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FRACTURES OF THE NECK OF THE TALUS

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The fracture of the neck of the talus is the commonest major injury of this bone and it is generally regarded as a serious traumatic lesion of the ankle (Coltart 1952, Pennal 1963, Mindell et al. 1963). This is mainly because of the various and severe complications which usually follow this fracture whenever it is associated with subtalar subluxation or dislocation of the body of the talus (McKeever 1963, Kenwright & Taylor 1970, Hawkins 1970).

The management of this fracture and of the complications is difficult. It has been improved, however, since Anderson (1919) described the mechanism of injury and by recognition of the importance of early reduction (Miller & Baker 1939, Boyd & Knight 1942). Nevertheless even today the results of treatment of this fracture as a whole are generally poor (Pennal 1963, Mindell et al. 1963, Hawkins 1970). This is mostly due to frequent complications such as avascular necrosis of the displaced talar body, osteoarthritis of the subtalar and/or the ankle joint and sepsis. Many of these injuries are compound or become open because of sloughing of the skin stretched over the dislocated body of the talus.

Classification

The fractures of the neck of the talus are generally divided into three groups of different severity and prognosis, i.e. the fractures with minimal or no displacement, the displaced ones associated with subluxation of the posterior subtalar joint and the fractures in which the body of the talus is completely dislocated from both the ankle and subtalar joints (Coltart 1952, Watson-Jones 1960, Pennal 1963, Hawkins 1970). This widely used classification is easy to make from the

Table 1. Types in twenty fractures of the neck of the talus.

Group	Type of injury	No. of cases
1	Fracture of the neck with minimal or no displacement and without dislocation	4
2	Fracture of the neck with displacement and subtalar subluxation or dislocation	9
3	Fracture of the neck with total dislocation of the body of the talus	6
4	Fracture of the neck with dislocation of the head of the talus	1
	Total	20

radiographic appearance; it suggests the severity of the injury in each group and indicates the line of the initial treatment and the prognosis.

MATERIAL AND METHODS

This is a series of 20 fractures of the neck of the talus treated from 1961 to 1970. Fractures involving the body of the talus and minor injuries such as flakes from the neck of the bone are not included in the series.

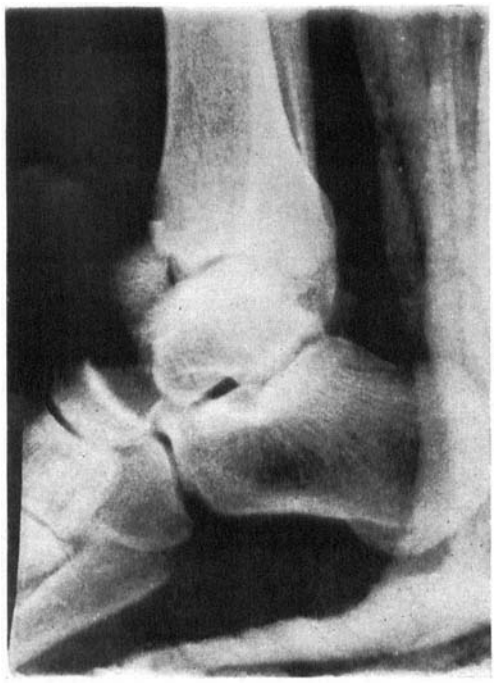

Figure 1. Lateral radiograph showing the unusual compound fracture of the neck of the talus with superior displacement of the head and dislocation of the astragaloscaphoidal joint before reduction. The injury became infected.

