

The challenging missing talus, surgical treatment and clinical outcomes: a review

Davide Calabrò¹, Elena Gasbarra¹, Donato Casamassima²,
Pasquale Farsetti¹, Arianna Di Marcantonio³

¹ Department of Orthopedic Surgery, University Hospital "Tor Vergata", Rome, Italy;

² Department of Orthopedic Surgery and Traumatology, San Camillo-Forlanini Hospital, Rome, Italy; ³ Department of Orthopedic Surgery and Traumatology, San Giovanni Addolorata Hospital, Rome, Italy

SUMMARY

Total talus extrusion, a rare and debilitating ankle injury, leads to severe pain, instability, and functional impairment. Its rarity complicates treatment and established guidelines are lacking. This review, adhering to PRISMA criteria, analyzed 113 cases from 53 articles (PubMed, Cochrane, CINAHL) which were retrieved using the keywords: "missing talus", "total talar extrusion", "talar extrusion", "open talar dislocation", and "open talus dislocation". The text was submitted to PROSPERO with registration number CRD42023385242. Primary talus reimplantation occurred in 86 cases, talectomy and tibio-calcaneal arthrodesis were alternatives. Avascular necrosis, arthritis, infections, and second surgical revision are the most frequent complications in both cases. The management debate centers on reimplantation versus removal. The evidence suggests immediate reimplantation, coupled with thorough debridement, antibiotics, and tetanus prophylaxis, mitigates complications and restores ankle anatomy. This review aims to establish comprehensive surgical guidelines for missing talus, optimizing recovery and function while minimizing long-term sequelae.

Key words: ankle injuries, talus, joint dislocations

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Correspondence

Davide Calabrò

E-mail: davide.calabro89@gmail.com

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Introduction

Total extrusion of the talus without soft tissue attachment (missing talus) is a rare, disabling injury, accounting for 0.06% of all dislocations and 2% of all talar injuries ^{1,2}. This condition typically results from high-energy trauma, which causes extensive damage to surrounding soft tissues and disrupts the talar blood supply ³⁻⁵. The significant forces exerted on the ankle joint can dislocate or extrude the talus. The main goal of treatment is to restore the anatomy of the foot and ankle joint, while preventing long-term complications such as arthritis or functional loss. However, there are no strong guidelines for surgical treatment, and management is often based on the surgeon's experience. Currently, only a few cases have been reported in the literature, offering various surgical treatments, including talectomy, immediate reimplantation, tibio-calcaneal arthrodesis, and ankle prosthesis. Pantalar extrusion treatment often results in unpredictable outcomes and carries risks of complications such as avascular necrosis (AVN) and infection ⁶. Immediate medical intervention is crucial, and treatment may involve surgical stabilization to reposition the talus, repair damaged structures, and restore function. The aim of

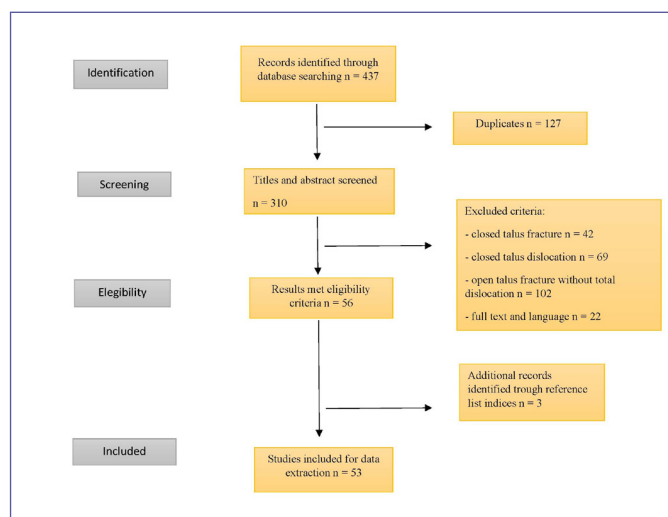


Figure 1. PRISMA flowchart process for the review.

our work is to summarize all surgical treatments and outcomes of this pathology, while also providing treatment recommendations based on a review of the literature.

