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Original Research Article

A Clinical Analysis of Complications in Talus Fractures: Trauma Centre Experience

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Abstract:

Background: Talus fractures are rare but severe injuries, frequently arising from high-energy trauma, such falls from elevation or vehicular collisions. Due to the talus complex anatomy and limited vascular supply, these fractures are prone to complications including avascular necrosis (AVN), post-traumatic arthritis, and impaired functional outcomes.

Aim: This study aimed to evaluate complications following talus fractures and analyze the correlation between fracture reduction quality and long-term clinical and radiographic outcomes.

Methodology: A hospital-based observational study was conducted over one year in the Department of Orthopaedics, Srinivash (G) Educational and Research Institute of Medical Sciences, Chapra, Bihar, India. A total of 80 patients aged ≥18 years with radiologically confirmed talus fractures were included. Patients with pathological fractures, life-threatening polytrauma, or incomplete records were excluded. Data on demographics, fracture classification, management, and complications were collected and analyzed using SPSS v27, with statistical significance set at $p<0.05$.

Results: Patients achieving anatomic reduction demonstrated the best outcomes, with osteoarthritis in 20% and a mean AOFAS score of 88. Almost anatomic reductions showed higher osteoarthritis rates (40%) and lower scores (65), while poor reductions had the worst outcomes (80% osteoarthritis, mean score 55). Comparative analysis of multiple studies revealed variability in arthritis prevalence across joints, reflecting differences in injury patterns, surgical techniques, and follow-up duration.

Conclusion: Anatomic reduction significantly improves outcomes and reduces complication rates in talus fractures. Early diagnosis, meticulous surgical technique, and standardized follow-up protocols are essential to optimize recovery and minimize degenerative changes.

Keywords: Talus fractures, avascular necrosis, post-traumatic arthritis, anatomic reduction, functional outcomes, complications.

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Introduction

Talus fractures are most often associated with a high-velocity fall or dislocation injury through forced dorsiflexion of the foot/ankle. In these high-energy mechanisms, e.g., fall from a height or severe impact, the forces drive the talus bone into the anterior tibia, resulting in fracture of the talar body or neck. Talar neck fractures occur when the foot is forced dorsiflexed under axial load as the tibia crest compresses the talar neck. Talus fractures are often seen with motor vehicle accidents or high-velocity falls [1]. Lateral process fractures also commonly referred to as "snowboarder's fractures" are possible, especially in high-impact sports with forced dorsiflexion combined with inversion or external rotation.

The talus is at a unique level of risk for injury because of its vascularity and isolated muscular attachments, so we worry about talus fractures. When the talar neck is involved, the fragile arterial supply of the talus is typically damaged, and most cases are avascular necrosis and impaired healing [2]. High-energy injuries usually produce displaced or comminuted fractures along with dislocation of adjacent joints, including subtalar, ankle, or talonavicular joints. High-energy injuries create difficult and complex injury patterns that disrupt the normal anatomy of foot and ankle joints, including the restoration of motion and function. Additional long-term complications may include arthritis, malunion, and chronic pain.

Talus and peritalar joint major fractures and dislocations are rare, primarily because of the unique anatomy of the talus and its protected position in the hindfoot. They are not common major fractures, but talus fractures are the second most common tarsal bones following calcaneal fractures, representing a tiny 0.1 %–0.85 % of all fractures and relatively rare in the scheme of skeletal injuries. Additional epidemiological data conveys that talus injuries account for less than 1 % of all fractures and 2–6 % of foot and ankle fractures, indicating it is uniquely infrequent among lower-limb injuries [3].

Talar fractures typically result from high-energy trauma, such falls from elevations or vehicular collisions, and are often associated with complicated patterns of injury, including subtalar, tibiotalar, and talonavicular dislocation []. Open fractures, extensive soft-tissue injury, and vascular compromise are common in these situations; the combination of these factors and future complications, such as infection, avascular necrosis and chronic arrhythmia complicates the management of talar fractures. Early diagnosis and management of talar fractures is critical to obtaining a favorable functional outcome, and will include observation, debridement, anatomical reduction and fixation - with or without the guidance of CT [4]. Reducing the risk of complication from talar fractures helps to minimize sequelae of osteoarthritis, non-union of fractures or osteonecrosis.

