International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(1): 102-107

www.orthopaper.com
Received: 11-11-2017
Accepted: 13-12-2017

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Clinical and surgical outcome following surgical management of talar neck fractures

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DOI: https://doi.org/10.22271/ortho.2018.v4.i1b.18

Abstract
Fractures of the talar neck & body remain a challenge to the treating surgeon due to the serious nature of the injury and to the potential complications of the treatment. Displaced fracture of the talar neck is associated with a high percentage of permanent disability. The key for the treatment of talus fracture is knowledge of anatomy and the blood supply

Aim of the Study: The aim of the study was to analyze Incidence, age, sex, mechanism of injury, Types of fractures and dislocations, Effectiveness of different methods of fixation, period for union of fractures, complications and their management, Functional outcome.

Clinical Material and Methods: Forty two patients were treated for fracture of talar neck at our institution. This study was conducted retrospectively and prospectively Fractures were classified according to HAWKIN'S classification with modification from S. Terry Canale. Three of them belong to type one (undisplaced); eighteen were type 2; nineteen were type 3; two type 4. The compound factures were classified according to Gustillo and Anderson. Road traffic accident was the cause of trauma in twenty two, fall from height being cause of injury in nineteen, one patient had fall of stone slab on the foot.

Treatment: Forty patients underwent surgery for the fixation of talar neck fractures. Thirty four of the fractures were operated with in twenty four hours after injury of the 40 patients who underwent fixation, open reduction and internal fixation was done in thirty two patients (seventeen type 3, twelve type 2, two type 4, one type 1). Cannulated /cancellous screws were used to fix talus in seventeen patients (16 antegrade, anteromedial to posterolateral. One posterolateral to anteromedial), Orthofix pins were used in eleven patients, K- wire used in twelve of them. All the fractures were evaluated at the end of six weeks after surgery. Plaster cast removed and radiological evaluation of the fracture was done and below knee cast re applied. In the evidence of fracture union active mobilisation started with strict non weight bearing continued until sound fracture union.

Conclusion: Clinical management of the talar neck fractures is complex. Prompt and precise anatomic surgical reduction, preservation of the blood supply, bone grafting of the medial neck comminution, rigid internal fixation to allow joint mobilization post operatively are the guidelines to be followed to reduce poor outcomes.

Keywords: fracture neck talus, avascular necrosis

Introduction
Fractures of the talar neck & body remain a challenge to the treating surgeon due to the serious nature of the injury and to the potential complications of the treatment [1]. Displaced fracture of the talar neck is associated with a high percentage of permanent disability. The key for the treatment of talus fracture is knowledge of anatomy and the blood supply.

The incidence of Talar fracture is 0.14% to 0.9% of all the fractures, which makes it one of the uncommon injuries in the orthopaedic trauma [6]. Fracture of the talus are second in frequency among all tarsal fractures. Talar neck fracture are second in frequency to chip and avulsion fractures of the talus [52].

Aim of the Study
The aim of the study was to analyze the following factors in relation to fracture neck of the talus.

- Incidence of age, sex, mechanism of injury in fracture neck of talus and associated injuries.

- Types of fractures and dislocations
- Effectiveness of different methods of fixation.
- The average period for union of fractures.
- Incidence of complications and their management.
- Functional outcome.

Classification of the Talar Neck Fractures [11, 12, 13, 29]

The classification given by Hawkin in 1970 is the most widely accepted classification system for talar neck fractures. Hawkins's classification system provides a logical order of talar neck fracture dislocation and was used to predict the development of avascular necrosis of the talar body.

The Hawkins classification is based on radiographic appearance of the fracture and the degree of displacement of the body of talus at the time of injury.

Group 1 is a vertical fracture neck of talus, undisplaced, the fracture entering the subtalar joint between middle and posterior facets. The body of the talus retains its normal position in ankle and subtalar joints. Only one of the three main blood supply to the body is interrupted.

Group 2, a vertical fracture of the neck of the talus is displaced, subtalar joint subluxated or dislocated and the ankle joint is normal. Two of the three main blood supply is interrupted in this injury.