Methods

The review was conducted in accordance with the general principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. A global search of publications was performed using the PubMed, Cochrane, and CINAHL bibliographic databases. The search aimed to identify papers relevant to our topic, with a timeframe covering from September 1 2022, to January 2025. Articles were retrieved from the inception of each database up to the search date. The search strategy was based on the keywords “missing talus”, “total talar extrusion”, “talar extrusion”, “open talar dislocation”, and “open talus dislocation”. The review was submitted to PROSPERO (n. CRD42023385242). Three independent authors reviewed all abstracts from articles resulted. The reference lists of each selected article were also examined to identify any additional relevant sources for the review. All cases of open total talar dislocation, with or without associated fractures of the talus, foot, or ankle were included. Exclusion criteria were: closed talus dislocation, closed or open talus fractures without dislocation, non-English language studies and articles with unavailable full texts. No publication date limit or patient age limit was given. Two other independent referees evaluated the methodological quality of the studies included. This search was limited to human subjects and journal articles, including case reports, case series, and reviews, published in English. The search strategy and flowchart are shown in Figure 1. The authors analyzed all titles, abstracts and full text, ultimately selecting 53 articles. Data on patient gender

and age were recorded. Other characteristics were examined: emergency and secondary surgery, incidence of major complications (AVN, osteoarthritis of the ankle, and infection) and functional outcomes (return to daily activities) for the patients. Despite the highly variable information reported, we established the following criteria for categorizing the outcomes:

- good: full weightbearing with near full range of motion, minimal pain, and minimal activity restriction;
- fair: full weight-bearing with moderate restriction of activity because of restricted range of motion or pain;
- poor: partial weight-bearing or severe restriction of activity caused by pain, or pain/instability that was as severe as to require arthrodesis or another corrective procedure.

Possible biases affecting the review include the rarity of the disease, which results in primarily case reports and small case series without control groups. A lack of data standardization may generate bias. Also, there is a variation in the evaluation scales used, and some studies did not use them. Due to the fact that most research does not report patient comorbidities and individual variables, there may be a confounding bias.

Results

Our review included 53 articles (13 case series and 40 case reports), reporting on a total of 116 cases of open total talus extrusion, with 82 males (70.6%) and 34 females (29.3%). The mean follow-up was 3 years. This rare injury is usually caused by high-energy trauma, primarily motor vehicle accidents, and falls from heights. The average time between injury and admission to the operating room was 6.7 hours. Primary talus reimplantation was performed in 86 cases (74% of all procedures), primarily using internal fixation, often with Kirschner wires or Steinmann pins. While primary reimplantation of the extruded talus was sometimes associated with major complications (AVN, early post-traumatic arthritis, and infection), this approach frequently resulted in satisfactory outcomes with only minor restrictions on daily activities. Full weight-bearing was typically achieved within 12 to 16 weeks. In all, 30 cases treated with surgical techniques other than reimplantation were reported (25.8% of all procedures). These included primary talectomy, tibio-calcaneal arthrodesis, and cement placement. Overall, they showed fair clinical outcomes, sometimes with complications such as leg length discrepancy, decreased hindfoot function, loss of bone stock, and failure of arthrodesis fusion.

Overall, 12 cases of infection were reported (approximately 10% of cases), of which 9 were present in talus reimplantation cases. One of the primary complications encountered was AVN, with a total of 24 cases. Of those, 19 cases were after reimplantations, and 5 were in other surgical procedures. However, secondary osteoarthritis was observed as a complication in 30 of the 116 patients. In some cases of reimplantation, a second surgical procedure was performed such as secondary

arthrodesis, surgical wound debridement, revision of the arthrodesis, talectomy, or below-the-knee amputation.

Discussion

The anatomical position of the talus makes it a crucial link between the leg and foot. The talus is anatomically divided into three segments (head, neck, and body) and two processes (lateral and medial)⁷⁻¹⁰. Its multiple articulations result in over 60% of its surface being covered by hyaline articular cartilage and ligament insertions⁸⁻¹¹. The blood supply to the talus is relatively weak. The body of the talus is supplied by three arterial branches¹². Open total talar dislocation is an injury involving the dislocation of the tibiotalar, subtalar, and talonavicular joints, with disruption of all surrounding ligaments (resulting in a “missing talus”). This rare injury is typically caused by high-energy trauma, such as motor vehicle accidents or falls from height, often when the foot is positioned in excessive supination and plantar flexion or pronation^{13,14}. These types of injuries are considered some of the most disabling and potentially catastrophic ankle injuries¹⁵, primarily due to the serious complications associated with open total talar dislocation. Complications can be classified as either early or late. One of the most feared early complications is infection, which is strongly associated with open fractures and talar extrusion¹⁶⁻¹⁸. Late complications can arise up to 12 months after the trauma and may include bone collapse, joint stiffness, post-traumatic arthritis, and bone necrosis¹⁹. Among the complications of total talus extrusion, AVN has a high incidence due to the loss of ligaments and vascular supply^{5,16,20}.

