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Talar Neck Fractures Treated With Closed Reduction and Percutaneous Screw Fixation: A Case Series

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Abstract

Talus fractures are the 2nd most common tarsal fractures. The incidence of fractures of the talus ranges from 0.1% to 0.85% of all fractures and 5% to 7% of foot injuries. Fractures of the talar neck account for almost 50% of all talus fractures and Approximately 14% to 26% of talar neck fractures have associated fracture of the medial malleolus (1). Treatment of type I and type II talar neck fractures is debated in the orthopedic community. Choosing which treatment to perform depends on injury severity, associated injuries, and surgeon experience and preference (2). In this article, we retrospectively review and provide our report of all talar neck fractures treated with closed reduction and percutaneous fixation between 2017 & 2022 at MGM Hospital Kamothe, Navi Mumbai.

Keywords: NIL

Introduction

Mechanism Of Trauma –

Talar fractures are frequently associated with a road traffic accident or a fall from a height with a component of hyperdorsiflexion of the ankle. The talar neck fractures as it impacts the anterior margin of the tibia. They were common in plane crash injuries in pilots in the 19th century as sudden deceleration would cause the rudder bar of a crashing airplane to hit the plantar aspect of the foot. (Historically called as Aviator's astragalus)(3)

Anatomy –

The talus is a unique bone with no muscles originating from or inserting onto it. The neck of the talus is roughened by ligamentous attachments and vascular foramina. It deviates medially 15 to 25 degrees and is the most vulnerable to fracture. The vascular supply is dependent on fascial structures to reach the talus; therefore, capsular disruptions may result in osteonecrosis. The vascular supply to the talus consists of:

1. Arteries to the sinus tarsi (peroneal and dorsalis pedis arteries)
2. An artery of the tarsal canal (branch of posterior tibial artery) – Most consistent blood supply to talar body but due to its course at the neck in the tarsal neck it is susceptible to injury
3. The deltoid artery (posterior tibial artery), which supplies the medial body, capsular and ligamentous vessels and intraosseous anastomoses (1)

Evaluation –

Clinically the patient presents with pain, swelling around the ankle associated with restricted range of motion. Radiographic AP, lateral & mortise views should be taken for proper evaluation. CT imaging should be performed to look for intra articular extension of the fracture. Canale view is done specifically to view the neck of the talus & is highly useful to see posttraumatic deformity. MRI is performed to assess for occult talar fractures and development of avascular necrosis. Here are the pre operative x rays of patient from our study.

Right ankle anteroposterior view showing neck of talus fracture

Right ankle lateral view showing neck of talus fracture

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The talar neck fracture classification system developed by Hawkins is frequently utilised. Nondisplaced Hawkins type I talar neck fractures can be managed with a cast immobilisation and no weight-bearing for roughly 6 to 12 weeks. In cases of polytrauma, predicted nonadherence, and/or required early mobility, 12–15 weeks are recommended. Dislocation of the subtalar joint causes displacement of Hawkins type II talar neck fractures. The typical recommendation is that any fracture with 2 mm of displacement or rotational deformity should undergo open reduction and internal fixation in order to reduce this type of fracture and reduce the risk for avascular necrosis (ORIF). The tibiotalar and subtalar joints are displaced and dislocated in Hawkins type III. Type 4 fractures which were initially described by Canale & Kelly involve displaced fractures and includes dislocation of tibiotalar, subtalar and talonavicular joints[(2)]

There is a direct correlation between the grade of Hawkin's classification & risk of avascular necrosis. [(3)]Type I injuries provide a limited risk for AVN because they may only affect one source of the talar blood supply. Two of the three major sources of blood flow may be damaged by type II injuries, and up to 40% of patients in this group may have AVN. All three routes of blood flow to the talus may be lost in type III injuries, and up to 84% of patients in this category may get AVN. and all patients who have type IV injuries acquire AVN. In 1970s Hawkin's discovered a subchondral lucency at the dome of the talus which arised around 6-8 weeks post trauma & what came to be known as Hawkin's sign which is a positive prognostic indicator of the absence of avascular necrosis. [(2)] Canale and

