

## OUTCOMES OF OPEN REDUCTION AND INTERNAL FIXATION OF FRACTURE OF NECK OF TALUS

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### ABSTRACT

**Background:** Talus is the second largest tarsal bone with unique importance regarding its location and anatomy. Almost 70% surface of talus is covered with articular cartilage. Its blood supply is predominantly extraosseous and is at risk during fractures.

**Objective:** To observe the long-term outcomes after surgical treatment of fracture neck of talus.

**Methods:** This is prospective cross-sectional study conducted at Department of Orthopedic Surgery Services hospital, Lahore during Dec 2017 to Feb 2020. After approval from hospital ethical review board, total number of 30 patients with fracture neck of talus, both males (20 patients) and females (10 patients) were included in the study. Each patient underwent X-rays of ankle joint AP, LAT and ankle mortis views. All these fractures were fixed with 4 mm cannulated screw by using combined anterolateral and anteromedial approach.

**Results:** Post-traumatic arthritis was observed in 15 patients (50.0%) out of the 30 patients with 10 (75.0 %) patients at subtalar joint and 5 (25.0 %) patients at ankle joint. Among these 30 patients, 8 (26.7%) patients were having Hawkins type 2, 14 (46.6%) with Hawkins type 3 and remaining 8 (26.7%) patients with were having Hawkins type 4 fractures. Osteonecrosis was mostly observed in Hawkins type 3 fractures 6 (42.8%) in Hawkins type 3, 2 (25.0%) patients in Hawkins type 2 fractures and 1 (12.5%) patient in Hawkins type 4 fractures. 1 (3.3 %) patient developed non-union and 1 (3.3 %) patient developed delayed union. 4(13.3 %) patients developed the superficial infection which was treated with IV antibiotics and wound irrigation.

**Conclusion:** We concluded from our study that familiarity with the complex vascular, bony, surgical anatomy and techniques for rigid fixation of fractures is of utmost importance for fracture neck of talus. Rate of osteonecrosis, arthritis, mal-union and non-union are still high even in the presence of rigid internal fixation of these fractures

**Key Words:** Fracture, neck of talus.

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### INTRODUCTION

Talus is a critical bone for normal function of ankle, subtalar and talonavicular joint. <sup>1,2</sup> Fracture of neck of talus is a rare injury. It accounts for 3-6 % of foot fractures. <sup>3</sup> The incidence of talus fractures is 0.1 - 0.85 % among all fractures. It is potentially a devastating injury that requires the comprehensive understanding of the

osteology, vascularity and surgical anatomy of talus so that the proper treatment could be devised.<sup>4</sup> Talus fracture are second most common tarsal bone fracture after the calcaneus, mostly these fractures occur at the level of neck in about 50% of the cases while 20% of the fractures occur at the body and remaining accounts for avulsion fracture. Injury to neck of talus can interfere with the normal biomechanical functions of these joint and result in loss of stability with the resultant deformity at the ankle joint.<sup>5</sup>

Fracture of neck of talus usually occur a result of high energy trauma such as fall from height or motor vehicle accident particularly in motor cyclists resulting in hind foot injury.<sup>6</sup> Sports injury including snowboarding can also result in fracture of the talus. The mechanism of injury is forced hyperextension of foot during the axial loading. During this event, neck of talus impinges against the anterior tibia resulting in fracture neck of talus. If this force continues, the body of talus is dislocated postero-medially. In 19 - 28 % of cases the medial malleolus is also fractured,<sup>7</sup> 20 – 30 % of the patients have open fractures<sup>8</sup>, while 50 % of multi-trauma patients also have associated fracture of talus.<sup>9</sup>

Talus is a saddle shaped bone being the second largest bone of hind foot after calcaneus. It is comprised of head, neck, body and two processes (posterior and lateral). It transmits the weight bearing forces from the leg to the foot. No muscles are attached directly on the talus but lot of ligaments are attached to the Talus which provide the stability to the ankle, subtalar to talonavicular joint. Talus has got a limited blood supply. Its blood supply comes from the posterior tibial artery, from dorsalis pedis artery and from the peroneal artery. Dorsalis pedis artery is the sole blood supply of neck of talus. Posterior tibial artery is an important primary blood supply of the dome of talus i.e; artery of tarsal canal comes from it and it must be protected from damage during the surgery. Anterior tibial artery provides branches to the talar head and dorsal aspect of the neck while peroneal vessels provide blood supply the tarsal sinuses. It forms the vascular sling with the artery of tarsal canal. The blood supply of talar neck is mostly extraosseous and is disrupted during fracture or dislocation resulting in osteonecrosis of the talus<sup>10,11</sup>. The most of the surface (70%) of talus is covered with articular cartilage and this is the reason that osteoarthritis is most common at the ankle joint particularly at the subtalar joint.<sup>12</sup>

