Injuries of the midfoot

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Summary Injuries of the midfoot are relatively rare but they can lead to significant morbidity if missed. Serious injuries may present in a subtle manner and are often misdiagnosed as a sprain. Small avulsion fractures of the navicular and cuboid may be misdiagnosed as a simple avulsion when in fact they represent a more severe midfoot injury. A high index of suspicion is required. Good quality X-rays with three views must be obtained and if suspicion exists further imaging with a bone scan, CT or MRI is necessary. Prompt diagnosis and early treatment will prevent long-term disability and morbidity. Salvage procedures following these injuries often involve arthrodesis that limit mobility and frequently lead to an unsatisfactory outcome.

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Introduction

Injuries of the midfoot are relatively rare. If these injuries are missed, however, they can lead to significant morbidity and disability. Early recognition of these injuries and prompt accurate treatment may minimise the long-term morbidity. Accurate diagnosis using standard three views X-rays and if necessary followed by CT, MRI or bone scans should identify most injuries and aid in the management. Salvage procedures often include arthrodesis of the affected joints and the results of this are rarely good. This review will describe the common injuries of the midfoot including their classification, investigations, treatment and outcome.

Anatomy of the midfoot

The midfoot is a relatively rigid structure in comparison to the hindfoot and forefoot and as such it provides a stable structure to transmit load. The bones comprising the midfoot include the cuboid, navicular and the three cuneiforms.

The cuboid supports the lateral column and is positioned between the calcaneum and the base of fourth and fifth metatarsals. The calcaneocuboid joint is saddle shaped. The dorsal surface is traversed by extensor digitorum brevis and peroneus tertius. Ligaments from the dorsum attach...
widely to the navicular, lateral cuneiform and fourth and fifth metatarsals. On the plantar aspect
the cuboid has a groove for the peroneus longus tendon. Ligaments on the plantar surface spread to
the fourth and fifth metatarsals and calcaneum as well as to the navicular and lateral cuneiform.
The cuboid articulates with the navicular and a facet for the navicular bone exists in 45.5–54.5% of
feet.1

The navicular (scaphoid) is interposed between the cuneiforms and talus. The joint surface is
concave proximally and convex distally with facets for the cuneiforms. Similar to the talus most of its
joint surface is covered with cartilage. The calcaneonavicular, talonavicular and navicular-cu-
neiform ligaments attach dorsally. The anterior, tibionavicular, part of the deltoid ligament also
supports the anteromedial aspect of the joint. The tibialis posterior tendon inserts into the medial
tuberosity. A separate tuberosity from the main navicular is known as the naviculare secundarium.
The head of the talus lies in a deep socket or acetabulum pedis formed by the navicular, anterior
calcaneum, the bifurcate ligament and calcaneo-
navicular ligaments. The superomedial calcaneo-
navicular ligament originates from the sustentaculum tali and inserts on to the navicular. The articular surface is smooth and fibrocartilagi-
inous on the volar aspect. The spring ligament
(inferior calcaneonavicular ligament) originates
from the coronoid cavity of the calcaneus ante-
riorly and inserts into the volar aspect of the
navicular. The bifurcate ligament (ligament of
Chopart) is formed by the lateral calcaneonavicular
and medial calcaneocuboid ligament.

The blood supply of the navicular is derived from
a branch of the dorsalis pedis artery dorsally and
from a branch of the medial planter artery volarly. The tuberosity receives branches from an anasto-
omosis of these two. A rich anastomosis exists around the circumference of the navicular and a paucity of vessels supplying the central one-third occurs in adults. Torg et al.2 showed with micro-
angiographic studies that the lateral and medial third were vascular and the central one-third avascular. This probably accounts for the increased rate of non-union and avascular necrosis seen following fracture.

The three cuneiforms are positioned between the
navicular and the first three metatarsals. They form
a transverse arch with the cuboid. The medial
articulates a plantar-based wedge, whereas the inter-
mediate and lateral cuneiform have a dorsally
based wedge. The middle cuneiform is recessed
8 mm relative to the medial and 4 mm relative to
the lateral cuneiform, which creates the mortise
for the second metatarsal base, rather like a tenon
in a tenon joint.