Due to the rarity of this type of injury, there are no established guidelines for its treatment. The management of this condition is based on surgical experience and limited case reports or small case series with class V evidence, which rarely result in full functional recovery¹⁸. The management of a totally extruded talus remains controversial, with options including removal (such as performing tibio-calcaneal arthrodesis or total talar prosthesis replacement) or reimplantation. The early complications associated with reimplantation include infection, and AVN. Smith et al. reported only one infection during the initial hospitalization period among 27 cases of open talar extrusion. The authors attributed the low infection rate to meticulous soft-tissue handling, staged procedures, early soft-tissue closure, and rigid fixation¹⁷. Vaianti et al. describe the case of a 27-year-old man who experienced total extrusion of the talus. The articular void left by the missing talus was filled with antibiotic cement, and the wound was closed primarily. Later, the original talus was reimplanted, and subtalar joint arthrodesis was performed. The patient was able to walk and bear full weight without support after 6 months¹⁶. Gulan et al. reported a case of missing talus where tibio-calcaneo-navicular arthrodesis was performed. The initial arthrodesis failed, and due to a painful and unstable an-

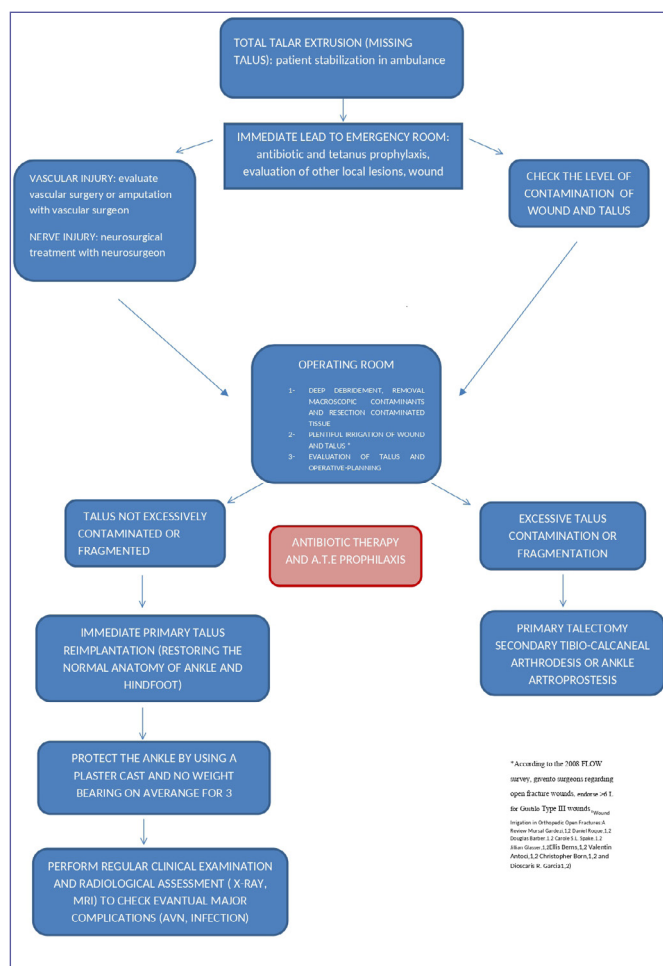


Figure 2. Comprehensive flowchart of the surgical treatment.

kle, a re-arthrodesis was successfully performed two years later²¹. Koller et al. presented two cases of total talus extrusion treated with sandwich block tibio-calcaneal arthrodesis using structural autografts harvested from the iliac crest. One case was treated with primary reimplantation of the talus, and the other with tibio-calcaneal arthrodesis. In the first case, the patient showed initial signs of AVN of the talus, which was managed with a period of weight-bearing restrictions. Ultimately, the patient was able to return to work. In the second case, the patient developed a 4 cm leg length discrepancy in the affected limb but reported no pain when walking⁵. This latter case highlights that talus reimplantation is a better option for preserving function and leg length. Additionally, we found a case report of missing talus treated with the insertion of a custom total talar prosthesis, which was affixed directly to the tibial cartilage 6 months after the injury. During this period, an antibiotic cement spacer was placed to stabilize the void and prevent capsular ligament retraction. At 2 years

of follow-up, the authors reported a good functional outcome with improvement in the AOFAS score ²³.

Looking at the literature, despite the high risk of major complications (infection, AVN), the most common management for this rare injury is immediate talus reimplantation, which often achieves a good functional outcome. For example, a recent report by our team describes the case of a 44-year-old male who experienced total talus extrusion and Lisfranc dislocation after a motorbike accident. The patient was treated with immediate reimplantation and K-wire with good outcome at 5 years ²⁴. Breccia et al. reported a case of open ankle dislocation with talar extrusion. They performed immediate reduction, surgical debridement, and stabilization using external fixation along with antibiotic coverage. At 18 months of follow-up, the patient had not developed the major complications typically associated with missing talus ⁶. Memisoglu et al. described the case of a 13-year-old child who experienced talar extrusion, which was treated with open immediate reduction and fixation using K-wires, followed by 10 weeks of cast immobilization. After 1.5 years of follow-up, the patient had an AOFAS score of 93 points, without any signs of avascular necrosis or arthritis ²⁵.