The main goals of treatment of fracture of neck of talus are to restore the biomechanical stability of hind foot after anatomical reduction of fracture of Talar neck. If displacement of fracture at the neck talus is more than 2 mm, it changes the biomechanics of subtalar joint resulting of arthritis of this joint.<sup>13</sup> If fracture of neck of talus is displaced, it must be treated immediately with open reduction and internal fixation of the fracture.<sup>14</sup> If the impact of trauma is such that it results in dislocation of the

talus, it must be reduced immediately to save the soft tissue and protect the blood supply to the talus.

Regardless of the fracture pattern, if there is skin compromise by the talar neck fracture, it must be treated operatively.<sup>5</sup> A lot of surgical approaches are available to treat talus fracture depending on the experience of the surgeon and fracture pattern. During the surgery injury to the ligaments should be avoided. Talus can be approached antero-laterally, antero-medially, postero-laterally, postero-medially and direct approach to the talus.<sup>15</sup> A combination of either anteromedial and anterolateral approach for reduction and temporary fixation for fracture of talus can be used<sup>16</sup>, followed by screw insertion from posterior to anterior direction to fix these fractures or from anterior to posterior.

Fixation can be achieved with cannulated screws, malleolar screws, K- wires and AO cancellous screws under image intensified. Fracture of neck of Talus can also be fixed with spring plates or with mini fragments plates with or without bone grafts. Unless the fracture is displaced, they can be missed on simple radiographs particularly in patients with polytrauma. The delay in treatment of these fractures result in compromised outcomes, stressing upon the significance of early management of these fractures.<sup>17, 18</sup> Occult injury to talus should be suspected when there is swelling and ecchymosis of foot and ankle joint. In these cases, in addition to routine X- rays, CT scans should be done to know the geometry of fracture.<sup>9</sup>

The objective of our study is to observe the long-term outcomes after surgical treatment of fracture neck of talus.

## METHODS

This prospective observational study was conducted at Department of Orthopaedic surgery, Services hospital Lahore from Feb 2018 to Feb 2020. After approval from the Ethical review board, a total number of 30 patients both males and females with age range of 16-60 years (Mean 32+- 15) were included in the study. There were 20 males and 10 females having fracture neck of Talus. All these patients were admitted through emergency department of this hospital. A written consent was taken from each patient. Each patient underwent X-rays of the ankle joint both AP, Lateral views and Ankle Mortis view. After the X-rays we applied above the knee backslab to each patient on the affected leg. (A lot of classifications are present to assess the fracture of neck of talus like Hawkin's, Sneppin, AO classification, Canale and Kelly classification and SOO classification.<sup>19</sup> In Hawkin's type 1 ( 0 – 10 % ), in Hawkin's type II ( 20 – 50 % ), in Hawkin's type III & IV ( 100 % chances of AVN). Modified Hawkin's classification was used to classify the fracture of neck of talus. Among 30 patients, 4 patients had associated fracture of medial malleolus and 10 patients

had open fractures. Patients with polytrauma, with age less than 16 years and patients with associated head and spine injury were excluded from the study. After fitness of patient regarding the anesthesia, each fracture was provisionally fixed with K-wires and after that was fixed

with 4 mm cannulated screws from anterior to posterior position. This procedure was done through anterolateral and anteromedial approach for reduction and fixation of talar neck fractures.



Fig 01: Open reduction and internal fixation for fracture neck of talus

## RESULTS

Among 30 patients, 8 patients were having Hawkins type 2 fractures, 14 with Hawkins type 3 fractures and 8 patients with Hawkins type 4 fractures. 20 patients had closed talar neck fractures while 10 patients had open fractures. Post-traumatic arthritis was detected in 15 patients, in 10 patients at subtalar joint and remaining 5 patients it was at ankle joint. Among these 15 patients, 3 patients had Hawkin's type II fractures, 9 with Hawkin's type III fractures and the remaining 3 patients had Hawkin's type IV fractures. In these patients, 6 patients had comminution at the fractures site while 9 patients had open fracture. Among the 10 patients who had subtalar arthritis, 6 patients underwent subtalar arthrodesis, while two patients underwent Blair Tibio-Talar arthrodesis after 12 months and in 01 patients triple arthrodesis was done. One patient out of 30 patients had non-union after 6 months postoperatively because of deep infection. This patient also developed osteonecrosis with collapse of talar dome. Infection was treated with wound irrigation and IV antibiotics but ultimately this patient ended up in subtalar arthrodesis. One patient developed delayed union (Hawkin's type III). Here the fractures united 5 months after the initial surgery.