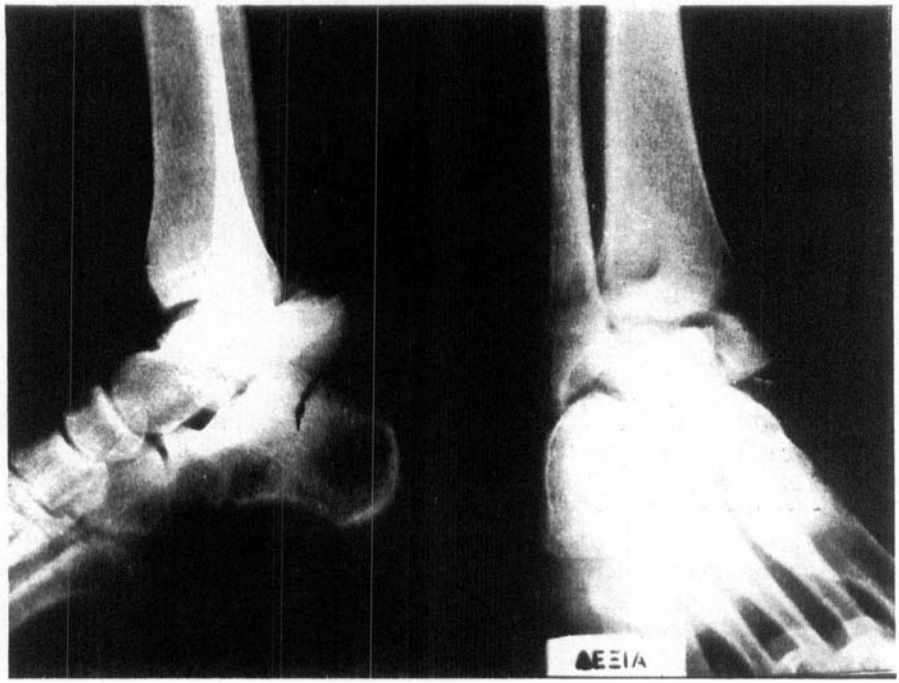

Figure 2 a. Lateral and antero-posterior radiographs showing an unusual fracture dislocation of group 3. The body of the talus is upside down. Note the associated fracture of the medial malleolus.

Age and sex: The age of the patients ranged from 9 to 59 years with an average age of 32 years. Sixteen patients were male and 4 female.

Cause and mechanism of injury. Thirteen of the patients were involved in motor cycle or car accidents and 7 had a fall from a height. It was difficult to determine the mechanism of injury in most of our patients. Many of those involved in car accidents were drivers or front seat passengers and it is presumed that a dorsiflexion force was the cause of the injury. Two of our 6 patients with total dislocation of the body of the talus had an oblique or vertical fracture of the medial malleolus in association with the fracture of the neck of the talus. This possibly indicates that external rotation and/or adduction forces in addition to hyperextension are involved in the mechanics of the injury.

Type of injury. The vertical fracture of the neck of the talus was usually associated with either subluxation of the subtalar joint or complete dislocation of the talar body (Table 1). There was one case in this series with a compound fracture through the anterior portion of the neck in which the head of the talus was displaced superiorly so that there was a dislocation of the astragalo-scaphoidal joint, the body of talus retaining its normal position in the ankle and the subtalar joint (Figure 1). This very unusual type of injury could not be classified in any

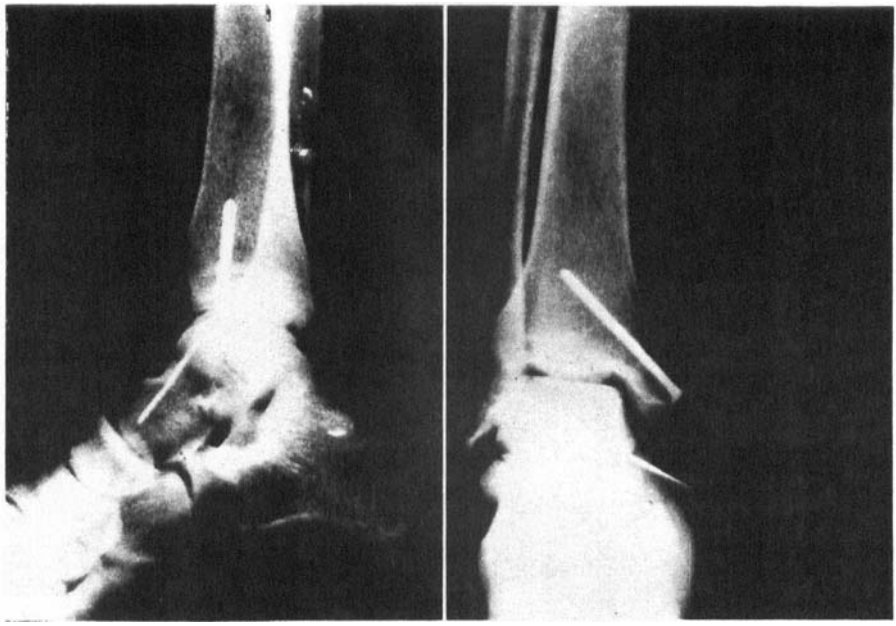

Figure 2 b. The same case at the end of open reduction and internal fixation of the fractures.

of the three groups in which the fractures of the neck of the talus are generally divided.