Kelly supported the Hawkins sign by conducting a study in 1978. One patient out of the 23 who displayed the Hawkins sign as early as 12 weeks after the lesion did not progress to AVN. In their article, the authors stated that this subchondral lucency is a symptom of hyperemia and disuse osteopenia and that it correlates well with the unlikely advancement of AVN in the talus. However, they cautioned that a negative Hawkins sign does not always imply that AVN will occur. With a negative Hawkins sign, 20 of 26 patients (76.9%) developed AVN, although only 6 patients (23.1%) did not. This study was conducted prior to the advent of MRI. Since then, research has proven that MRI is the most accurate approach for detecting AVN. In a study conducted by David Thoradson & Mark Triffon in 2016 they used MR imaging to detect the presence of avascular necrosis after open reduction and internal fixation of talar neck fractures and classified the MR scans in the following manner – Type A, no abnormal signal changes in the body of the talus; Type B, signal changes in less than 25% of the body; Type C, signal changes in 25% to 50% of the body; and Type D, signal changes in greater than 50% of the body. Plain anteroposterior radiographs correlated well with MR scans in patients with type D scans. Further study of patients with Hawkins type III fractures and Hawkins type II fractures with equivocal radiographic evidence of avascular necrosis is warranted to try to identify those patients at risk for collapse and perhaps to guide weightbearing recommendations.([4])

Talar fracture dislocation was described first in the 1500s by Egyptians. Frabricus in 1608 reported a fracture dislocation resulting in talectomy. In 1909, Stealy advocated talectomy for talar fracture dislocation and it continued to be the surgical treatment of choice until the early twentieth century [(5)]

Management of the talar neck fracture continues to challenge us even today despite the advancements in its understanding. Factors that account for this paradox include (1) the relative infrequency with which the average orthopaedic surgeon encounters this fracture, (2) the talus being well hidden by the surrounding osseous structures, making adequate exposure, assessment of reduction, and the ability to obtain stable fixation difficult, and (3) the lack of appreciation of the complex biomechanical relationship among the ankle, subtalar, and midtarsal joints. [(6)]

Closed reduction and percutaneous fixation was proposed as an alternative to ORIF by Fayazi and colleagues in 2002. This technique is carried out to shorten surgery time, maintain and/or minimise disruption of the blood flow to the talus, and decrease further trauma to the soft tissue. Although current research suggests that posttraumatic subtalar arthritis is the most frequent consequence following surgical therapy, avascular necrosis is the most incapacitating condition. Our research examined the possibility that using a closed reduction and percutaneous fixation procedure for talar neck fractures could reduce its incidence and possibly enhance clinical outcomes.

In this article, we examine the results of several talar neck fracture cases treated at our facility with closed reduction and percutaneous fixation.

Materials And Methods –

The retrospective analysis of all talar neck fracture cases treated at our hospital between 2017 and 2022 was approved by the institutional review board. The senior surgeon, Dr. Sarabjeet Singh Kohli, identified ten patients in his database of surgical cases. Seven patients satisfied our review criteria for having had closed reduction and percutaneous fixation of the talus. The exclusion criteria being paediatric patients, open injuries, and fractures of Hawkins type IV. Four of the seven patients had injuries consistent with Hawkins type I, two with type II, and one with type III. Six individuals were left for the trial after one patient with a type I fracture was lost to follow-up. The Hawkins method and radiographs were utilised to categorise all injuries.

Closed reduction internal fixation was done for each of those 6 patients and a transfixion pin was placed through the calcaneal tuberosity and attached to a traction bow. Reduction was facilitated by placing the foot in plantarflexion and carefully manoeuvring the heel from varus to valgus with the aid of the transfixion pin. All patients underwent closed reduction and internal fixation with percutaneous pinning.