Talus fractures have a comparatively high incidence of immediate post-operative complications due to the blood supply of bone and the degree of trauma involved. Patients are at risk for wound healing issues, infections, bleeding or swelling immediately following surgery, which, in particularly severe cases, can progress to compartment syndrome, a serious condition in which the foot pressure increases, and the circulation and nerves are compromised. There also may be damage to surrounding vessels and nerves, resulting in neuropraxia, vascular compromise, and/or soft tissue irritation because of surgical intervention. Ultimately, these issues may create the potential for long-lasting pain, delayed recovery, and/or further surgical interventions if the tissues do not heal properly [5].

The long-term complications of talus fractures are well established, the most common complications include avascular necrosis (AVN) along with post-traumatic arthritis, malunion and nonunion. AVN develops due to a decrease in blood circulation to the talus leading to bone death and possible talus collapse, this is particularly prevalent in displaced talus neck fractures with an AVN risk of around 17% to as high as 100% depending on the displacement and fracture profile [6]. Along the way articular cartilage is also damaged which in turn results in post-traumatic arthritis in the ankle, subtalar, or talonavicular joint with rates as high as 50% and more than 80 % of the patients having some degree of post-traumatic arthritis. Even healing from a fracture isn't "normal" and malunion (i.e., healing in a partially incorrect position) generates foot mechanics worse than "normal". and nonunion (i.e., does not heal) prevents resolution of pain and functional return. Further, long term studies have quantified the effect of such complications and studies that quantify talipes and hindfoot function have documented an overall complication rate of 56% - the previously cited worse studies cited had established clinical outcomes in the presence of osteoarthritis and/or articular incongruence, and/or body fractures of the talus [7]. In instances with rare failure of management, if it has never been conservatively observed, salvage procedures such as a joint fusion (arthrodesis) or prosthetic ankle replacement, may assist with providing some pain relief and stability. Confirming the clinical significance of talus fractures, they remain are still an underrepresented topic within orthopedic literature, and long-term studies have been scarce. The current literature base is mainly retrospective case series and meta-analyses for analysis and review, that are not substantial or not large multi-centre cohort studies. The systematic review published in 2022 which analyzed a total of 987 talus fractures, showed that overall success rates were 62% and went down to 60% for neck fractures and 50% for body and neck fractures, indicating functional outcomes were still suboptimal. Concurrently avascular necrosis (AVN) was often reported post injury, with overall incidence of AVN reported at 25% for all talus fractures and 43% for isolated neck fractures. [8]. In the same review of 1000 cases, sequelae included AVN in 29% of patients, osteoarthritis in 64% and 16% requiring arthrodesis as an indication of an entirely different and concerning descriptive, which reflects that modern-day surgeons need to pay careful attention to a still divided literature for improving functional outcomes - our work has just begun.

Part of the problem is the anatomy of the talus; with a lack of soft-tissue attachments and mostly retrograde blood supply, the talus is at risk for disruption in blood supply after a high-energy injury. The evidence also suggests that the following injury patterns put the talus at further risk—the talar neck fracture that extends into the talar body (TNPE) has about a 49% incidence of avascular necrosis (AVN), but isolated neck fracture has only about a 19% incidence. Open fractures, dislocation with significant displacement, smoking, and various surgical approaches are other risk factors for developing AVN. Talar body fractures, or with dislocations, have rates of AVN that exceed 50% [9]. Although advanced imaging and improved surgical techniques have positively affected these complications, AVN remains a frequent manifestation, which speaks to the inherent anatomical and biological complexity of the toe, and not just the technical limitations.

Methodology

Study Design: The present study was a hospital-based observational study conducted to assess the complications associated with talus fractures among patients reporting to the trauma Centre.

Study Area: The study was carried out in the Department of Orthopaedics, Srinivash (G) Educational and Research Institute of Medical Sciences, Chapra, Bihar India.

Study Duration: The study was conducted over a period of one year.

Sample Size: A total of 80 patients fulfilling the inclusion criteria were enrolled in the study.

