

Original Research Article

Treatment and evaluation of talus neck fracture

Niranjan D. Tadvi*

Department of Orthopaedics, Govt. Medical College and Sir. T. Hospital, Bhavnagar, Gujarat, India

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***Correspondence:**

Dr. Niranjan D. Tadvi,

E-mail: dr.niranjantadvi@gmail.com

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ABSTRACT

Background: Talus fractures rank second in frequency of all tarsal bone injuries and talar neck fractures account for approximately 50% of these. The purpose of this study was to evaluate clinical and radiological outcomes with a long follow-up of displaced and operatively treated talar fractures.

Methods: The study was a prospective study of ten cases of closed talar neck fracture evaluated and treated at the Department of orthopaedics, Sir. T. Hospital, Bhavnagar from 19 May 2011 to 17 March 2013. Out of ten patients, nine turned up for follow up, one was lost.

Results: Reduction was anatomical in five cases (50%), nearly anatomical in 3 cases (30%) and poor in two cases (20%). One patient (10%) developed an early superficial infection and required surgical irrigation and debridement and appropriate antibiotic treatment. Using the AOFAS ankle-hindfoot scale, the average functional score was 74.2 points. There was excellent result in one patient, good result in three cases, fair in six and no poor result found.

Conclusions: Talar neck fractures (Hawkins type 2 and 3) treated with anatomical reduction and near anatomical reduction having satisfactory clinical and functional outcome, whereas (Hawkins type 4) having fair to poor outcome with complication like AVN, arthritis and malunion due to poor initial reduction.

Keywords: Talus neck fractures, Avascular necrosis, AOFAS ankle-hindfoot scale, Hawkins type of fracture

INTRODUCTION

Fractures and dislocations of the talus and peritalar joints are uncommon. However, talus fractures rank second in frequency (after calcaneal fractures) of all tarsal bone injuries.¹ The incidence of fractures of the talus ranges from 0.1 - 0.85% of all fractures. Talar neck fractures account for approximately half of all talar fractures.² The head, neck, or body of the talus when injured can affect with normal coupled motion of these joints which results in permanent pain, loss of motion and also deformity. Nondisplaced fractures have a favorable outcome in most cases. Fracture displacement if fails to recognize can lead to under treatment and poor outcomes.¹ Displaced talar neck fractures having difficulties in gaining correct

reduction and also difficult to assess. Therefore, operative treatment is considered for all displaced fractures.

Common complications include osteonecrosis and malunion and prompt and accurate reduction minimizes their incidence and severity.¹ The use of 4 mm cortico cancellouse screws for fixation with using medial approach, postero-lateral approach and sometime combined anteromedial and anterolateral approach. Talar neck fractures are considered to have higher morbidity, being subject to avascular necrosis (AVN), arthritis and non-union of the talar fragments.³

The purpose of this prospective study was to evaluate clinical and radiological outcomes with a long follow-up

of displaced and operatively treated talar fractures. This study aimed at the following objectives.

1. Presentation of clinical and roentgenographic result that is obtained with talar neck fracture fixation and to review the result reported in literature.
2. To outline a classification useful in decision making and treatment protocol.
3. To evaluate outcome of different type of talus neck fracture.
4. To discuss the recognition and incidence of AVN and post traumatic ankle arthritis and its management.

METHODS

The study was a prospective study of ten cases of closed talar neck fracture evaluated and treated at the Department of orthopaedics, Sir. T. Hospital, Bhavnagar from 19 May 2011 to 17 March 2013. Out of ten patients, nine turned up for follow up, one was lost. For selection of case I used following criteria.

Inclusion criteria

Inclusion criteria were only displaced fracture of neck of talus; only closed fracture; Hawkin's type II, III and IV; Age from 20 to 65 years.

Exclusion criteria

Exclusion criteria were talus fracture of body, lateral or posterior process and osteochondral fractures; all open fracture; Hawkin's type I.

All patients were given primary treatment in form of below knee elevation and elevation to reduce oedema, after doing X rays and 3D CT scan in required cases. After all pre op work out, patients with fracture dislocation were operated immediately to avoid neuro vascular complication. Calcaneum st pin sketelal traction with elevation and glycerin maxef applied to reduce local oedema.

