

OUTCOME OF OPEN REDUCTION AND INTERNAL FIXATION OF ISOLATED TALUS NECK FRACTURES VERSUS FIXATION OF TALUS NECK FRACTURES WITH CONCOMITANT IPSILATERAL FOOT AND ANKLE FRACTURES

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INTRODUCTION

Fracture of the talus is a relatively uncommon but disabling fracture with an incidence of 0.1 to 2.5 % of all fractures, and 3% to 5% of foot and ankle fractures. More than 50% of the talus fractures involve the neck of the Talus.¹ Anderson termed Talar neck fractures as "Aviator Astragalus" in 1919 after observing an increased frequency of these fractures in wartime fighter pilots during plane crashes resulting in forceful dorsiflexion of the ankle and tibiotalar axial compression.² Talus fractures are usually encountered in younger persons due to high-energy trauma like road traffic accidents, falls from significant height and sports injuries.³ Because of its soft tissue envelope that is potentially unforgiving, its complex anatomy, critical and unique blood supply and abundant articular cartilage coverage, the talus is very vulnerable to avascular necrosis (AVN), particularly after a displaced

ABSTRACT

OBJECTIVES

This study aimed to compare the radiological and functional outcomes of open reduction and internal fixation of isolated Talus neck fractures with Talus neck ipsilateral foot and ankle fractures.

METHODOLOGY

This retrospective study was conducted in the Orthopaedics Division, Lady Reading Hospital, Peshawar. The medical records of Talus neck fractures fulfilling the inclusion criteria and operated on in the last five years were reviewed. Patients were divided into group A (isolated Talus neck fractures) and group B (Talus neck fracture with concomitant ipsilateral foot and ankle fractures). Postoperative radiological fracture union, osteoarthritis, avascular necrosis (AVN) and functional outcome using the American Orthopaedic Foot and Ankle Society (AOFAS) were assessed and compared in both groups.

RESULTS

34 patients, with 18 (52.94%) patients in group A and 16 (47.05%) in group B. The mean AOFAS score at one year was 95.34±3.3 in group A and 74.11±2.2 in group B (P=0.001). Non-union was noted in 1(6.25%) patient in group B and none in group A. AVN Talus was documented in 02(11.11%) patients in group A and 07(43.75%) in group B (P=0.02). Postoperative osteoarthritis was noted in 3(16.66%) patients in group A and 5(31.25%) in group B. Multivariate regression analysis revealed that smoking, concomitant ipsilateral foot and ankle fractures, fracture classification and quality of postoperative fracture reduction were significant predictors of increased postoperative AVN of the Talus.

CONCLUSION

Open reduction and internal fixation of isolated Talus neck fractures have significantly better radiological and functional outcomes than fixation of Talus fractures with concomitant ipsilateral foot and ankle fractures.

KEYWORDS: Avascular Necrosis, Hawkins Classification, Open Reduction and Internal Fixation, Outcome, Talus Neck

fracture of the neck of the talus.¹ The risk of AVN in fracture of the talus neck is related to subtalar joint dislocation, as AVN is reported in 25% to 50% of patients with fracture of the talus neck associated with subtalar joint dislocation.⁴ Other complications include infection, non-union, malunion and post-traumatic osteoarthritis, all leading to adverse functional outcome and compromised quality of life.⁵ Undisplaced Talus neck fractures are treated non-operatively. In contrast, displaced fractures are treated with open reduction and internal fixation.⁶ Depending upon fracture geometry and overlying skin conditions, a variety of fixation techniques have been employed for treating Talus neck fractures, including K wires, external fixators, screws, mini fragment and fixed angle plates.⁷ Anatomical reduction, stable fracture fixation and early mobilization, however, should be the aim of fracture fixation.¹ Fracture of the Talus may have concomitant fractures of the foot and ankle, including fracture of the