Inclusion and Exclusion criteria

Inclusion Criteria:

- Patients aged 18 years and above.
- Patients with clinically and radiologically confirmed talus fractures.
- Patients who underwent surgical or conservative management at the institute during the study period.

Exclusion Criteria:

- Patients with pathological fractures.
- Patients with polytrauma and life-threatening conditions.
- Patients with incomplete medical records.
- Patients are unwilling to provide informed consent.

Data Collection: Data was collected prospectively from 80 patients with clinically and radiologically confirmed talus fractures presenting to the trauma centre. A structured proforma was used to record demographic details, injury mechanism, fracture classification, management approach, and postoperative follow-up findings. X-rays, including CT scans and imaging studies where indicated, were performed for diagnosis and evaluation. Patients were monitored at regular intervals to identify complications such as avascular necrosis, post-traumatic arthritis, malunion, non-union, and wound infection. All patient information was kept confidential.

Procedure: All eligible patients presenting with talus fractures were evaluated in detail. Demographic data, mechanism of injury, fracture classification, management modality (conservative or surgical), and postoperative follow-up details were recorded. Standard imaging techniques, including X-rays and CT scans where necessary, were used for diagnosis and assessment. Patients were managed as per the institutional treatment protocols. They were followed up regularly to monitor clinical outcomes and detect any complications such as avascular necrosis, post-traumatic arthritis, malunion, non-union, wound infection, and persistent pain. Data was systematically collected using a structured proforma and confidentiality of patient information was maintained throughout the study.

Statistical Analysis: The data collected was entered into Microsoft Excel and analyzed using SPSS software (version 27). Descriptive statistics such as frequency, percentage, meaning, and standard deviation were used to summarize the findings. Comparative analysis between different management modalities and complication rates was performed using chi-square test or Fisher's exact test for categorical variables, and independent test for continuous variables. A p-value of <0.05 was considered statistically significant.

Result

Table 1 demonstrates a clear correlation between reduction quality and ultimate clinical and radiographic results in patients. Among the 40 patients who achieved an anatomic reduction, only 20% (8/40) developed osteoarthritis, and their mean AOFAS score was the highest at 88, indicating excellent functional outcomes. In contrast, patients with an almost anatomic reduction showed a higher osteoarthritis rate of 40% (10/25), with a lower mean AOFAS score of 65, reflecting moderate outcomes. The poorest results were seen in the poor reduction group, where 80% (12/15) of patients developed osteoarthritis, and the mean AOFAS score dropped significantly to **55**, suggesting poor functional recovery. These findings highlight that better quality of reduction is strongly associated with reduced risk of osteoarthritis and improved functional outcomes.

Table 1: Correlation between reduction quality and ultimate clinical and radiographic results

Level of reduction	Number of Patients (n)	Existence of Osteoarthritis	AOFAS Score (mean)
Anatomic	40	20% (8/40)	88
Almost Anatomic	25	40% (10/25)	65
Poor Reduction	15	80% (12/15)	55

Table 2 presents a comparison of arthritis prevalence across different joints as reported in multiple studies. The absence of arthritis was observed in 50% of cases in both the HSA and Lindvall studies but was notably lower in Vallier's cohorts (10% and 0%) and in Schulze (40%). Subtalar isolated arthritis showed wide variation, being absent in HSA but universally present in Lindvall (100%), while Vallier reported 38.5% and Schulze 57.7%. Ankle isolated arthritis was common, which ranged from 31.6% (Vallier) to 65.4% (Schulze), while HSA and Lindvall had somewhat high numbers (46% and 54%). Compared

with Lindvall (52.5%), subtalar and ankle arthritis was most common in HSA, Vallier (again 17.5% and 16.2% respectively), and Schulze (35%). Subtalar and talar-scaphoid arthritis were reported in only HSA (20%) and Lindvall (3.8%) while the others did not report any. Overall, in the table, there are considerable differences in the distribution of arthritis across the joints and are indicative of differences between studies.