Group 3, a vertical fracture neck of talus which is displaced and the body of talus is dislocated from both the ankle and subtalar joint. All the three main sources of blood supply to the body of the talus are damaged in this injury.

Group 4 was described by Terry Canale and Kelly in 1978, in which the fracture of talar the neck was associated with dislocation of the body from the ankle or subtalar joint and with an additional dislocation or subluxation of the head of the talus from the talonavicular joint.

Type I

Type 2

Type 3

Type 4

Clinical Material and Methods

Forty two patients were treated for fracture of talar neck at our institution. This study was conducted retrospectively and prospectively. Among them 40 were male and 2 female patients, aged between 17 to 56 year, average being 30 years. Most of them being in their third decade.

On arrival of the case after primary care, the limb was splinted and under adequate analgesia, clinical and radiological assessment was made. Ankle anteroposterior and lateral, and foot anteroposterior & lateral films were routinely made. If fracture of the neck of the talus was found Canale and Kelly view was taken to assess the comminution of the neck of the talus.

Fractures were classified according to HAWKIN'S classification with modification from S. Terry Canale. Three of them belong to type one (undisplaced); eighteen were type 2; nineteen were type 3; two type 4. The compound factures were classified according to Gustillo and Anderson [11, 26].

Thirty three of them were closed fractures, nine were compound fractures (five type 2, three type 3, one type 4). Seven of the fractures had associated medial malleolus fracture (three type 2, three type 3, one type 4), five of them had bimalleolar fracture (two type 2, three type 3) other fractures found were (5 femur, 4 tibia, other metatarsal fractures in the foot 5, 2 fracture vertebra {all stable, no neurological deficit}, calcaneal facture were found in two, one pelvic fracture, one fracture patella, one fracture humerus, one hip dislocation.

Road traffic accident was the cause of trauma in twenty two, fall from height being cause of injury in nineteen, one patient had fall of stone slab on the foot (direct impact on the dorsum of the foot).

Treatment

Pre-operative assessment was made with respect to the type of fracture, comminution of the neck, displacement of the fragments and extent of soft tissue injury. Splinting, limb elevation, cold pack application was done to minimise soft tissue swelling.

Forty patients underwent surgery for the fixation of talar neck fractures. Two type one fractures were treated with below knee plaster cast. Thirty four of the fractures were operated with in twenty four hours after injury. One of the polytrauma patient had fat embolism, other had compound fracture femur and compound tibia with hypovolemic shock, four of them being referred from other hospital after 24 to 36 hours after injury (two type 3, one type 2, one type 4) all the fractures were operated with in 24 hours of admission.

For closed fractures, under spinal /general anaesthesia and under image intensifier control the fracture was reduced. If the anatomical reduction was achieved, provisional fixation with the k –wire was done followed by Cannulated screw / Orthofix pins were used to stabilize the fracture. Eight of the patients were treated with closed reduction & fixation; six type two, two type three. Whenever the closed reduction failed open reduction was done.

In compound fractures meticulous debridement of the wound was done. All the compound fractures were fixed after reduction of the fracture under vision. Most of the fixation was done with the K wires to keep the hard ware material to minimum of the 40 patients who underwent fixation, open reduction and internal fixation was done in thirty two patients (seventeen type 3, twelve type 2, two type 4, one type 1). The type I fracture which was associated with compound fracture lower third tibia was fixed with K wire & external fixator for tibia.

Cannulated /cancellous screws were used to fix talus in

seventeen patients (16 antegrade, anteromedial to posterolateral. One posterolateral to anteromedial), Orthofix pins were used in eleven patients, K- wire used in twelve of them (always two pins or two K wires were used and the stability of the fixation was checked under image).

Osteotomy of the medial malleolus was carried out in 16 patients, lateral malleolus was osteotomised in one patient (out of forty patients, seven had medial malleolar fracture and five had bimalleolar fracture which helped in reduction of the fracture). Most of the medial malleolus was fixed with malleolar screw.

When ever soft tissue was healthy surgical wounds were closed primarily and compression bandage was given.