medial malleolus (11%), fracture of the lateral malleolus (6%), bi-malleolar fractures (6%) and fracture of the calcaneus (6%).⁸ Studies have shown that Talar neck fractures with concomitant foot and ankle fractures cause increased morbidity, more frequently require secondary surgery and pose a significant risk of AVN than isolated Talar neck fractures.^{9,10} Displaced concomitant fractures of the foot and ankle may require simultaneous or staged open reduction and internal fixation, but the optimum treatment, however, is still controversial.¹⁰ Furthermore, limited literature is available regarding comparison of functional and radiological outcome of isolated Talus neck fracture with concomitant ipsilateral foot and ankle fractures. The objective of our study was to compare the radiological and functional outcomes of open reduction and internal fixation of isolated Talus neck fractures with Talus neck fractures with concomitant ipsilateral foot and ankle fractures. To the best of our knowledge, this will be the first study in Pakistan. The results of our study will help in better understanding of Talus neck and ipsilateral foot and ankle fractures, particularly in terms of prognosis and counselling of the patient. This would help in the formulation of institutional and national evidence-based management protocols for Talus neck fractures with concomitant ipsilateral foot and ankle fractures.

METHODOLOGY

This retrospective study was conducted in the Orthopaedic Department, Lady Reading Hospital Peshawar. Ethical approval of the study was granted by the Institutional Review Board, Lady Reading Hospital Peshawar (No.310/LRH/MTI, dated:19/05/2026). Medical records of all patients who were operated on for Talus neck fractures during the time period extending from Jul 2020 to Jul 2025 were extracted from the electronic Health Management Information System (eHMIS) of our hospital. All adult patients of both genders and all ages who were received within a week after sustaining closed Talus neck fractures (Hawkins type II, III, IV) with or without concomitant foot and ankle fractures and operated on with open reduction and internal screw fixation for Talus neck fractures in our hospital were included in this study.¹¹ All the included patients had complete radiological and clinical records, and a follow-up duration of more than one year. All open Talus fractures, re-surgery cases, pathological fractures, bilateral fractures and those associated with neuropathic foot, lower limb and upper limb long bone fractures were excluded. All the patients had complete history and radiological investigations (x-ray ankle AP, lateral view, Mortise view and 3D CT scan). All the patients were operated on by the same

surgical team with identical surgical protocol. All the patients were operated on a radiolucent table under general or spinal anaesthesia and tourniquet control, with the patient in supine position and C-arm assistance. Anterolateral approach for open reduction and internal fixation of Talus neck fractures was adopted in all cases. In this approach, a 10 cm skin incision starts about 3 cm proximal to the ankle joint along the lateral margin of Extensor Hallucis Longus. The fracture site was exposed, reduced, and provisionally held with one or two K wires. After confirming fracture and joint reduction under the image intensifier, two parallel proper-size 4 mm cancellous screws were passed from the head of the talus towards the neck and body of the talus, and compression was applied. Fracture reduction and screws placement were again checked with the image intensifier. (fig I) The wound was closed in layers, and a below-knee fracture splint was applied. All patients with talus neck fractures with concomitant ipsilateral foot and ankle fractures were treated simultaneously for their associated fractures. Depending upon the fracture type and displacement, the associated fractures were treated with either K wires or screws. (fig II) Post operatively the quality of fracture reduction was radiographically assessed using Lindvall criteria and labelled as Anatomical Reduction (no step in the neck or body and no angulation), Nearly Anatomical Reduction (step of 1 to 3mm or varus angulation of less than 5 degrees) and Poor reduction (articular mismatch or a step or gap of more than 3 mm or angulation of neck more than 5 degrees).¹²



Figure 1: Radiographs Showing Isolated Talus Neck Fracture (Hawkins Type II) Fixation



Figure 2: Radiographs Showing Simultaneous Fixation of Talus Neck Fracture and Concomitant Medial Malleolus Fracture