Numerous accessory bones exist around the
midfoot and they are thought to be developmental
anomalies. The os tibiale (naviculare secundarium)
is located on the posteromedial aspect of the
navicular and incorporated in the tibialis posterior
tendon. It is seen in 3–12% of feet and may have a fibrous, fibrocartilaginous or bony connection. The os supranaviculare (Pirie’s bone) is located dorsally to the talonavicular joint and the os vesalianum lies just proximal to the fifth metatarsal tuberosity base. The os peroneum lies in the tendon of peroneus longus under the cuboid. Tendon ruptures often occur in the region and may be misdiagnosed as an avulsion fracture of the fifth metatarsal or cuboid. Awareness of these accessory bones is important to avoid misdiagnosing fractures.

The midfoot joints consist of the Chopart’s joints
i.e. the talonavicular and calcaneocuboid, and the
lesser tarsal bones, the navicular, cuboid and
cuneiforms.

The cuboid and navicular act as an amphiarthro-
sis and move together on the anterior calcaneum
and talar head. A longitudinal and transverse axis
exist. The longitudinal axis is 15° upwards to horizontal and 9° medial.3 The movement around
this axis is supination and pronation and also helical
with a screwlike action. The second transverse axis
is steeper and oblique with dorsiflexion-abduction
or plantarflexion-adduction with the calcaneus and talar head fixed.

With the hindfoot in varus the axis of the midtarsal joints are no longer congruent and motion in the midfoot is reduced. This allows the midfoot to become a rigid lever arm through which propulsion can occur during gait. With hindfoot valgus the axes are parallel and the midfoot becomes flexible. This allows the foot to adapt to different surfaces and also allows energy absorption during heel strike, which decreases stresses in the midfoot joints. The medial column, i.e. the
talonavicular, naviculocuneiform and first and second tarsometatarsal joint, is relatively rigid
compared to the lateral column, i.e. calcaneocu-
boid, cuboid, fourth and fifth metatarsal joint.
Therefore, patients tolerate arthrodesis in the
medial column better than in the lateral column.

Midtarsal joint injuries

Injuries of the midtarsal joints are rare and
frequently overlooked. They often occur in young
patients4 and have important economic conse-
quences. In one review high energy road traffic
accidents accounted for 72% of these injuries and 33% of injuries involved the Chopart and/or Lisfranc joints. Associated fractures occurred in 74% of cases. However, these injuries can occur with low energy force as a simple fall or twist. Delayed or inadequate treatment can lead to permanent disability. The largest series was that reported by Main and Jowett who reviewed 71 midtarsal joint injuries. In their series a delay in the diagnosis was seen in 41% of cases. The injuries were classified based on the direction of force and the resulting displacement. Five groups were identified and these form the basis of the current classification:

- longitudinal,
- medial,
- lateral,
- plantar,
- crush injuries.

## Longitudinal injuries

These accounted for 41% of injuries. The mechanism of injury is a force transmitted along the metatarsals in the plantarflexed foot that leads to compression of the navicular between the talus head and cuneiform. The navicular splits and a medial fragment is displaced medially. With more severe injuries an impaction fracture of the talus can occur. With less plantarflexion of the foot the navicular can displace dorsally with impaction of the lower pole. Undisplaced fractures are treated with a below knee walking cast. Displaced fractures will require closed or open reduction and internal fixation. In Main and Jewett’s series five out of 15 patients with pure longitudinal injuries without bony displacement medially had a poor result, compared to two out of 14 when medial displacement was present. In addition undisplaced injuries had a better outcome compared to displaced.

## Medial injuries

In 30% of injuries forces from the lateral to medial side of the foot lead to medial injuries. There are three resulting fracture patterns:

- fracture sprain,
- fracture subluxation/dislocation,
- swivel dislocation.

Fracture sprains are caused by an inversion strain and X-rays show a flake fracture of the talus or navicular medially and a flake fracture of the calcaneus and cuboid laterally. In a subluxation/dislocation injury the whole foot displaces medially at the talonavicular and calcaneocuboid joint. A swivel dislocation is an unusual injury where the talonavicular joint is disrupted and the calcaneocuboid joint remains intact. The foot does not invert or evert but rotates, swivelling on the interosseus talocalcaneal ligament. High falls accounted for the majority of cases.

