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## A case series: Talus neck fractures treated with open reduction and internal fixation with dual approach- anteromedial and anterolateral

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### Abstract

**Background:** Talus neck fractures are rare but potentially devastating injuries, which require a comprehensive understanding of its anatomy, blood supply, fracture classification and management.

**Materials and Methodology:** This was a prospective study of 8 cases of closed displaced talus neck fractures, managed at Sheth L.G. hospital. We used Modified Hawkins classification to classify fracture pattern, treated with open reduction internal fixation and outcome was evaluated with help of two parameters: functional and radiographical.

**Results:** We found an average score of 81 points out of 100 (good) using AOFAS Ankle-hindfoot scale after 1 year follow-up. While two out of eight patients developed osteonecrosis of talus which was visible in their 1 year follow up x-rays.

**Conclusion:** We can conclude that dual approach- antero-medial and antero- lateral to the displaced talus neck fracture, allows full visualization of the fracture and anatomical reduction, which results in good functional outcome.

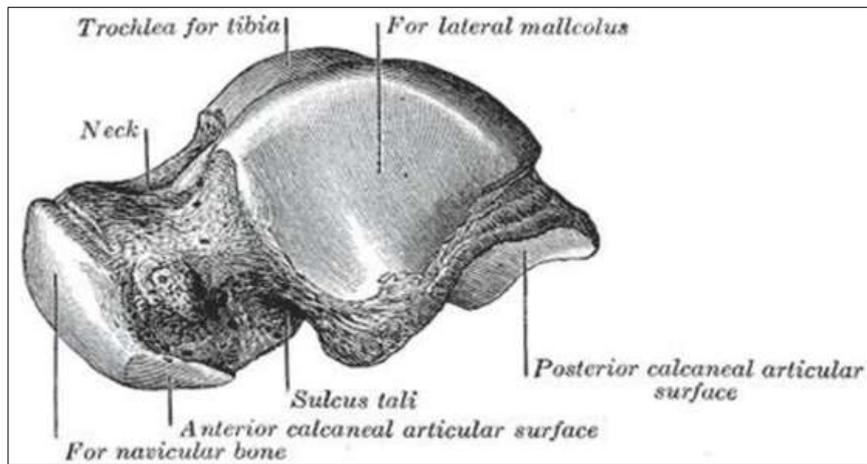
**Keywords:** Talus neck fractures, modified hawkin classification, dual approach, osteonecrosis

### Introduction

Fractures of the talus are rare, an incidence ranging from 0.1 – 2.5% of all fractures, out of which fractures of the neck of the talus are most common and accounting for 50% of all talus fractures [1, 2]. The mechanism responsible for this injury is forced dorsiflexion of the foot, which drives the weak trabecular bone of the neck of the talus against the stronger anterior tibial plafond which occur after high-energy trauma such as a fall from a height or motor vehicle accident [3, 4, 5]. Non-displaced talus neck fractures have a favorable outcome in most cases but displaced talus neck fractures having difficulties in gaining correct reduction and also difficult to assess. Therefore, operative fixation has been recommended with the use of screws and/or plate using antero-medial, antero-lateral and/or dual approach [6]. The infrequency of these injuries is in part responsible for the historically poor outcomes and high rate of complications like osteonecrosis and post-traumatic arthritis as there was lack of data to guide treatment [7]. This prospective study will focus on the current understanding of the surgical anatomy, classification, imaging, and use of dual approach for reduction and internal fixation of talus neck fractures.

### Surgical Anatomy

The talus is 60% to 70% covered in articular cartilage. It has no muscular attachments and articulates with adjacent bony structures via capsulo-ligamentous restraints. It is anatomically divided into 3 main structures: the body, the neck, and the head, as well as two processes: the lateral and posterior processes.