All the patients followed a supervised rehabilitation protocol with regular follow-up in OPD. Partial weight bearing was allowed at 6 to 8 weeks and full weight bearing at 10 to 12 weeks, depending upon clinical symptoms of absence of pain and radiological appearance of callus formation and obliteration of fracture lines. The radiological outcome at one-year follow-up included fracture union, non-union, mal-union, osteoarthritis and AVN. The functional outcome was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) score and interpreted as excellent outcome (90 to 100 score), good (70 to 89), fair (50 to 69) and poor outcome (<50).¹³ For comparative analysis, the records of all patients with fracture of the neck of the talus were divided into two groups. Group A had ORIF of isolated Talus neck fractures, while group B had ORIF of talus neck fractures with treatment of concomitant ipsilateral foot and ankle fractures. SPSS version 27 was used for data analysis.

RESULTS

The data of 34 Talus neck fractures, including 18(52.94%) isolated Talus neck fractures (Group A) and 16(47.05%) Talus neck fractures with ipsilateral foot and ankle fractures (Group B), were available for analysis.

Table 1: Comparison of Baseline Demographic and Clinical Variables of Both Groups.

Variables	Isolated Talus neck fractures (Group A) n=18(52.94%)	Talus neck Ipsilateral foot and ankle fractures (Group B) n=16 (47.05 %)	p-value
Age(Years)	32.41±3.12	31.33±2.11	0.10
Gender:			0.09
.Male	16(88.88%)	15(93.75%)	
.Female	02(11.11%)	01(6.25%)	
Aetiology of fracture:			0.22
.Road traffic accidents	15(83.33%)	14(87.5%)	
.Fall from height	03(16.66%)	02(12.5%)	
Side of fracture:			0.31
.Right	14(77.77%)	13(81.25%)	
.Left	04(22.22%)	03(18.75%)	
Smoking status:			0.08
.Nonsmoker	11(61.11%)	12(75%)	
.Smoker	07(38.88%)	04(25%)	
Diabetes Mellitus:			0.30
.No	17(94.44%)	15(93.75%)	
.Yes	01(5.55%)	01(6.25%)	
Hawkins classification:			0.12
.Type II	12(66.66%)	10(62.5%)	
.Type III	04(22.22%)	03(18.75%)	
.Type IV	02(11.11%)	03(18.75%)	
Postoperative radiographic fracture reduction (Lindvall criteria):			0.06
.Anatomical Reduction	15(83.33%)	13(81.25%)	
.Nearly Anatomical Reduction	02(11.11%)	01(6.25%)	
.Poor reduction	01(5.55%)	02(12.5%)	
Average union time(months)	6.41±2.2	7.33±1.7	0.81
Average follow-up(months)	14.4±2.2	15.1±1.3	0.11

Table 2: Univariate and Multivariate Logistic Regression for Predicting AVN in Our Study.

Variable	Univariate Regression Analysis			Multivariate Regression Analysis		
	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age	1.20	0.41-3.51	0.73	--	--	--
Gender	0.91	0.52-1.59	0.31	--	--	--
Fracture side	0.75	0.33-1.70	0.94	--	--	--
Aetiology of fracture	1.22	0.83-1.79	0.11	--	--	--
Smoking	1.61	1.04-2.49	0.03	1.78	1.24-2.56	0.002
Diabetes	0.33	0.09-1.21	0.64	--	--	--
Concomitant Ipsilateral Foot and Ankle Fractures	2.01	1.18-3.42	0.01	2.11	1.35-3.30	0.001
Fracture classification	2.03	1.30-3.17	0.002	2.01	1.07-3.78	0.03
Post-Operative fracture reduction	1.73	1.08-2.77	0.02	1.81	1.15-2.85	0.01
Follow-up period	1.12	0.60-2.11	0.12	--	--	--