Fracture sprains are stable and can be treated by a short period in a below knee walking cast and thereafter protected with a medial arch support and a hard soled shoe. They can displace if initially left unprotected. A fracture subluxation/dislocation requires prompt reduction either closed or open. The fracture is stabilised with a K-wire or screws. K-wires are removed at 6 weeks and non-weight bearing is maintained for a further 6 weeks. If screws are used protection in a below non-weight bearing-knee cast for 6 weeks is followed by partial to full weight bearing in a cast or fracture boot for a further 6 weeks. They are removed at 12 weeks. A medial arch support is prescribed for 9–12 months in both cases.

## Lateral injuries

These accounted for 17% of injuries. Again the patterns include a fracture sprain, fracture subluxation/dislocation and a swivel type injury. In fracture sprains an abduction force causes an avulsion of the navicular tuberosity or flake fragment medially with an impaction injury on the lateral side (Fig. 1). This fracture pattern has also been termed the nutcracker fracture. These injuries usually occur following a fall. A lateral subluxation/dislocation at the talonavicular and calcaneocuboid joint usually occurs following a high fall or road traffic accident. Treatment is similar to medial injuries. The outcome is better with sprains. The nutcracker injuries can be treated by restoring the lateral column length and fusing the calcaneocuboid joint or, in younger patients, by bone grafting and temporary stabilisation of the calcaneocuboid joint. Dewar and Evan recommended reattaching the avulsed navicular fragment and fusing the calcaneocuboid joint because of better results than achieved with a plaster cast.

## Plantar forces

These accounted for only 7% of injuries seen in Mann and Jowett’s series. These often follow high energy injuries like road traffic accidents. Injuries
can vary from a sprain to fracture subluxation/dislocation and swivel injuries.

**Crush injuries**

These were the least common injuries seen and accounted for only 6% of cases. Only crush injuries were associated with a compound injury. No constant pattern of injury is seen and the outcome in Mann and Jowett's series was only fair in 75% of cases. Soft tissue injury is common and insuring an adequate soft tissue envelope for the foot becomes a primary goal. The principle of management of the osseous structure is maintaining adequate medial and lateral column length to avoid cavus or planus deformities, respectively. The aim is to obtain a plantigrade foot and to preserve motion in the Chopart joints by using stable internal fixation or arthrodesis to maintain anatomical alignment. If stable fixation of a comminuted navicular is not possible, a bridging plate from the talus to the first metatarsal can be used and removed at 3 months. Sangeorzan et al. used this technique in seven patients and all fractures healed without loss of position. Compound injuries are treated in a standard fashion with early debridement and fracture stabilisation followed by secondary soft tissue closure. Compartment syndromes can occur and should be treated appropriately.

Crush injuries to the midfoot are rare and often reported as isolated case reports. Larger series have reported a variety of treatment techniques including lag screw fixation across the navicular fragments. Main and Jowett used either open or closed reduction and plaster cast, debridement or excision of the bone in four patients, resulting in three fair and one poor result.

**Associated problems**

Midfoot injuries are rare and can be easily missed or misdiagnosed as an ankle sprain. A high index of suspicion should be maintained and simple avulsions of the navicular tuberosity should not be considered in isolation. Howie et al. found that of 14 patients with a navicular tuberosity fracture seven had damage to the anterior process of the calcaneus which may have represented an occult subluxation of the midtarsal joint. All seven patients had prolonged symptoms and three had persistent but not disabling pain 3 years after injury. These injuries were seen in middle aged women falling a short distance. Occasionally ecchymoses on both sides of the foot may be seen and can indicate an occult injury. Good quality X-rays including an AP, lateral and oblique should be obtained and if necessary a CT scan should be requested. Prompt reduction and immobilisation may prevent long-term disability. High energy injuries may be associated with compound injuries and compartment syndrome and these should be treated promptly. A below knee amputation was necessary in 1.9% of cases in a study by Thermann et al. In the same study 11.6% of cases required a fasciotomy for compartment syndrome. The outcome of longitudinal injuries is correlated with the severity of injury and displacement. Reduction may improve outcome but this is not guaranteed as cartilage damage may already be present at injury. Considerable impairment was seen at an average follow-up of 9 years in the study reported by Thermann et al. In cases where severe joint destruction is seen a primary arthrodesis may be indicated. The outcome of lateral injuries is not as good as medial injuries and salvage procedures often include a triple arthrodesis. Main and Jowett demonstrated that the outcome following these injuries depends on the stability of the medial column.