This procedure begins with an attempt of closed reduction. Intraoperatively image intensifier is used to check whether satisfactory reduction has been achieved. In case of unsatisfactory anatomical reduction, conversion to open reduction maybe necessary. Once satisfactory reduction is achieved and verified under image intensifier a small incision is made on the posterolateral aspect of the heel anterior to the Achilles tendon and posterior to the peroneal tendons. Blunt dissection is done through the subcutaneous tissue to the talar dome. Under fluoroscopic guidance, a 2.0-mm guide wire is inserted slightly superior to the posterolateral talar tubercle and perpendicular to the fracture line. The guide wire is then moved in an anteromedial fashion and is advanced through the dorsum of the foot using the 3 hole AO guide. The second wire is also placed through the same incision just lateral to the 1st wire. Next, 2 partially threaded 4.5-mm cannulated screws are inserted over the 2 guidewires and the skin was sutured with ethilon 3-0. The patient is placed in a 3-sided coaptation splint. Post operative x rays showing closed reduction internal fixation with percutaneous cannulated cancellous screws.

Left ankle AP view showing talus neck fracture fixed with closed reduction & internal fixation with CC screws

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Left ankle lateral view showing talus neck fracture fixed with closed reduction & internal fixation with CC screws

Four postoperative criteria were evaluated using the Hawkins scoring system : pain, limp, ankle range of motion and subtalar range of motion. The maximum number of points being 15.

No pain is - 6 points; pain on fatigue - 3 points; pain while walking - 0 points. The range of motion (ROM) of the ankle and the subtalar joint are each given a score on a three-point scale: 3 for full ROM, 2 for partial ROM, 1 for joint fusion, and 0 for fixed deformity. Scores between 13 and 15 were deemed excellent, 10 to 12 were deemed good, 7 to 9 were deemed fair, and 6 or less were deemed poor. Excellent and good results were satisfactory.

The presence of the Hawkins sign was evaluated six to eight weeks following the injury for the six individuals who were followed up. Additionally, for the purposes of this investigation, a diagnosis of posttraumatic subtalar arthritis was made when reduced range of motion (ROM) and/or pain at the subtalar joint were observed in conjunction with degenerative changes on radiographs.

Results –

The range for the mean age at the time of injury was 20–56 years; the mean time between injury and fixation was 29.6 hours; the mean surgery time was 102 minutes; the mean hospital stay was 1.5 days; and the mean follow-up was 81.5 weeks. Open Hawkins II talar neck fracture on the contralateral foot, ipsilateral talar body fracture, ipsilateral medial malleolar fracture, occipital skull fracture, ipsilateral acetabular fracture, and ulnar styloid avulsion fracture were the concomitant fractures in five individuals. Four of the six patients had good outcomes, one had a fair outcome, and one had a poor outcome. Two of the four patients who had excellent results developed subtalar arthritis, whereas the other two did not develop AVN. Two of the three type I patients had good outcomes, and one patient had a fair outcome. One of the two type II patients achieved good results, while the other did not. The one type III patient experienced excellent outcomes.

The type II patient who had a poor outcome also had a fractured talar body on the opposite side. Subtalar arthrodesis was eventually performed on this patient after they developed AVN and subtalar arthritis and were treated with steroid injections. Subtalar arthritis also developed in two additional patients (type I and type III). Six to eight weeks following the incident, three of the six individuals who were checked had a Hawkins sign. None of these 3 patients experienced AVN. One of the three patients without a Hawkins sign had a type II fracture and radiographic AVN, but the talar dome collapse did not follow. Type of injuries and outcomes are among the data. The patient with a talar body fracture in addition to the talar neck fracture had the sole unfavourable outcome. Posttraumatic arthritis and pain affected three patients. One patient had radiographic AVN identified, but the talar dome did not collapse.

Discussion –

Numerous problems, such as AVN, malunion, nonunion, and posttraumatic arthritis, are linked to talar neck fractures. For displaced talar neck fractures, ORIF is recommended. Canale and Hawkins concurred that ORIF is necessary for type III and type IV talar neck fractures. Treatment still depends on the severity of the damage, any accompanying injuries, the surgeon's experience and preferences, and the type I and type II of the injury.