In group 3 injuries there was one case of a fracture of the neck with a unique degree and direction of rotation of the dislocated body of the talus (Figure 2 a). In this case the talar body, dislocated from both the ankle and the subtalar joints, was rotated through 180 degrees on its transverse horizontal axis so that it was lying upside down. This case has been reported as an extremely unusual type of fracture-dislocation (Pantazopoulos et al. 1972).

Apart from the open fracture with the unusual dislocation of the head of the talus in group 4, one fracture-dislocation in group 3 was a compound injury while a second one became open and infected because of sloughing of the skin stretched over the displaced body of the talus.

Treatment

The group 1 fractures were treated by immobilisation in a non-weightbearing below-knee plaster for 8–12 weeks at which time there was evidence of union in every case.

In 5 out of the 9 fractures of group 2, reduction was accomplished by closed methods. The foot was immobilised for the first 6–8 weeks in plantar-flexion so that satisfactory reduction of both the fracture and the dislocation were obtained and in eversion whenever there was medial subtalar subluxation. Then the plaster was changed and the foot immobilised in less flexion or neutral position until there

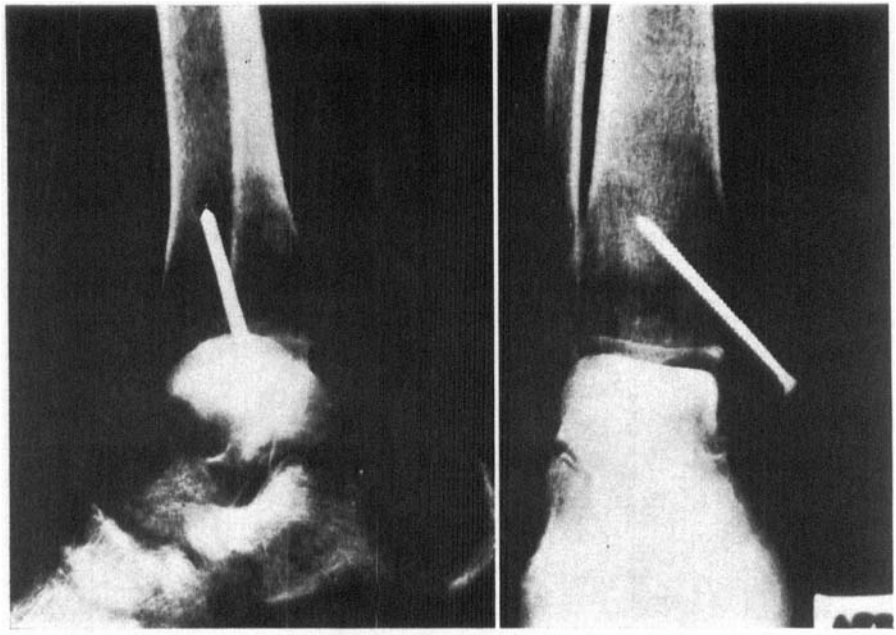

Figure 2 c. Eight weeks later at the time of removal of the Kirschner wire and change of plaster. Avascular necrosis of the body of the talus is obvious.

was radiographic evidence of union, usually for another 6–8 weeks. Protected weightbearing was then allowed. Open reduction was carried out in the remaining 4 cases of this group after attempted closed manipulation had failed. A medial approach was used and the fracture was usually fixed by a Kirschner wire. Postoperatively the leg was immobilised in a below-knee plaster until the fracture was united, usually for 12–14 weeks. In the case of avascular necrosis of the body of the talus, a usual complication in this group of fractures, plaster immobilisation was prolonged and so was the non-weightbearing period which varied from 5–12 months from the time of injury.

In most of group 3 fracture-dislocations closed reduction was attempted as an emergency, without success. Open reduction therefore was carried out for all the patients of this group and for the single case of group 4, apart from one case for which astragalectomy was performed. This was the patient whose admission was delayed and in whom sloughing of the skin occurred over the displaced talar body and sepsis developed. A tibio-calcaneal fusion was carried out later. As a routine a Steinmann pin was inserted transversely through the calcaneum to facilitate closed reduction. Then the pin was left in place since it was found to be a great help in distracting the os calcis from the tibia during open reduction. As in group 2 the medial approach was used and the fracture was usually fixed by a Kirschner wire (Figure 2 b). Plaster immobilisation was continued for various periods of time after union of the fracture while weightbearing was not allowed for 5–14 months since in all cases in this group avascular necrosis of the body of the talus developed.

Table 2. Complications for each group of fractures.