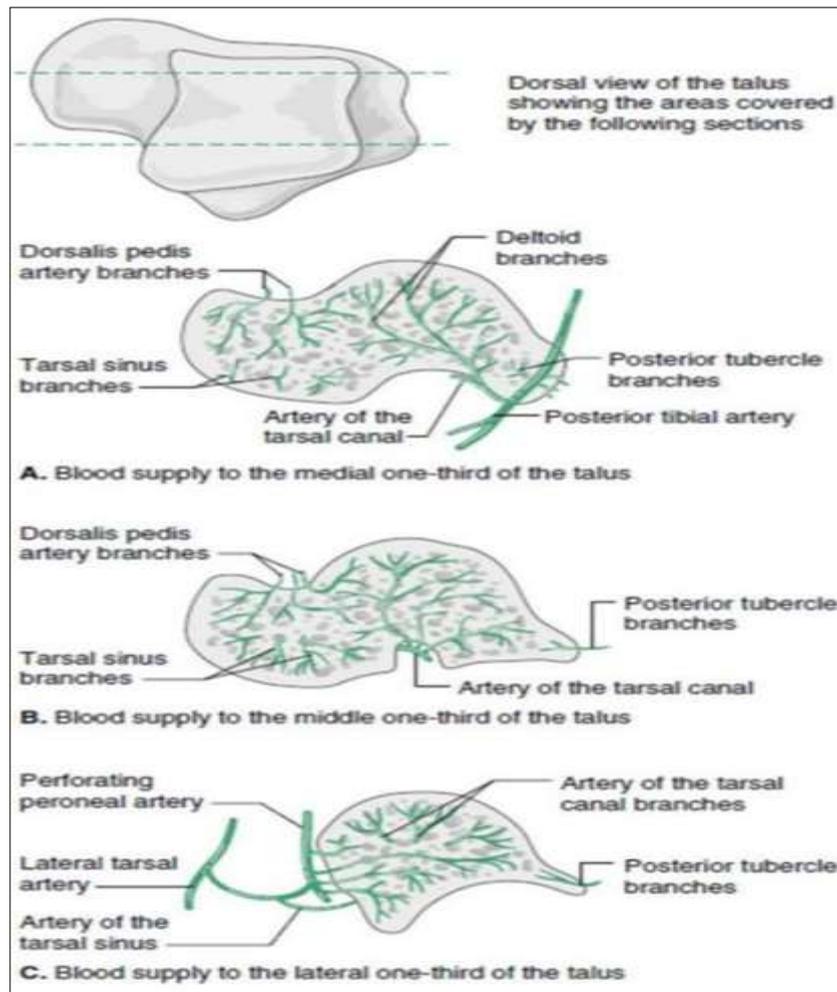


**Fig 1:** Anatomy of talus [9]

**Blood supply of Talus**

The talus has a rich network of extra- and intra-osseous anastomoses that is vulnerable to disruption from trauma. The extra-osseous blood supply of the talus comes from three arteries including the anterior tibial, posterior tibial, and peroneal artery. The head and neck of talus is supplied by the dorsalis pedis

artery and the artery of the tarsal sinus which branches from peroneal artery. The talus body is supplied by the artery of tarsal canal and deltoid artery, which are branches of posterior tibial artery and the artery of the tarsal sinus. The posterior tubercle of the talus supplied by direct branches from posterior tibial artery.



**Fig 2:** Blood supply to the talus [8]

**Materials and methodology**

We treated 12 patients of talus neck fractures, out of them we included 10 patients who were fulfilled following inclusive and exclusive criteria. They were treated with dual approach and internal fixation at Department of Orthopedics, Sheth

L.G. Hospital, Ahmedabad from 1<sup>st</sup> May, 2019 to 31 May, 2021. Out of 10 patients two were lost on follow up.

**Inclusion criteria**

1. Closed talus neck fractures

2. Adult age group (18-50 years)
3. Type II, III, IV displaced talus neck fracture according to Modified Hawkins Classification.

#### Exclusion criteria

1. Open talus neck fracture
2. Talus body fracture or lateral / posterior process fracture.
3. Type I non-displaced talus neck fracture according to Modified Hawkins Classification.
4. Previous h/o fracture on same limb.

All patients were presented with severe pain and swelling of the hind foot and midfoot, difficulties in movement of ankle. Gross deformity seen in one patient, which was associated sub-talar and ankle joint subluxation. Two patients were associated medial malleolus fracture. All cases were closed injuries without distal neuro-vascular deficiency.

We advised initial radiographic views, which include antero-posterior (AP), lateral and mortise views of the foot and ankle. We had used Modified Hawkins Classification system to classify talus neck fractures based on lateral radiographs. Additionally we advised 3D CT-scan for better understanding of fracture pattern and it's displacement in few cases.