Clinical evaluation

Patients were presented with severe pain, significant swelling of the hind foot and midfoot, difficulties in movement of respected ankle. Gross deformity may be present, depending on the displacement of the fracture and any associated subtalar and ankle joint subluxation or dislocation. All were closed injuries without distal neurovascular deficiency.

Radiographic evaluation (X-ray)

This evaluation process was divided in three different types.

- Anteroposterior (AP) view,

- Lateral view,
- Oblique views of the foot and ankle.

This allows classification of the fracture and an assessment of associated injuries.

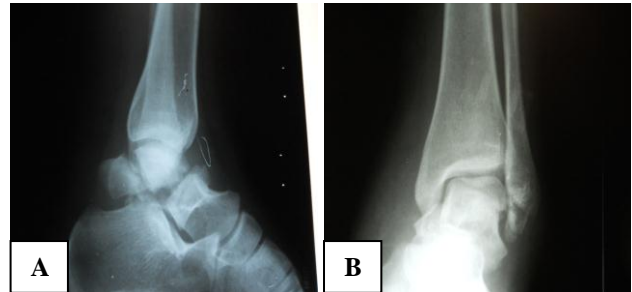


Figure 1: (A) Lateral view; (B) AP (antero-posterior) view radiographs of the entire talar body.

Canale and Kelly view

The special oblique view of the talar neck which was described by Canale and Kelly, provides the best evaluation of talar neck angulation and shortening, which is not appreciable on routine radiographs.⁴

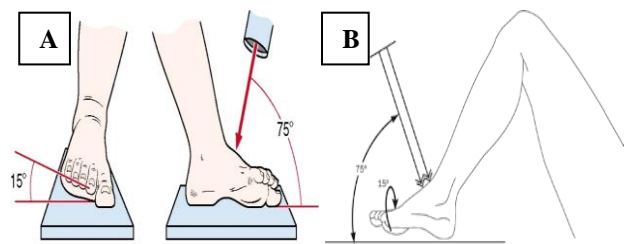


Figure 2: The Canale view, as described by Canale and Kelly, is a useful en face image of the talus used to most accurately identify step-off or malalignment in talar neck fractures.⁴ (A and B) When obtained correctly, it should correct for the 15° declination of the talus and its overlap of the calcaneus by everting and plantar flexing the foot in relation to the image machine; (C) Radiographic presentation of Canale and Kelly view.

This view should be obtained to assess initial displacement of all talar neck fractures before embarking on an operative reduction.

Computed tomography (CT scan)

CT scan is valuable for preoperatively assessing talar body injuries with regard to fracture pattern, degree of comminution, and the presence of loose fragments in the sinus tarsi.

Treatment

The goal of treatment of talar neck fractures was anatomic reduction, which to be required attention to proper rotation, length, and angulation of the neck fracture. Open reduction and internal fixation was recommended for displaced fractures.

Surgical approach

The medial approach easy access to the talar neck and is commonly used. An incision just medial to the tibialis anterior starting at the navicular tuberosity exposes the neck and can be extended proximally to facilitate fixation of a malleolar fracture or to perform a malleolar osteotomy. Surgical exposure can contribute to circulatory compromise of the talus. Care must be taken to avoid stripping of the dorsal neck vessels and to preserve the deltoid branches entering at the level of the deep deltoid ligament.

The disadvantage of the medial approach is that the exposure is less extensile than that which can be achieved along the lateral aspect of the neck. This limited exposure makes judging rotation and medial neck shortening difficult. Medial neck comminution or impaction can be underestimated; if either condition is present, compression-screw fixation of the medial neck will result in shortening and varus malalignment. In these circumstances, a separate lateral exposure allows a more accurate assessment of reduction and better fixation. The anterolateral approach lateral to the common extensor digitorum longus. Peroneus tertius tendon sheath provides exposure to the stronger lateral talar neck. A wide enough skin bridge must exist between the two incisions, and stripping of the dorsal talar neck must be avoided.

Posterolateral approach

An incision is made lateral to the heel cord in the interval between the flexor hallucis longus and peroneal muscles. This allows safe access to the entire posterior talar process. Care must be taken during exposure to avoid injury to the peroneal artery and its branches. All patients were positioned supine on a radiolucent table and a tourniquet was applied.

Manipulative reduction was always attempted initially under fluoroscopy. If the reduction was satisfactory, a percutaneous fixation with two or three K-wires (four patients) was done.