Group	No. of cases	Sepsis	Avascular necrosis	Osteo-arthritis
1	4	–	–	1
2	9	–	4	6*
3	6	1	5§	4
4	1	1	–	1
Totals	20	2	9	12

* Includes the four (4) cases with avascular necrosis which also developed osteoarthritis.

§ Excludes only one patient of group 3 in whom infection developed, and the body of the talus was excised.

RESULTS

All the patients were reviewed by us and evaluated on the basis of pain, presence of limp, and range of movement in the ankle and subtalar joint according to Hawkins' (1970) numerical rating.

The follow-up varies from one and a half to nine years. The complications for each type of fracture are shown in Table 2 and the clinical results in Table 3.

Complications

All the fractures of group 1 had an excellent or good result. Complications did not appear apart from slight osteoarthritis of the subtalar joint in one patient aged 54 years.

In the majority of group 2 injuries (6 out of 9) and in all the cases of group 3, serious complications developed resulting as a rule in a fair or poor outcome.

Table 3. Clinical results for each group of fractures.

Group	No. of cases	Excellent	Good	Fair	Poor
1	4	3	1	–	–
2	9	2	2	2	3
3	6	–	1	2	3
4	1	–	–	–	1
Totals	20	5	4	4	7

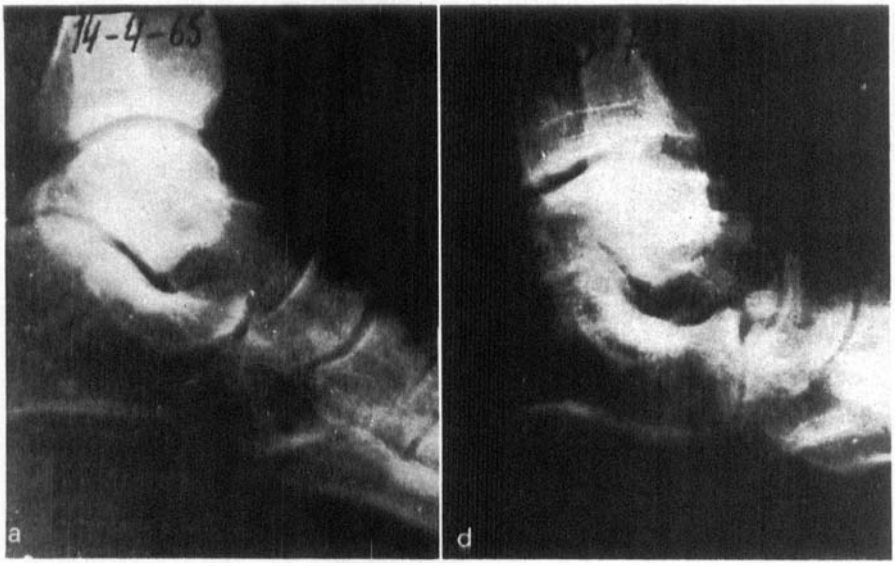

Figure 3 a. Lateral radiograph showing advanced replacement process of the bone of the talar body two years following avascular necrosis.
Figure 3 b. Six years later. Collapse of the body of the talus has occurred and osteoarthritis developed.

Avascular necrosis occurred in 4 out of the 9 group 2 fractures and in all of group 3. All these patients developed osteoarthritis in the subtalar and/or the ankle joint with collapse of the talar body in many of them (Figure 3) regardless of the length of time of protection from weight-bearing, being from five months to more than one year. The only exception so far is one case of group 3 in which osteoarthritis could still develop since the period from the time of injury is only one and a half years.

Osteoarthritis developed in two more cases of group 2. In one of them the dislocation of the subtalar joint had been overlooked.

Sepsis occurred in 2 out of the 7 cases of groups 3 and 4. One of these was the closed injury with delayed admission and sloughing of the skin and the other was the compound unusual fracture-dislocation of group 4.

Clinical results

Three of the 4 patients of group 1 had an excellent result while the 4th had a good outcome, since only slight osteoarthritis of the subtalar joint developed.