Another recent article by Mohammad et al. reports the case of a 34-year-old woman involved in a road traffic accident, resulting in talus extrusion with a talar neck fracture. Due to the high risk of AVN and postoperative arthritis leading to secondary procedures, the decision was made to perform talar neck fixation with a cortical screw and primary talus reimplantation, along with tibiotalar calcaneal arthrodesis using a hindfoot nail. At 2 years of follow-up, the patient did not show signs of AVN or infection and had a fair functional result ²⁷. Kasha et al. reported the case of a 40-year-old male patient who presented with a Gustilo-Anderson grade 3B open injury to the ankle, accompanied by talar extrusion and bone loss distal to the talar neck, along with a calcaneal fracture. The treatment involved triple arthrodesis combined with the Masquelet technique to stabilize the joints and reconstruct the bone defect. After 8 weeks, the bone cement spacers were removed and replaced with allografts, with the construct stabilized using K-wires and cannulated cancellous screws. At 7-year follow-up, the patient was able to resume all of his activities, with successful graft incorporation and joint fusion, and no evidence of infection. He reported mild pain on the plantar aspect of the heel due to the calcaneal bony architecture, but this was managed with soft cushioned footwear and did not subjectively affect function.

Some studies have reported positive results following primary talectomy and tibio-calcaneal arthrodesis ²⁰⁻²⁶. However, this approach has shown unsatisfactory outcomes, including increased pain, limb shortening, a tendency toward varus deformity, and tibio-calcaneal instability or collapse ²¹. These studies support the idea that immediate reimplantation of an extruded talus, when combined with extensive wound debridement, preventive antibiotics, and a tetanus toxoid booster, can prevent the most disastrous complications (infection, talus

collapse) and restore the ankle's anatomy. The findings of our work highlight that reimplantation or salvage of the talus does not lead to a high rate of infection or symptomatic AVN. Primary reimplantation offers several advantages over primary arthrodesis, such as improved hindfoot function and restored ankle joint function. This is due to the restoration of bone stock and preservation of the physiological joint space. From this, we can deduce that maintaining the anatomy of the ankle and hindfoot as closely as possible to the original is critical. It is preferable to perform a second, definitive arthrodesis operation if symptomatic AVN or arthritis develops in the following years, particularly in younger patients.

The low rate of infections found in this review leads us to recommend primary bone salvage, provided accurate and timely diagnosis and treatment are carried out. A comprehensive flow-chart of the surgical treatment is shown in Figure 2. The loss of an entire joint bone, such as the talus, inevitably leads to arthrodesis, a near-total loss of ankle range of motion, and reduced function of the hindfoot and gait. However, acute reimplantation can delay the need for secondary tibiotalar arthrodesis due to chronic complications, thus ensuring a better lifestyle and return to sport during this period. Our study has several limitations, which should be acknowledged. Due to the rarity of talar extrusion, all the articles reviewed were either case reports or small case series without controls. Additionally, the varying amounts of information provided by different authors posed a challenge. For example, some authors reported outcomes using the American Orthopaedic Foot and Ankle Society (AOFAS) ankle hindfoot scale, while others only discussed pain, range of motion, and the ability to return to usual activities. Furthermore, some authors detailed surgical approaches, fixation methods, weight-bearing status, and rehabilitation, while others only offered general treatment information. This work is limited by the broad nature of the subject, and the information presented is generalized as a result. Additionally, some of our data come from a mix of cases involving isolated talar open extrusion and talus dislocations with fractures of surrounding bones, which may limit the generalizability of our findings.

Conclusions

Among the various treatment options for this rare injury, immediate reduction and fixation of the talus, combined with complete wound debridement, proper washing, antibiotic prophylaxis, and appropriate clinical follow-up, may successfully prevent infection and facilitate early revascularization. This approach also preserves normal ankle anatomy, restores joint mechanics, hindfoot height, and bone stock for future function and reconstructive procedures. Major surgical interventions, such as talectomy and tibio-calcaneal fusion, should be reserved as salvage procedures.

Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions

DC: study concept, analysis and writing; PF: supervision; ADM: data collection, analysis and writing; DC: data collection and analysis; EG: data collection and analysis.

Ethical consideration

Not applicable.

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