In cases of unsatisfactory reduction medial malleolar osteotomies were performed in 4 patients, (3 patients had medial malleolus fracture) via a postero-medial approach for two talar body fractures in order to increase the visualisation of the talus. Dual approaches were used in all patients in this study. All open wounds were initially debrided and irrigated according to a local protocol. No arthroscopic techniques were used in this study.

Fixation

Once the fracture has been reduced, it is provisionally stabilized with Kirschner wires. Two or three screws ss 4 mm cancellouse screw (one medial and one lateral) are inserted from posteriorly and directed anteriorly into neck and head, in 7 patients.

Where as in 3 patients treated with combined antero medial and antero lateral approach, two or three screws ss 4 mm cancellouse screw (one medial and one lateral approach) were inserted from anteriorly and directed posteriorly into body of talus. All screws were countersunk and directed along the talar axis. Mini-plates were not used and no bone grafting was used in this series.

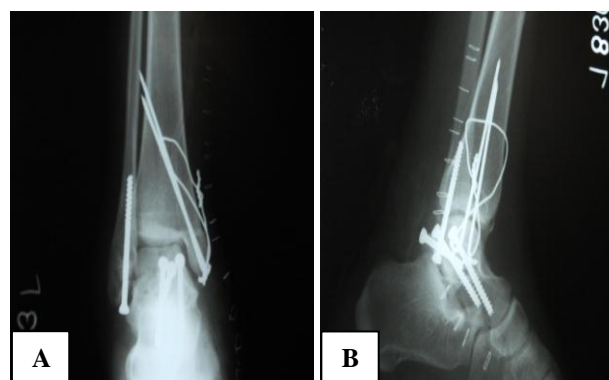


Figure 3: Postoperative radiographic images of fixation with cancellouse screw. (A) AP view; (B) lateral view.

Lag screws can be used unless there is significant neck comminution that would result in neck shortening or malalignment when the fracture is compressed. Bone graft is occasionally necessary to make up for large impaction defects of the medial talar neck, but in this study no bone grafting required. Associated fracture of lateral malleolus and medial malleolus fracture or osteotomy was treated with malleolar screw and tension band wiring (TBW).

Post-operative care

All patients were immobilised in below knee slab with elevation upto stitched removal followed by below knee non weight bearing cast in neutral alignment up to 1 and half months with allowing toes mobilization. After 2 months removed cast and started physiotherapy with non-

weight bearing. After 3 month repeat x-ray done in 6 patients' progressive weight-bearing combined with physiotherapy, where as in 4 patients after 4and half month.

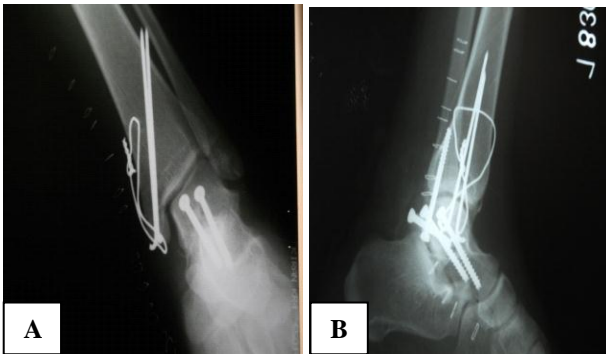


Figure 4: Postoperative radiographics images of treated with malleolar screw and tension band wiring. (A) AP view; (B) lateral view.

Post-operative evaluation

The quality of reduction was assessed on postoperative radiographs, in the anteroposterior and lateral views according to the following criteria proposed by Lindvall et al.⁵

- An anatomical reduction meant that there was no step-off at the neck or body and no frontal angulation.
- A nearly anatomical reduction was defined as a 1 mm to 3 mm step-off of any fracture fragment or slight varus angulation ($\leq 5^\circ$).
- A poor reduction was an articular or neck mismatch, a step-off or gap of >3 mm, or neck angulation of $>5^\circ$.⁵

Analysis of the subtalar joint was also used as one of the criteria to rate the quality of the reduction. Radiographs of the foot and ankle were prepared at approximately six and twelve weeks as well as six and twelve month intervals postoperatively and were used to look for a secondary displacement, time to union and avascular necrosis.