Several authors, notably Baumhauer and Alvarez, have examined the blood supply to the talus. This source is quite susceptible to talar neck fractures. The majority of the blood arteries that feed the talus enter the head and feed the body backwards. In this arrangement, talar neck fractures may lead to AVN of the talar dome and body. The probability of AVN is inversely correlated with the severity of the damage because of the talus's particular blood supply. The deltoid ligament may be the only source of blood supply left for the dome in type III and type IV fractures. It is crucial to make an effort to protect the soft-tissue envelope that surrounds the talus. Percutaneous reduction is a successful technique for talar neck fractures. Compared with conventional open surgery, the mini- invasive procedure produces rapid bone healing and better functional results [(7)]

There have been no instances of talar malunion, and the majority of Hawkins type I talar neck fractures have favourable clinical outcomes with low risk of AVN. Unsatisfactory outcomes have been observed in type II fractures in as many as 60% of cases, AVN in as many as 71% of cases, and arthritis in as many as 64% of cases. Type III fractures have a worse prognosis than type I and type II fractures, and complications are common. These fractures may be open in 50% of cases, which raises the danger of talar body infections. Up to 91% of these instances have reported receiving unsatisfactory results, and up to 100% have had AVN.

The bad results for these injuries are caused by a number of variables. First, the articular cartilage is severely harmed by the insult to the talus surface at the time of injury, and the damage may lead to posttraumatic arthritis. Second, when ORIF is necessary, severing the soft tissues around them disrupts the already compromised blood supply, which may hasten the emergence of AVN in the talus. Third, if treatment is put off, there is a higher chance that AVN will develop later on8,12,15 even though current studies demonstrate that time to reduction does not predict outcomes, union, or the formation of AVN.

This retrospective study's goal was to assess the incidences of AVN and overall clinical results in talar neck fracture patients who had closed reduction and percutaneous fixation. We looked at the outcomes of six of these patients. Four of these patients (or 67%) received excellent scores (13–15 points) using the Hawkins grading system. Hawkins foot score was reported by Canale and Kelly to be 59%, which is good, but they also included patients who received both ORIF and closed reduction.

Talar neck fracture complications are well documented. In a group of 41 patients, Grob and colleagues observed a 37% incidence of posttraumatic subtalar arthritis [(8)], Canale and Kelly reported a 52% incidence of AVN, and Lorentzen and colleagues reported a 52% incidence of AVN. While Lindvall and colleagues reported a 100% incidence of radiographic post-traumatic arthritis including at least the subtalar joint [(9)], Lorentzen and colleagues reported a 65% incidence of subtalar arthritis (mean follow-up, 22 months) [(10)]. In line with Lorentzen and colleagues' findings, we discovered a 50% incidence of subtalar arthritis and a 17% rate of AVN in the current investigation at a mean follow-up (20 months). We have slightly lower rates of subtalar arthritis and AVN than those reported in the literature, which could be related to our small study size.

Although the study's small sample size and brief follow-up are reasonable criticisms, we should note that the mean follow-up for the four patients who received satisfactory results was 81.5 weeks. This result adds significance to the study because enough time was given for any complications in these patients to be documented. Additionally, the patient who had a favourable outcome merely underwent a 12-week follow-up.

We could contend that this patient's Hawkins score might have been higher with a longer follow-up period (ie, the outcome might have been better). Finally, the possibility of percutaneous fixation is eliminated because these injuries are uncommon and frequently coexist with other conditions that may require ORIF. The soft tissue around the talus is preserved with closed reduction and percutaneous fixation, in our opinion, which reduces the likelihood of radiographic AVN.

However, further research is necessary, especially studies involving a broader patient base. Additionally, it would be beneficial to compare talar neck fractures treated with closed reduction and percutaneous fixation vs talar neck fractures treated with ORIF in the same patient population. Last but not least, time to reduction may be a significant predictor of functional outcome and may be taken into consideration in future research.

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