**Fig 3:** A case of 20 years old male admitted with right side closed Hawkin's type III talus neck fracture associated with medial malleolus fracture.

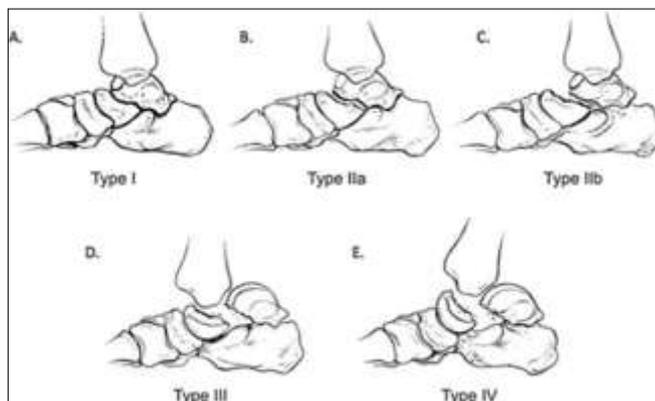


**Fig 4:** Canale and Kelly described a view to assess the alignment and degree of comminution of the talus neck [5].

#### Modified Hawkins Classification

The most commonly used classification system for talus neck fractures was originally described by Hawkins and later modified by Canale and Kelly [3].

- a) Type I- Non-displaced talus neck fracture
- b) Type IIA- Talus neck fracture with subtalar subluxation
- Type IIB- Talus neck fracture with subtalar dislocation
- c) Type III- Talus neck fracture with subtalar and tibiotalar dislocation
- d) Type IV- Talus neck fracture with subtalar, tibiotalar and talonavicular dislocations.



**Fig 5:** Modified Hawkins classification system for talus neck fractures [17].

All patients were given primary treatment in form of below knee slab and elevation to reduce edema, after doing radiographs. Open reduction with dual approach and internal fixations were used for these fractures.

Antero-medial approach was used to make an incision medial to the anterior tibial tendon. This incision could be extended proximally if a malleolar osteotomy was required, or in the presence of a medial malleolar fracture that required operative fixation after talus fixation.



**Fig 7:** Antero-medial approach

The antero-lateral approach was taken between the tibia and fibula and in line with the fourth ray, just lateral to the extensor digitorum longus. This approach allowed anatomic reduction of the lateral talus neck.

When this incision is used in conjunction with the antero-medial approach, it is important to maintain an adequate skin bridge to avoid skin necrosis. Dissection of deltoid ligament, inferior to neck and sinus tarsi should be avoided to maintain the vascular supply of the talus neck.



**Fig 8:** Antero-lateral approach

Provisional reduction of the fracture was done with the help of Kirschner wire. Anterior-to-posterior headless lag screws (two medial and/or one lateral) were inserted. They were directed posteriorly into the body from adjacent to the articular surface of the talus head. All screws were countersunk and directed along the talus axis. Mini plates were not used and no bone grafting was used in any case. Associated fracture of medial and lateral malleolus fracture or osteotomy was treated with the screws or tension band wiring.



**Fig 9:** Immediate post-operative x-ray

### Post-Operative Evaluation

Early range of motion encouraged once the slab was removed. Below knee slab with elevation advised for 4-6 weeks. The patients were advised to start range of motion exercise in non-weight-bearing until there was evidence of sufficient healing on radiographs, typically between 6 weeks and 3 months after injury. After 3 month repeat x-ray was done in all patients then they were advised to start partial to full weight-bearing combined with physiotherapy.

At final follow-up after 1 year, range of motion (ROM) was assessed with a goniometer and the American orthopaedic

foot and ankle society (AOFAS) ankle-hindfoot score was also determined for all 8 patients. In this scale, 50 points were assigned to function, 40 points to pain, and 10 points to alignment.

Usually, the scoring system is divided as following.

Excellent: 90 and 100;

Good: 75–89;

Fair: 50–74;

Poor: <50.

### Result

Results of the study were presented in numbers and percentages.

Reduction was anatomical in six cases (75%) and nearly anatomical in two cases (25%). One patient developed an early superficial infection and required surgical irrigation and debridement and appropriate antibiotic treatment. There was no skin necrosis observed.