Osteonecrosis was defined on plain radiographs as any area of increased density of the talar dome relative to the adjacent structures (Hawkins sign).^{6,7} At final follow-up, anteroposterior, lateral and mortise radiographs were prepared. Hindfoot alignment was measured and was categorized as following.⁸

- Normal between 4° and 8° of valgus.
- A varus malunion if the angle was inferior to 4° of valgus.
- A valgus malunion if the angle was superior to 8° of valgus.

Post-traumatic osteoarthritis

Post-traumatic osteoarthritis was defined as any loss of joint space, formation of osteophytes, or development of subchondral sclerosis or cysts. Those joints were affected by osteoarthritis (subtalar, tibiotalar talonavicular joint) were noted.

At final follow-up, range of motion (ROM) was assessed with a goniometer, and the American orthopaedic foot and ankle society (AOFAS) ankle-hindfoot score was also determined.⁹ This scoring system classified the evaluated items into three major categories: pain, function and alignment.

In this scale, 50 points were assigned to function, 40 points to pain, and 10 points to alignment.^{8,9}

Usually, the scoring system is divided as following.

- Excellent : 90 and 100
- Good : 75–89
- Fair : 50–74
- Poor : <50

The subtalar joint mobility was evaluated with the ankle in the neutral position.

- Normal or mild restriction (75–100% normal) = 3 points,
- Moderate restriction (25–74% normal) = 2 point,
- Severe restriction (less than 25% normal) = 1 point.

Results of the study were presented in Mean \pm SD or numbers and percentages. The values were entered in MS Excel and statistical values were calculated.

RESULTS

The minimum follow-up was 24 months with an average follow-up of 36 months. Reduction was anatomical in five cases (50%), nearly anatomical in 3 cases (30%) and poor in two cases (20%). One patient (10%) developed an early superficial infection and required surgical irrigation and debridement and appropriate antibiotic treatment.

Two patients presented an initial lack of reduction, one of these patients underwent a second surgery to improve the reduction (on the second day) and the other has not been revised. There was no skin necrosis and nonunion was not observed. There was no reflex sympathetic dystrophies and deep vein thrombosis observed.

Avascular necrosis (AVN) of the talus one patients (10%) presented an osteonecrosis of the talus, occurred in type IV talar neck fracture with poor initial reduction (Table 1).

Table 1: Patients data.

Pt. No.	Age/ Sex	Hawkins type of fracture	Initial Reduction	Early complication	Indication of secondary surgery	Secondary surgery	Hindfoot alignment	AOFAS score
1	F/44	III	Near Anatomical				4° valgus	71
2	F/35	IV	Poor	Initial Lack of reduction	AVN	TT arthrodesis	N/A	57
3	M/56	III	Anatomical				0° valgus	89
4	M/32	III	Anatomical		Stiffness	Arthrolysis	2° valgus	74
5	M/52	IV	Near Anatomical				3° valgus	67
6	F/38	II	Anatomical	Superficial infection			0° valgus	90
7	M/37	III	Near Anatomical				3° valgus	78
8	M/46	III	Anatomical				2° valgus	85
9	F/29	IV	Poor	Initial Lack of reduction	Arthritis and malunion	ST arthrodesis	6° valgus	58
10	M/54	III	Anatomical				2° valgus	73

The radiographic finding of osteonecrosis was made within the first six months after injury, no signs of revascularisation were seen, and these patients needed secondary surgery (10%), in form of tibio talar arthrodesis (Table 1). One patient (10%) required an ankle arthrolysis at ten months due to stiffness in ankle joint. Subtalar arthritis occurred in type IV talar neck fracture with poor initial reduction in one patient (10%) (Table 1).

Malunion with hindfoot alignment 6° varus and subtalar arthritis occurred in type IV talar neck fracture with poor initial reduction in one patient (10%) (Table 1). The fracture type (type IV), the quality of the initial reduction also significantly influenced the malunion rate.

Using the AOFAS ankle–hindfoot scale, the average functional score was 74.2 points (range 57–90 points). There was excellent result in one patient, good result in three cases, fair in six and no poor result found.

Table 2: Statistical description of patients (n=10).