DISCUSSION

In our study, all the Talus fractures united in group A, while in group B, 2(12.5%) patients did not unite. Avascular necrosis was noted in 02(11.11%) patients in group A and 07(43.75%) in group B ($P<0.05$). Postoperative osteoarthritis was recorded in 3(16.66%) patients in group A and 5(31.25%) in group B. The functional outcome was significantly better ($P<0.05$) in group A (mean AOFAS score 95.34 ± 3.3) than in group B (mean AOFAS score 74.11 ± 2). After an extensive literature review, we observed that most of the literature on talus neck fractures with concomitant ipsilateral foot and ankle fractures consists of case reports and case series, and good quality prospective studies are lacking.^{14,15,16,17} Nonetheless, four main reasons can explain this adverse outcome of fixation of Talus neck fractures with concomitant ipsilateral foot and ankle fractures in our study. First, patients with talus neck fractures sustained concomitant ipsilateral foot and ankle fractures due to very high-energy trauma, which causes severe initial fracture displacement, involves multiple articular surfaces and significantly damages the soft tissue envelope, which further compromises the blood supply of the talus and healing potential.⁹ Although anatomical reduction of the Talus fracture was critical in both groups, concomitant ipsilateral foot and ankle fractures worsened the outcome independent of fixation quality of the Talus. Second, the postoperative rehabilitation and mobilization of the foot with concomitant fractures was relatively delayed, which caused impaired circulation to the extremity, resulting in inferior functional outcome in group B than in group A.¹⁸ Third, studies have shown that there is

significantly increased activity of Osteoclasts and all other markers of inflammation in multiple fractures compared to isolated Talus neck fractures, which may contribute to chronic inflammation and immune modulation, resulting in accelerated pathogenesis of AVN in Talus neck fractures.^{19,20} Fourth, patients in group B had osteoarthritis and AVN and the associated pain and discomfort significantly contributed to lower functional outcome in this group. Similar to our study, Srinath *et al*⁹ compared the results of 63(55%) isolated Talus neck fractures with 52(45%) Talus neck fractures with concomitant ipsilateral foot and ankle fractures. Both groups had identical baseline demographic characteristics. The rate of AVN was 30%(n=19) in isolated Talus neck fractures and 46%(n=24) in Talus fractures with concomitant fractures of the foot and ankle. After adjusting for confounders, these authors concluded that the risk of AVN was higher in isolated Talus neck fractures than in concomitant foot and ankle fractures. The increased frequency of AVN was significantly associated with complex fracture type, compromised skin envelope, surgical approach and fracture reduction quality. In our study, smoking, concomitant ipsilateral foot and ankle fractures, fracture classification and quality of fracture reduction were significant predictors of increased postoperative AVN of the Talus. Fracture classification(Hawkins) reflects injury severity and disruption of anatomical structures. Our results showed a higher rate of AVN in Hawkins type III than type II. The utility of the Hawkins classification is further enhanced. Furthermore, accurate fracture reduction tends to maximize the restoration of blood circulation around the talus. This implies that surgical technique should be meticulous and fracture reduction should be anatomical to avoid AVN in both groups. Smoking causes disturbances in the microcirculation, thrombosis and vasospasm, resulting in reduced blood supply and ultimately increasing the risk of AVN.²¹ All patients with talus neck fractures should be strictly advised to quit smoking in the perioperative period to decrease the chances of postoperative AVN. Zhang et al treated 207 Talus fractures (including ipsilateral concomitant foot and ankle fractures in 87 patients) and formulated and validated a machine learning prediction model for postoperative AVN.¹⁸ These authors identified six independent risk factors, including smoking, BMI, classification of Talus fractures, fracture type, associated ipsilateral foot and ankle fractures and quality of postoperative fracture reduction for AVN of the talus. Sautet and colleagues reviewed the records of 58 Talus neck fractures, including 13 Hawkins type I fractures, 30 type II and 15 type III fractures, with 64 % isolated Talus neck fractures.²² These authors noted AVN in 7%, subtalar osteoarthritis in 45% and