Two patients (25%) presented with x-ray changes suggestive of osteonecrosis (ON) of the talus (Hawkins sign) with no clinical symptoms. Malunion, nonunion and subtalar arthritis was not observed in any of these patients.

Using the AOFAS ankle-hindfoot scale, the average functional score was 82.5 points (range 72–90 points). There was an excellent result in two patients, good in five patients, fair in one and no poor result found.

**Table 1:** The following table shows the details and results of the cases which were studied:

S. No.	Age & Gender	MOI	Fracture type	Associated Injury	Injury to surgery time	Immobilization time	Approach	Result-After 1 year (Ankle-Hind foot scale)	Complications (After 1 year)
1	20-M	RTA	Type III	Medial malleolus fracture	2 days	8 weeks	Dual (AM-AL)	86	Osteonecrosis
2	26-M	RTA	Type II-B	No	3 days	6 weeks	Dual (AM-AL) + Medial malleolus osteotomy	80	NIL
3	30-M	FFH	Type II-A	No	1 day	6 weeks	Dual (AM-AL)	90	NIL
4	25-M	FFH	Type II-A	No	2 days	6 weeks	Dual (AM-AL)	87	NIL
5	45-M	RTA	Type III	NO	1 day	8 weeks	Dual (AM-AL)	77	NIL
6	22-M	FFH	Type II-A	NO	2 days	6 weeks	Dual (AM-AL)	88	NIL
7	30-M	FFH	Type II-A	NO	1 day	6 weeks	Dual (AM-AL)	80	NIL
8	35-M	RTA	Type IV	Medial malleolus Fracture	1 day	10 weeks	Dual (AM-AL)	72	Osteonecrosis

RTA – Road Traffic Accident

FFH – Fall From Height

AM-AL – Antero medial-Antero lateral



**Fig 10:** A year follow up x-ray and clinical photographs.

### Discussion

Talus neck fractures classically result from high-energy trauma such as in the motor vehicle accidents or falls from a height. The most commonly proposed mechanisms are an excessive ankle dorsiflexion and an axial compressive load. The management of these fractures is complex and there is a high complication rate [11, 12].

Advanced imaging with CT scan was recommended in talus neck fractures. The disadvantage of Antero-medial approach is that the exposure is less extensile which makes difficult to judge rotation and medial neck shortening. In these circumstances, a separate antero-lateral exposure allows a more accurate assessment of reduction and better fixation. Thus we used dual antero-medial and antero-lateral approaches for full visualization of the talus neck. The common complications after talus neck fracture fixation were osteonecrosis (ON), post-traumatic arthritis (PTA), mal-union (Varus), non-union, skin necrosis and deep soft tissue infection [13, 14].

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. The surgical delay also seems important and most authors recommended urgent reduction and stabilization of displaced talus neck fractures [9, 20].

Risk of varus malunion is a complication in this fracture type. This risk is mainly influenced by the the fracture type, initial quality of reduction and the osteo-synthesis 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 [22].

Arthritis of the ankle and subtalar joint can occur in the absence/presence of osteonecrosis. For isolated tibiotalar arthritis with or without collapses of the talar dome requires a tibiotalar or tibiotalocalcaneal arthrodesis. The site and number of joints for surgical arthrodesis must be decided in each individual case and considered for symptomatic arthritic joints if conservative treatment is insufficient.

In this study of displaced talus neck fractures, a fast and slightly aggressive operative treatment was preferred to avoid avascular necrosis (AVN) and post-traumatic arthritis (PTA). However, one case superficial infection and two cases of AVN (25%) were noted.

Rate of complications like are dependent on the fracture type (Hawkins classification) but, not associated to functional outcome of the patient as documented in Talus Fractures: Evaluation and Treatment; Paul T. Fortin, MD, and Jeffrey E. Balazsy, MD [6].

**Table 2:** Complications following Talus Neck Fracture

Fracture type	Osteonecrosis	Post-traumatic arthritis	Malunion
Type I	0%-13%	0%-30%	0%-10%
Type II	20%-50%	40%-90%	0%-25%
Type III/IV	8%-100%	70%-100%	18%-27%

### Conclusion

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. Using dual antero-medial and antero-lateral surgical approaches, we can minimize post-operative complications like loss of reduction, malunion, nonunion, osteonecrosis and post-traumatic arthritis.

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