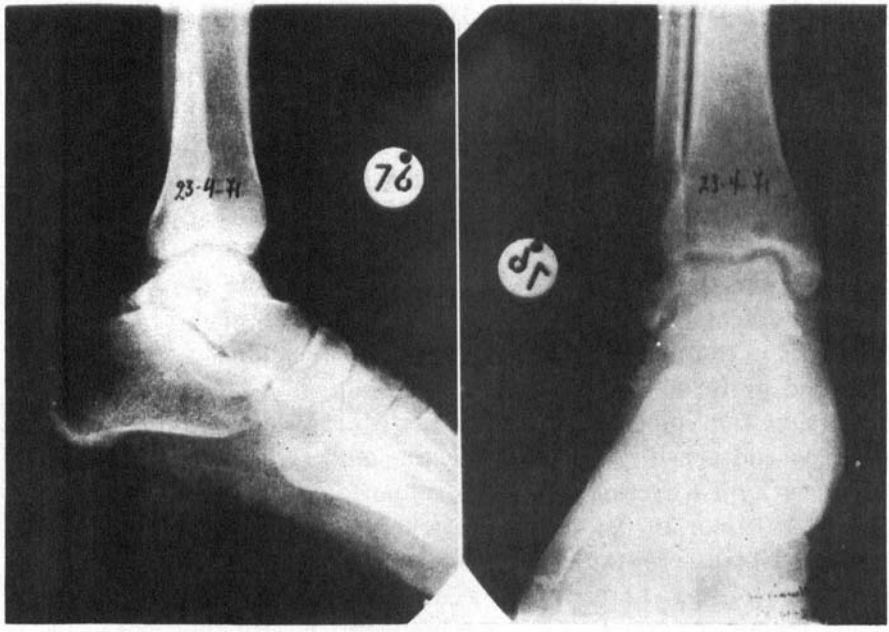

Figure 4. Lateral and antero-posterior radiographs showing only slight osteoarthritis of the subtalar joint seven years after avascular necrosis of the body of the talus following a neck fracture-dislocation. The repair process of the dead bone of the body has almost been completed.

Of the 9 patients of group 2, 5 had only a fair or poor outcome as a result of avascular necrosis in 3 of them and osteoarthritis in the other two. The fourth patient with avascular necrosis in this group had a good result. Only slight osteoarthritis of the subtalar joint had developed seven years after injury (Figure 4).

Five out of the 6 patients of group 3 had a fair or poor result because of sepsis in one case and avascular necrosis with osteoarthritis in the other four. The 6th case of this group was classified as a good result, although osteoarthritis could still appear.

The unusual type of injury of group 4 for which eventually a pantalar arthrodesis was carried out is classified as a poor result according to the rating used.

DISCUSSION

The fractures of the neck of the talus as a whole are serious injuries and of poor prognosis. The severity of the injury, however, and the

incidence of complications vary greatly with the type of fracture. In a group 1 fracture serious complications do not occur and the results of their treatment are very good (Coltart 1952, Pennal 1963, Kenwright & Taylor 1970, Hawkins 1970). In group 2 fractures the prognosis is unfavourable while in those of group 3 it is very poor indeed, because of the development of frequent and serious complications (Coltart 1952, Pennal 1963, Mindell et al. 1963, Hawkins 1970).

The occurrence of avascular necrosis of the body of the talus predominates in the prognosis of this injury. Therefore the management of the avascular necrosis and the primary treatment are the main problems in the therapy of these fracture-dislocations.

Closed or the usually required open reduction should be done on admission for compound and closed injuries alike to prevent skin necrosis and sepsis. Accurate reduction and fixation of the unstable fractures by a Kirschner wire is of importance (McKeever 1963, Kenwright & Taylor 1970). The medial approach is usually recommended through which screwing of the commonly fractured medial malleolus is also performed (Coltart 1952, Pennal 1963, Hawkins 1970). When it is not fractured, osteotomy of the malleolus is probably preferable to the release of the deltoid ligament. This would better facilitate the reduction of group 3 fractures and it interferes less with the arterial branch of the deltoid ligament. This artery is described as one of the three main sources of blood supply to the body of the talus and it has many anastomoses with the other arteries contributing to the blood supply of the talus (Mulfinger & Trueta 1970).

Avascular necrosis of the body of the talus can be easily identified 6–8 weeks after the injury because the body of the talus unaffected by osteoporosis shows up apparent increased density at that time (Figure 2 c). True increase in the density of the avascular talar body is clearly demonstrated later and for many years following the injury. This is an absolute increased density, however, and it represents the healing process of the bone which has been dead. This can only occur while the bone is being revascularised. As new bone is being laid down on the surface of the necrotic trabeculae which have not yet been absorbed completely, increased density appears on the radiographs, as with revascularisation of other bones (Harris & Bobechko 1960, Catto 1965 a, 1965 b).