Routinely a posterior below knee slab was used post operatively.

Compound facture were redebrided, followed by secondary closure when permitted. Limb was immobilized in below knee slab untill sutures were removed. After wound healing a below knee plaster cast was given and patients mobilized non weight bearing with the help of axillary crutches.

All the fractures were evaluated at the end of six weeks after surgery. Plaster cast removed and radiological evaluation of the fracture was done and below knee cast re applied. In the evidence of fracture union active mobilisation started with strict non weight bearing continued until sound fracture union.

Results and Analysis

All the fractures were evaluated at six weeks after fixation and at every four week interval subsequently. All the patients were on non-weight bearing crutch walking with below knee plaster cast until radiological union of the fracture.

Ten of the fractures united by twelve weeks, 19 united in 14-16 weeks, twelve of them united by 18–20 weeks. Average time taken for union being 15.4 weeks. No cases of non-union was noted. One talar body was excised due to osteomyelitis.

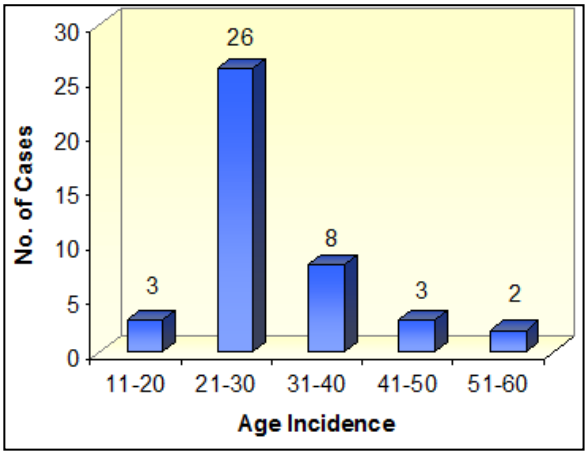
Hawkins scoring system [29, 12, 14] was used for evaluation of the out come of treatment of talar neck fractures. (Hawkin's scoring system is given in proforma for evaluation).

Sixteen of them had excellent outcome {one type one, thirteen type 2, one type 3, one type 4}, good result in twelve patients {one type 1, two type 2, nine type 3}. Fair result in seven patients {one type 1, two type 2, four type 3}, seven patients had poor out come (one out of the ten compound fractures had osteomyelitis, four AVN with complete collapse of the body, two had secondary osteoarthrosis.

Avascular necrosis of the body of the talus was noted in eleven of the fractures (two type 2, nine type 3). Four patients had collapse of the body (three type 3, one type 2).

Arthritic changes were noted in five of the patients which were proportional to the severity of the initial injury. Four patients were treated with Blair's arthrodesis. Three of the patients (type 3) underwent triple arthrodesis. One patient was treated with sub talar fusion (type 2). Two type 3 underwent pantalar fusion in two stages. One ankle arthrodesis was done for secondary orthrosis of the ankle. Arthrodesis of the joints were done only for persistent symptomatic patients after trial of conservative treatment.

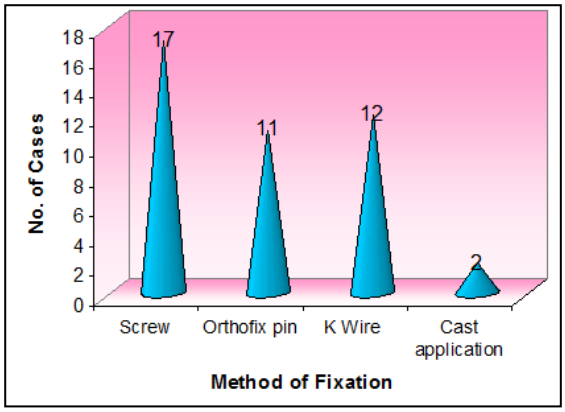
One case of compound fracture with osteomyelitis was treated with repeated debridement and excision of the body followed by immobilisation in plaster cast which finally ended in fused peritalar joints. Remaining eight compound factures healed without osteomyelitis.