Osteonecrosis was seen mostly in Hawkin's type III injury and in comminuted fractures. It was seen in 02 patients

with Hawkin's type II fractures, in 6 patients with Hawkin's type III Talar neck fractures and in 01 patients with Hawkin's type IV fractures. (Table no:1). Among these 9 patients, 6 patients showed sign of revascularization after 20 – 24 weeks. All these 6 patients were followed for 6 months after return of normal bone density. Remaining 3 patients developed collapse of talar dome 30 weeks after the surgery (24 -30 weeks,  $p < 0.05$ ).

Among 10 patients who had open fractures, 4 patients got infection which was superficial one. It was treated with continuous irrigation and IV antibiotics. There was no recurrence of infection in all these 4 patients after 06 weeks of treatment.

Foot function index was worst in patients with comminution at the fracture site. It was worst in 2 patients (disability index = 37.7, pain = 26, activity =21  $p < 0.03$ ), which was significant. It was moderately deranged in 8 patients. The mean standard musculoskeletal function assessment was 26 comparing with the uninjured patients with hind foot problem (as published reference value is 9.3). Greater level of disability was present in our 10 patients. All these 8 patients had comminution at the fracture site which adversely affected the MFA score ( $p < 0.002$ ). (Table no: 2) 20 patients returned to their original jobs (66.7%), 08 (26.7%) patients had to modify their jobs and 02(6.6%) patients changed their jobs.

Table 1: Complications of fracture Neck of Talus

Complication n = 30	Complications		Complications according to Hawkins Classification		
	No	Yes	Type II (n = 8)	Type III (n = 14)	Type IV (n = 8)
OSTEONECROSIS	21 (57.1%)	9 (42.9%)	2(22.2%)	6 (66.6%)	1(11.2%)
ARTHRITIS	15 (50.0%)	15 (50.0%)	3(20.0%)	9 (60.0%)	3(20.0%)
DELAYED UNION	29 (96.6%)	1 (3.4 %)	0 (0.0 %)	1(100.0%)	0 (0.0 %)

Table 2: Foot Function Index Scores and Musculoskeletal Function Assessment Score among comminution.

Foot Function Index Scores					P value	Musculoskeletal Function Assessment Score	P value
Comminution	Disability	Pain	Activity	Total			
Yes	37.2	26.0	21.0	28.4	P=0.03	26.0	P=.002
No	25.3	13.3	11.4	15.6			

At follow up, early ROM were encouraged once the slab was removed usually at 4-6 weeks. Each patient was followed on the day after the surgery, at 06 weeks, 03 months, 06 months and thereafter at 01-year, 1.5 year and finally after 02 years. At each follow up, every patient underwent X-rays of ankle joint AP view, Lateral view and Ankle Mortis view. Patients were allowed protected weight bearing after 09 weeks and full weight bearing was started after 03 months. During these follow up each patient was assessed for non-union, malunion, osteonecrosis, osteoarthritis and infection.

Assessment of foot function was done with foot function index which is a specific lower extremity outcome index. It is consisted of pain score (81 points), disability (81 points) and activity (45 points). Total score was taken as the average of these scores i.e; higher the score, greater is the derangement of function of foot.

Musculoskeletal function assessment ranges from 0-100, higher the score, lower the level of overall function of foot. The MFA was affected by Hawkins type, comminution at the fracture site and in open fractures.

Data was entered and analyzed in SPSS Ver:27.0. The predictive variables were fracture type, fracture comminution and Hawkin’s type. The clinical outcomes were osteonecrosis, post traumatic arthritis and collapse of dome of Talus. Functional outcomes, FFI and MFA score were assessed by Student t-test.