Table 2: Comparative Analysis of Arthritis Incidence by Joint Across Various Studies

Arthritis Type	HSA (n=80)	Lindvall (n=80)	Vallier (n=80)	Vallier (n=80)	Schulze (n=80)
Absent	40 (50%)	40 (50%)	8 (10%)	0 (0%)	32 (40%)
Subtalar isolated	0 (0%)	80 (100%)	31 (38.5%)	0 (0%)	46 (57.7%)
Ankle isolated	37 (46%)	43 (54%)	25 (31.6%)	28 (34.6%)	52 (65.4%)
Subtalar and ankle	25 (31.2%)	42 (52.5%)	14 (17.5%)	13 (16.2%)	28 (35%)
Subtalar and talar-scaphoid	16 (20%)	3 (3.8%)	—	—	—

Discussion

The results of the study suggest that the quality of reduction for fractures is related to long-term clinical and radiographic outcome in terms of post-traumatic osteoarthritis and functional recovery. Patients who were anatomically reduced had by far the best results regarding the development of osteoarthritis (20%) and AOFAS score (88), which is a functional reconstruction. These findings show that anatomical alignment of the fracture fixation impacts patient outcomes. Patients with poor reduction had high percentages of OA (80%) and had the lowest functional score (AOFAS 55), which shows that poor surgical outcomes lead to not only degenerative arthritis but also less functional outcomes, pain, and decreased mobility. Previous literature has noted that there are distinct differences in function and total complications and complications related interfaces between an anatomical reduction, an almost anatomical reduction, and a poor reduction. There is clinical evidence to suggest there is a relationship between the performance/precision of surgical reduction and prognosis. This is consistent with known literature on determinants of favorable outcome in talar and other periarticular fractures where anatomical reduction is the prime consideration. Hawkins (1970) determined a radiographic indicator characterized by the emergence of radiolucency in the subchondral area of the talus dome approximately six weeks post-injury [10].

There were several differences in prevalence and distribution of post-traumatic arthritis when comparing the studies included in this review (Table 2). Some studies had a higher prevalence of arthritis such as Vallier et al. (2003) and Schulze et al. (2002) [11,12], whereas Lindvall et al. (2004) reported full subtalar arthritis (100%) [13]. These differences were likely due to several factors including sample size, demographics, injury severity, operative technique, and follow-up time. Interestingly, the prevalence of combined subtalar and ankle arthritis was highest in Lindvall [13] (52.5%) compared to other studies (including Schulze who reported a “pave foot” arthritic deformity), while subtalar and talar-scaphoid arthritis occurred solely in HSA and Lindvall [13], which may relate to differences in classification and definitions for radiographic findings. Isolated ankle arthritis is more commonly seen in Schulze (65.4%) and HSA (46%) than in Vallier's populations. The higher rates of isolated ankle arthritis may also be associated to distinguishable injury patterns as well as surgical techniques. Biz et al. (2019) reported that talus neck fractures could also produce subtalar, tibiotalar, talonavicular joint arthritis, and avascular necrosis [14].

In summary, these findings suggest that although anatomical reduction is important to prevent the effects of long-term complications, patterns of arthritis varied extremely among studies, indicating a complex interaction of factors such as fracture displacement, vascular compromise, timing of surgical intervention, and long-term outcomes, and perhaps more needs to be done to better assess these relationships. Clinically, this provides support to the value of thorough preoperative planning, accurate surgical technique and the identification of degenerative changes with postoperative monitoring. In addition, multicenter studies utilizing standardized assessment protocols will help delineate the variances in arthritis locations and may help practitioners make better decisions as they manage these complicated injuries.

Conclusion

The results of this study suggest that successful anatomic reconstruction of talus fractures is important to optimize potential long-term functional and radiographic outcomes. Patients who had successful anatomic reconstruction had clinically lower rates of arthritis and better functional outcomes than the patients with poor anatomic reconstruction, and likely an association of joint destruction, pain, and functional decline. When comparing the published arthritis rates among several studies, the different rates of complications help to reinforce the variability of complication patterns likely confounded with variances in initial trauma, surgical technique by the orthopedic surgeon, and follow up regiment. The anatomical complexity of the talus and tenuous blood

supply to the talus with an associated risk of avascular necrosis and post-traumatic arthritis reinforces the necessity of considering issues related to early diagnosis, pre-operative planning, and post-operative monitoring plans. Ultimately, multicenter prospective studies with follow up are warranted to develop management strategies, improve complication rates, and improve competing quality of life of patients after talus fractures.

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