Variable	Number/Mean±SD
Age (years)	42.3±9.53
Sex	
Males	6 (60%)
Females	4 (40%)
Hawkins classification	
Hawkins I	0
Hawkins II	1 (10%)
Hawkins III	6 (60%)
Hawkins IV	3 (40%)
Quality of reduction	
Anatomical reduction	5 (50%)
Nearly anatomical reduction	3 (30%)
Poor reduction	2 (20%)
Postoperative AOFAS score and classification	74.2±11.65
Excellent	1 (10%)
Good	3 (30%)
Fair	6 (60%)
Poor	0

DISCUSSION

Talar neck fractures classically result from high-energy trauma to the lower extremities such as that which occurs in airplane crashes, motor vehicle accidents or falls from a height.¹⁰ The most commonly proposed mechanisms are an excessive ankle dorsiflexion with a cantilever effect for the talar neck fracture and an axial compressive load for the talar body fractures.^{10,11} The management of these fractures is complex and there is a high complication rate. Undisplaced talar neck or body fractures are treated conservatively in most cases with very good results. However, for displaced fractures, open reduction and internal fixation is the rule for most authors.^{5,12}

In this study of displaced talar neck fractures, a fast and slightly aggressive operative treatment was preferred to avoid wound complications and avascular necrosis. However, one case of AVN (10%) and two cases of initial lack of reduction (20%) and only 50% anatomical reduction were noted. For a better initial reduction, some authors recommend a dual anteromedial and anterolateral approach. This dual approach is sometimes associated with a medial malleolar osteotomy.¹³ This technique permits good visualisation of the talus but increases the risk of skin necrosis or infection (10–20% depending on authors) and increases the duration of surgery.^{13,14}

Avascular necrosis is a common complication after talar fractures. Recent studies reported, the osteonecrosis rate was variable from 11–50% and all authors agreed that initial degree of fracture displacement was an important risk factor for osteonecrosis.^{5,10,15} The surgical delay also seems important and most authors recommended urgent reduction and stabilisation of displaced talar fractures.^{5,7}

Risk of mostly varus malunion is a complication in this fracture type. This risk is mainly influenced by the initial quality of reduction or the fracture type but also by the osteosynthesis technique. For talar neck fractures, Juliano et al insisted on the restoration of the talar length and particularly the medial side; they recommended avoiding compression screwing across an area of comminution at the origin of a talar neck shortening.¹⁶ Similar result with one case of varus malunion with compression screws was observed in this study.

The lack of good or excellent results may be explained by the exclusion in this study of the undisplaced fractures because such fractures have an excellent prognosis. The majority of the talar surface is articular cartilage.¹⁶ This explains the high risk of osteoarthritis after a talar fracture. Many authors revealed a relationship between hindfoot misalignment or osteonecrosis and osteoarthritis.¹⁶ However, arthritis of the ankle and subtalar joint can occur in the absence of osteonecrosis or joint incongruity.

When avascular necrosis is limited or for isolated tibiotalar arthritis with major collapses of the talar dome

requires a tibiotalar or tibiotalar calcaneal arthrodesis. The site and number of joints for surgical arthrodesis must be decided in each individual case. In the same way, arthrodesis may be considered for symptomatic arthritic joints if conservative treatment is not sufficient.¹

In order to optimize the initial reduction and to decrease the rate of malunion, a single approach could be used with the help of new fluoroscopic systems. Indeed, some fluoroscopic systems can generate 3D images directly in the operating room.¹⁷ An arthroscopy can help with anatomical reduction of those fractures but it requires a well-trained surgeon.

CONCLUSION

Talus fractures often present as complex injuries. Optimal diagnosis and management require a thorough understanding of the osseous anatomy and the vascular supply of the talus. Fractures with significant displacement or associated dislocation require urgent reduction to afford the best outcome.

Talar neck fractures have been associated with a high incidence of complications, including osteonecrosis, infection, skin necrosis, malunion, nonunion, and posttraumatic arthritis. The high-energy nature of the injury required to produce a displaced talar neck fracture also causes severe associated soft tissue damage, including damage to the precarious blood supply.

Anatomic reduction and internal fixation of displaced neck fractures to restore and to maintain alignment has a key role in minimizing the complications rate. However, the sequelae of post traumatic complications may be inevitable. Even in the absence of osteonecrosis following anatomic fracture reduction and fixation, patients frequently experience chronic pain and stiffness due to posttraumatic arthritis.

In this study talar neck fracture (Hawkins type 2 and 3) treated with anatomical reduction and near anatomical reduction having satisfactory clinical and functional outcome, whereas (Hawkins type 4) having fair to poor outcome with complication like AVN, arthritis and malunion due to poor initial reduction.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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