**DISCUSSION**

Talus has got peculiar anatomy. It is located in between tibia, fibula, calcaneus and the navicular bone. Despite of the relative infrequency of talar neck fractures, a lot of efforts have been made for better understanding of the nature and outcomes of this injury as well as best possible treatment.<sup>17,19</sup> Surgical focus should be anatomical

reduction and fixation of these fractures with restoration of the anatomy of peri-talar joints.<sup>20</sup> Most of the studies follow the dual approach (anteromedial and anterolateral) to fix these fractures.<sup>15</sup> 4 mm cannulated screws were inserted from anterior to posterior positions in a divergent way for fracture neck of talus.<sup>9</sup>

Fracture neck of talus results from high energy trauma such as motor vehicle accidents or fall from height.<sup>6</sup> The most common mechanism is fracture dislocation at the ankle joint with anterior surface of tibia causing compressive load at neck of talus.<sup>12</sup> The management of these injuries are complex and is associated with high complication rate. For displaced fracture neck of talus, open reduction and internal fixation of these fractures is the rule adopted by most of the orthopedic surgeons.<sup>20</sup> Risk of AVN by most of the studies is 10-50 % depending on the Hawkin’s type and fracture comminution.<sup>11,15</sup> In our study it was 30%.

A lot of studies have been conducted to fix the talar neck fractures with cannulated screws. All these studies have comparable results with our study regarding the malunion, non-union, osteonecrosis, post traumatic arthritis and infection rate.<sup>1,2,8</sup>

Asham L.S et al. concluded from their study that fracture comminution and dislocation of talus is associated with osteonecrosis. Injury to the skin also confirms that high energy trauma result in more complication and has got worst prognosis. They recommended the rigid internal fixation of fracture neck of talus after the soft tissue swelling subsided. It results in less complication rate.<sup>10</sup>

Tadvi ND in his study regarding 10 fractures of talar neck came to the conclusion that Hawkins type 2 and type 3 fractures had satisfactory clinical and functional outcomes while type 4 fractures had poor results due to poor reduction.<sup>5</sup>

In his study for 8 cases of Talar neck fractures treated with open reduction and internal fixation Dr. Raghav noted 25 % avascular necrosis. The average AOFAS ankle hind foot scale was 82.5. They came to the conclusion that anatomical reduction and rigid internal fixation has a key role for minimizing the complication rate.<sup>14</sup>

In 2018, Azeez DA conducted his study on management of fracture neck of Talus and its clinical evaluation. According to him fracture neck of Talus has high complication rate like osteoarthritis, AVN, skin necrosis, mal-union and non-union. High energy trauma results in soft tissue damage and compromising the vascular supply of neck of Talus. Adequate reduction and internal fixation of these fractures result in minimizing the complication rate.<sup>14</sup>

In another study conducted by Suthar RD et al. They came to the conclusion that anatomical reduction and rigid internal fixation has a vital role in reduction of post-operative complication for fracture neck of talus. They advised the combined anteromedial and anterolateral approach to reduce the complications like AVN, non-union, malunion and arthritis.<sup>13</sup>

In a study conducted by Georgina crate et al in 2021. He came to the conclusion that AVN, post traumatic arthritis, non-union and infection rate was less than previously described studies. In his study AVN was 5.19 % while post operative arthritis 18.8 % with non-union rate of 4.7 %.<sup>7</sup>

Biz, c'et al treated 27 patients with isolated 28 displaced closed talar neck fractures. In his study the subtalar joint was most frequently affected joint in 22 patients regarding the arthritis followed by tibiotalar and talonavicular joint. Moreover, AVN affected 01 patient while 06 patients had both post traumatic arthritis and AVN.<sup>20</sup>

All these studies are comparable to our study regarding the rigid internal fixation of Talar neck fractures. Moreover, rate of complications like AVN, arthritis is related to the Hawkin's type. Anteromedial and anterolateral approach provide better understanding and visualization of the fracture site.

## CONCLUSION

We concluded from our study that familiarity with the complex vascular, bony, surgical anatomy and techniques for rigid fixation of fractures is of utmost importance for fracture neck of talus. Rate of osteonecrosis, arthritis, mal-union and non-union are still high even in the presence of rigid internal fixation of these fractures.

## LIMITATIONS OF STUDY

In our study, the number of patients was less. Moreover, still, a longer follow-up is required for further evaluation and assessment of the patients with Talar neck fractures.

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## ETHICAL REVIEW BOARD APPROVAL

The study was approved from Institutional Review Board of Services Institute of Medical Sciences / Services Hospital, Lahore via reference No. 138/17 dated December 1,2017

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#### **AUTHOR’S CONTRIBUTIONS**

**MZIS:** Manuscript writing, Data collection

**MK:** Statistical analysis Data collection

**TH:** Manuscript writing

**MA:** Data collection, Research Methodology

**SH:** Data collection, validation, evaluation of Data

**AI:** Statistical analysis