tibiotalar in 19%. Mean AOFAS was 74, with 20% having an excellent outcome, 30% good, 28% acceptable and 22% poor outcome. This study reported that poor fracture reduction, subtalar osteoarthritis, AVN and smoking were associated with poor functional outcome. Alley reported that 99 (16.2%) patients out of a total of 610 in their study had medial malleolus fractures, with an overall frequency of AVN of 42.1%.²³ Advanced age, smoking, dual surgical approach, open fractures, concomitant medial malleolar fractures, and Hawkins type IIA, IIB fractures were associated with an increased risk of AVN ($P < 0.05$) in this study. Contrary to our results, Roddy *et al* treated 128 Talus fractures and noted that, at 10.4 years of follow-up, the mean Foot and Ankle Ability Measure (FAAM) score was 83, post-traumatic arthritis was 47%, and the re-surgery rate was 30%.²⁴ These authors reported that age, location of fracture and ipsilateral foot and ankle fractures were not associated with poor outcomes; rather, increased BMI, higher Injury Severity Score (ISS) and salvage procedure were associated with poor outcomes. Similarly, Daryoush reported that sustentaculum fractures were present in 40.7% of Hawkins II (973.7%) and post-traumatic subtalar osteoarthritis was documented in 23.1%.¹⁷ The rate of subtalar osteoarthritis did not exceed in this combined injury at 24 months when compared to isolated Talus fracture. We fixed Talus neck fractures with 4 mm cannulated screws, as there are no superior results of plate fixation in Talus neck fractures.²⁵ Moreover, screw fixation has the added advantage of preserving blood supply of the talus.¹ Lee and Ryu treated 31 Talus neck fractures (Hawkins type III) and achieved union in all cases at 4.9 months.²⁶ The AOFAS score and Foot Function Index (FFI) score were 80.18 (range 36 to 90) and 31.43 (range 10 to 68), respectively. AVN was noted in 15 (55%) patients, ankle arthritis in 6 (22%) patients and infection in 4 (15%) patients. These authors used 4 mm cannulated screws, headless screws and locking compression mini plates for fixation. These authors concluded that the technique of fixation had no significant association with functional outcome or development of osteoarthritis ($p > 0.05$). We used the anterolateral approach for fixing all Talus neck fractures in both groups. The literature supports the use of this approach for ORIF of Talus neck fractures. Parmeshwar treated 30 Talus neck fractures using three approaches (anteromedial, anterolateral and combined) and noted AOFAS scores of 76.34, 77.16 and 78.34, respectively, at 18 months of follow-up.²⁷ These authors reported no significant association of surgical approach with functional outcome.

LIMITATIONS

The design of our study was retrospective. Although our multivariate analysis is valuable in providing exploratory insight into postoperative Avascular Necrosis of the Talus, due to the small sample size ($n=34$) and low total AVN events ($n=09$), the Events Per Variable (EPV) ratio of our Multivariate Logistic Regression is low. Therefore, our results should be cautiously interpreted, and further validation of these risk predictors with large sample size studies is needed. Furthermore, we could not determine the BMI of our patients or the association of BMI with fixation outcome. We therefore recommend further prospective studies to verify our results.

CONCLUSIONS

Open reduction and internal fixation of isolated Talus neck fractures have significantly better radiological and functional outcomes than fixation of Talus fractures with concomitant ipsilateral foot and ankle fractures. Fractures of the neck of the talus can have an uncommon combination of concomitant ipsilateral foot and ankle fractures. One should have a high index of suspicion and should not miss these concomitant fractures. For early recognition and prompt simultaneous treatment, the preoperative assessment of Talus fractures should be comprehensive.

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AUTHORS CONTRIBUTION

Faaz Ali Shah - Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Final Approval

Aimal Sattar - Concept & Design; Data Acquisition; Drafting Manuscript; Supervision; Final Approval

Zia Ullah Jan - Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Final Approval

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.



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