Mechanism of Injury	No. of Cases
Road traffic accident	22
Fall from height	19
Direct injury	1

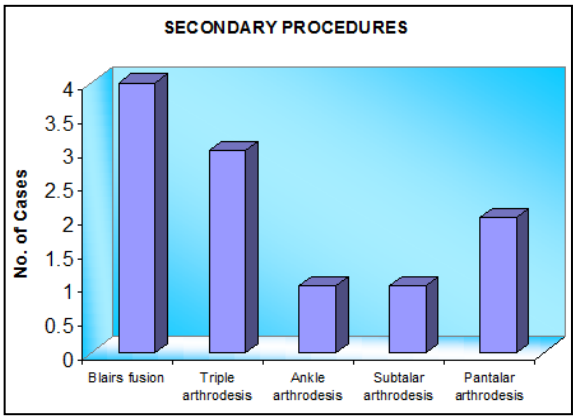
Incidence according to hawkin's classification

Type I	3	7.14%
Type II	18	42.86%
Type III	19	45.23%
Type IV	2	4.76%



Incidence of Complication

Complication	No. of Cases	Percentage
Avascular necrosis	11	26.2%
Secondary orthrosis	5	11.9%
Malunion	2	4.8%
Osteomyelitis	1	2.3%



Results

	Type I	Type II	Type III	Type IV	Total
Excellent	1	13	1	1	16 (38%)
Good	1	2	9	0	12 (28.6%)
Fair	1	2	4	0	7 (16.7%)
Poor	0	1	5	1	7 (16.7%)

Results reported as good or excellent after talar neck fractures [6]

Group	Hawkins 1970	Canale 1978	Penny 1980	Comfort 1985	Pajenda 2000	Our series 2002
I	100%	93%	40%	100%	95%	66.7%
II	44%	57%	36%	83%	95%	83.33%
III	15%	37%	9%	100%	70%	52.63%
IV	-	0	0	100%	10%	50%

Hawkin's Type I

8 weeks

4 months follow up

Hawkin's Type 2

Post Op

Avascular necrosis with collapse of the body

Post traumatic osteoarthrosis

Discussion

We treated forty two talar neck fractures. This was retrospective as well as prospective study done to evaluate the outcome of treatment in our institution. In our study 40 were male out of 42 cases (95.23%), the average age being 30 years.

Twenty two of the fractures were due to road traffic accident (52.4%), 19 were due to fall from height (45.2%), one case (2%) was due to direct fall of stone slab over the foot. According to modified Hawkins classification we had three type 1 fracture, 18 type 2 fractures, 19 type 3, two type 4 fractures. Of the three type 1 fracture one had excellent outcome.

Among other two fractures one was associated with ipsilateral compound tibial fracture (Gustillo & Anderson type three) which was treated with percutaneous fixation and tibia was treated with external fixator for six weeks followed by above knee cast for ten weeks. Although talar fracture united uneventfully residual stiffness in the sub talar & ankle joint (due to immobilisation for fracture tibia) resulted in Hawkins score of 9 (fair result).

The other type one fracture with ipsilateral depressed calcaneal fracture resulted in fused subtalar joint resulting in good outcome (10/15).

Generally type 1 fractures have excellent or good out come in all studies {Hawkins (1970) 100%, Canale (1978) 93%, Penny (1980) 40%, Comfort (1985) 100%, Peterson (1977) 75%, Pajenda (2000) 95%} [6]. But in our cases out come of type I talar fractures was influenced by the natural history of the associated fractures.

Among eighteen type two fractures, thirteen had excellent out come, two good, two fair & one poor. A total of fifteen out of eighteen fractures were in excellent / good group, 83.3%

{Hawkins (1970) 44%, Canale (1978) 57%, Penny (1980) 36%, Comfort (1985) 83%, Peterson (1977) 32%, Pajenda (2000) 95%} [6]. Out of three fair / poor out come, one patient had secondary arthrosis which was treated with triple arthrodesis who is pain free at present. The second patient with avascular necrosis without much collapse of the body had persistent pain and limitation of subtalar movement and was rated as poor out come, he refused fusion of the joint. The third patient who had limited ankle movement secondary to concomitant compound bimalleolar fracture was rated as fair group (9/15). Among the eighteen, six fracture were treated with closed reduction & percutaneous fixation. These fractures were in excellent/good out come group, hence when ever closed anatomical reduction can be achieved and a per cutaneous fixation is done, excellent outcome can be expected.