Opinions vary greatly as to the proper management of avascular necrosis of the body of the talus. Operative methods of treatment such as bone grafting or subtalar fusion to encourage the replacement pro-

cess of the dead bone and talectomy with or without tibio-calcaneal arthrodesis have not been proved worth considering (Pennal 1963, Kenwright & Taylor 1970, Hawkins 1970). On the other hand osteoarthritis usually develops in the subtalar joint, in which case only arthrodesis of this joint is required. Even when fusion of the ankle would be demanded the chances of successful arthrodesis are much higher when the talar body has been left in place and replaced by living bone.

Avascular necrosis is better managed by first allowing the fracture to heal in a non-weightbearing plaster after it has been accurately reduced and fixed by a Kirschner wire. Non-union did not occur in our cases with avascular necrosis and according to other reported series it is an exceptionally rare complication, although some delay in healing could occur (Pennal 1963, Mindell et al. 1963, Kenwright & Taylor 1970, Hawkins 1970). In this case immobilisation in plaster should be maintained until radiographical union. Once the fracture has united, the question arises as to the period of time during which protection from weightbearing is required. This period varied from several months to more than a year in 7 of our 9 cases with avascular necrosis but prolonged non-weightbearing did not always prevent collapse of the talar body. On the other hand in the remaining 2 cases collapse did not occur in spite of initiation of weightbearing soon after the healing of the fracture. This has also been found by many other authors (Mindell et al. 1963, Hawkins 1970). For these reasons and the fact that no surgery has been proved to speed up the prolonged replacement process of the avascular body of the talus or to prevent its collapse, it seems reasonable that progressive weightbearing could be allowed once bony union of the fracture of the neck of the talus has been achieved.

SUMMARY

This is a report of 20 fractures of the neck of the talus followed up from one and a half to nine years.

They are classified in the 3 usually described groups, to which a further group has been added to include one case of a fracture with an unusual dislocation of the head of the talus.

Their initial treatment and the final results are mentioned and discussed. In group 1 fractures a very good result is the expected outcome. The prognosis of group 2 fractures is unfavourable while for those in

group 3 it is very poor because of the development of serious complications which are difficult to treat.

Provided a satisfactory primary treatment of these fracture-dislocations has been carried out, the outcome almost entirely depends on the appearance of avascular necrosis of the body of the talus. The treatment of this complication is discussed.

REFERENCES

Anderson, H. G. (1919) *Medical and surgical aspects of aviation.* Oxford University Press, Hodder & Stoughton, London.

Boyd, H. B. & Knight, R. A. (1942) Fractures of the astragalus. *Sth. med. J. (Bgham, Ala.)* **35**, 160.

Catto, M. (1965 a) A histological study of avascular necrosis of the femoral head after transcervical fracture. *J. Bone Jt Surg.* **47-B**, 749.

Catto, M. (1965 b) The histological appearances of the late segmental collapse of the femoral head after transcervical fracture. *J. Bone Jt Surg.* **47-B**, 777.

Coltart, W. D. (1952) Aviator's astragalus. *J. Bone Jt Surg.* **34-B**, 545.

Harris, W. R. & Bobechko, W. P. (1960) Radiographic density of avascular bone. *J. Bone Jt Surg.* **42-B**, 626.

Hawkins, G. L. (1970) Fractures of the neck of the talus. *J. Bone Jt Surg.* **52-A**, 991.

Kenwright, J. & Taylor, R. G. (1970) Major injuries of the talus. *J. Bone Jt Surg.* **52-B**, 36.

McKeever, F. M. (1963) Treatment of complications of fractures and dislocations of the talus. *Clin. Orthop.* **30**, 45.

Miller, O. L. & Baker, L. D. (1939) Fracture and fracture-dislocation of the astragalus. *Sth. med. J. (Bgham, Ala.)* **32**, 125.

Mindell, E. R., Cisek, E. E., Kartalian, G. & Dziob, J. M. (1963) Late results of injuries to the talus. *J.Bone Jt Surg.* **45-A**, 221.

Mulfinger, G. L. & Trueta, J. (1970) The blood supply of the talus. *J. Bone Jt Surg.* **52-B**, 160.

Pantazopoulos, T., Kapetsis, P., Soucacos, P. & Giannakis, E. (1972) Unusual fracture-dislocation of the talus. *Clin. Orthop.* **83**, 232.

Pennal, G. F. (1963) Fractures of the talus. *Clin. Orthop.* **30**, 53.

Watson-Jones, R. (1960) *Fractures and joint injuries.* 4th ed., Vol 2, E. & S. Livingstone Ltd., Edinburgh and London.

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