. Diagnosis and treatment of talar dislocation fractures illustrated by 3 case reports and review of literature. Int J Surg Case Rep. 2015;16:106–11.
6. Marti R. Talus and Calcaneus frakturen. In: Frakturbehandlung bei Kindern und Jugendlichen. Weber BG, Brunner C, Freuler F, eds. New York: Springer, Berlin Heidelberg; 1978:376-87.
7. Hawkins LG. Fractures of the neck of the talus. J Bone Joint Surg (Am). 1970;52:991–1002.
8. Metzger MJ, Levin JS, Clancy JT. Talar neck fractures and rates of avascular necrosis. J Foot Ankle Surg. 1999;38:154–62.
9. Lindvall E, Haidukewych G, DiPasquale T, Herscovici D Jr, Sanders R. Open reduction and stable fixation of isolated, displaced talar neck and body fractures. J Bone Joint Surg (Am). 2004;86:2229–34.
10. Canale ST. Fractures of the neck of the talus. Orthopedics. 1990;13:1105–15.
11. Metzger MJ, Levin JS, Clancy JT. Talar neck fractures and rates of avascular necrosis. J Foot Ankle Surg. 1999;38:154–62.
12. Canale ST, Kelly FB Jr. Fractures of the neck of the talus:Long-term evaluation of seventy-one cases. J Bone Joint Surg Am. 1978;60:143-56.
13. Vallier HA, Nork SE, Barei DP, Benirschke SK, Sangeorzan BJ. Talar neck fractures:results and outcomes. J Bone Joint Surg (Am). 2004;86:1616–24.
14. Weber BG. Brüche von Knöcheln und Talus. Bewährtes und Neues in iagnostik und Therapie. Langenbecks Arch Chir. 1981;355:421-5.
15. Beck E. Die Talusfraktur. Orthopäde. 1991;20:33-42.
16. Dávid A, Muhr G, Möllenhoff G. Talusfrakturen – Therapie und Ergebnisse. In: Das obere Sprunggelenk – Angeborene und erworbene Schäden (Ed. Stahl Ch). ecomed. Fortschritte in Orthopädie und Traumatologie, Landsberg/Lech; 1996: 103-104.
17. Schulze W, Richter J, Klapperich T, Muhr, G. Funktionsergebnisse nach operativer Therapie von Talusfrakturen. Chirurg. 1998;69:1207-13.

18. Penny JN, Davis LA. Fractures and fracture-dislocation of the neck of the talus. J Trauma. 1980;20:1029-37.
19. Grob D, Simpson L, Weber BG, Bray T. Operative treatment of displaced talus fractures. Clin Orthop. 1985;199:88-96.
20. Szyszkowitz R, Reschauer R, Seggl W. Eighty-five talus fractures treated by ORIF with five to eight years of follow-up of 69 patients. Clin Orthop. 1985;199:97-107.
21. Elgafy H, Ebraheim NA, Tile M, Stephen D, Kase J. Fractures of the talus: experience of two level 1 trauma centers. Foot & Ankle Int. 2000;21:1023.

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