In nineteen type three fractures, ten were in excellent / good out come group; 52.6% {Hawkins (1970) 15%, Canale (1978) 37%, Penny (1980) 9%, Comfort (1985) 100%, Peterson (1977) 55%, Pajenda (2000) 70%} [6]. Two of these were treated by closed reduction and percutaneous fixation. Four of the 19 fractures were rated as fair and five of the 19 fractures were rated as poor. The causes of compromised out come were avascular necrosis, subtalar stiffness due to secondary arthrosis, and malunion. Three fractures with AVN and collapse were treated with Blair's fusion, one with triple arthrodesis, two pantalar arthrodesis in two stages.

One type four variant (fracture neck of talus with dislocated head of talus from talonavicular joint with reduced ankle and sub talar joint) [33] had excellent outcome. The other compound type four fracture resulted in osteomyelitis which was treated with repeated debridements and excision of avascular body which ended in fusion at sixteenth week in a below knee cast.

All our fixations were stable. None of the reductions were lost where K wire or Orthofix pin was used. We did not have any delayed union (ie more than six months for union after injury, Peterson). The average time taken for union was 15.4 weeks, with no nonunions.

Using Hawkins scoring system we had 38.1% excellent, 28.6% good, 16.7% fair, and 16.7% poor results.

Incidence of AVN was 26.2% (in literature the overall incidence is 21% - 58%) [52], post traumatic arthrosis was found in 11.9% (the incidence of post traumatic orthrosis may increase with longer follow up, unsatisfactory results ranger as high as 60% in the literature) [52]. Osteomyelities was found in 2.3% of the cases. Malunion was found in 4.8% of the cases.

Most of our poor results were from type 3 and type 4 group. Hence the final out come of the talar neck fractures is mainly determined at the time injury, but with proper management good results can be achieved.

Conclusions

Clinical management of the talar neck fractures is complex and fraught with complications. An intricate knowledge of the anatomy and the blood supply to the talus is necessary for proper treatment. Often the outcome of talar neck fracture is determined at that time of injury, better results can be achieved by following some simple guidelines [6, 21].

Prompt and precise anatomic surgical reduction, preferring the medial approach with secondary antero-lateral approach, preservation of the blood supply, bone grafting of the medial neck comminution, rigid internal fixation to allow joint mobilization post operatively are the guidelines to be followed to reduce poor outcomes.

Since mal-union is one of the major reason for poor clinical result, initial recognition of the talar neck fracture pattern is of paramount importance. Often with these injuries dorsal or medial comminution is seen. Attempted reduction without the appreciation for this hyperdorsiflexion impact injury may lead to a dorsal or varus mal union or mal rotation leading to significant decrease in subtalar motion [6].

The incidence of post traumatic osteonecrosis can be reduced with emergent treatment of displaced fractures. The presence of avascular necrosis does not necessarily mean a poor result, as long as collapse of the dome does not occur, restoration of the joint may take place. Weight bearing is determined by fracture healing, rather than by the state of the avascular talus. If osteonecrosis develops and is symptomatic, a modified Blair arthrodesis or tibiotalar arthrodesis has had reasonable success [15, 16, 17].

In the case of post traumatic arthrosis, ankle arthrodesis or subtalar arthrodesis should provide acceptable pain relief and function, if planned and executed carefully. The active patient is not disabled by the fusion of the tibiotalar joint, but the fused subtalar joint is difficult to compensate. By the fusion of the tibiotalar joint, revascularization may take place and may save the subtalar joint.

An established osteomyelitis of the talus may be resistant to treatment because it is composed almost entirely of cancellous bone and is largely devoid of blood supply after fracture through the neck. The preferred treatment in fractures complicated by infection is excision of the infected bone followed by arthrodesis [16, 17, 25].

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