**Fractures of the navicular**

The navicular bone is termed the keystone for the vertical stress on the medial arch. Following
trauma it is essential to restore the anatomy to avoid deformity and later disability. The tenuous central blood supply has been described and it is hence more likely to develop avascular necrosis or a non-union compared to other midfoot structures (Fig. 2). The diagnosis of navicular fractures has been described as 'sometimes obvious, frequently difficult and occasionally elusive'. Fractures of the navicular are rare but more common than fractures of the cuboid or cuneiforms. Pain and tenderness over the navicular region should be investigated with AP, lateral and oblique X-ray views. Normal X-rays with persistent pain warrant further investigation with a bone scan, CT scan or MRI to rule out occult fractures. Watson-Jones first described these injuries as a fracture of the tuberosity, fracture of the dorsal lip and a transverse or horizontal fracture of the body. DeLee classified these into four groups, which is currently the adopted classification. These are the cortical avulsion fracture also known as the 'chip' fracture, tuberosity fracture, fractures of the body, and stress fractures.

Dorsal cortical avulsion fracture

The mechanism is usually a twisting injury with inversion and plantar flexion or eversion of the foot. The dorsal talonavicular ligaments and capsule or the anterior part of deltoid is under tension leading to an avulsion fracture. These fractures are the most common and accounted for 47% of fractures in the largest series reported by Eichenholtz and Levine. Giannestras and Sammarco noted the association with lateral sprains of the ankle. Careful examination will distinguish between the two. An occult injury of the Chopart joints should be suspected. Treatment of this injury is conservative with a short period of immobilisation with a simple support bandage. Persistent symptoms can be treated by excision of the fragment. Large fragments which involve more than 25% of the joint surface should be treated by ORIF to minimise discomfort, reduce the risk of osteoarthritis and prevent subsequent midtarsal subluxation.

Tuberosity fracture

These injuries result from twisting with eversion or valgus of the hindfoot. The tibialis posterior tendon and anterior part of the deltoid ligament are under tension resulting in an avulsion of the navicular tuberosity (Figs. 3 and 4). These injuries may be associated with a compression injury of the lateral column, which represents a more serious midfoot injury, which requires treatment as outlined above. These fractures should not be confused with an accessory navicular (os tibiale externum), which has a smoother outline. If doubt exists the other foot can be X-rayed as accessory ossicles are often bilateral. For simple avulsion injuries symptomatic treatment with a supportive bandage is all that is required. For severe discomfort a period in a
walking cast may be required. Non-union is often asymptomatic but excision of the fragment may be indicated when painful. A large fragment or diastasis of more than 5 mm may be an indication for ORIF followed by a non-weight-bearing cast for 8 weeks.\textsuperscript{21}

Navicular body fractures

Fractures of the body are rare. They usually result from a direct axial load secondary to a fall or by indirect force. A vertical fracture is thought to result from forcible plantar flexion and abduction of the midfoot. Main and Jowett considered these fractures as part of the longitudinal midtarsal joint injuries. These fractures occur with high energy trauma and may be associated with soft tissue injury and compartment syndrome. Good quality X-rays should be obtained including an AP, lateral and oblique and if necessary a CT scan. Pinney and Sangeorzan et al.\textsuperscript{14} classified these fractures into three types (Fig. 5). In type 1 fractures the fracture line is transverse in the coronal plane with a dorsal fragment that is less than 50\% of the body (Fig. 6). AP X-ray may show a normal medial border. The most common is type 2 when the fracture line passes from dorsolateral to plantarmedial with the main large fragment being dorsomedial. In type 3 fractures there is central or lateral comminution and there may be disruption of the medial column of the foot and lateral displacement of the foot (Fig. 7). In addition disruption of the calcaneocuboid joint may be seen. Sanders and Hansen noted that with the medial fragment intact the foot may displace medially with varus of the hindfoot.\textsuperscript{22}

Non-displaced fractures can be treated by a non-weight-bearing cast for 8–10 weeks until union. In displaced fractures closed reduction is unlikely to be maintained and ORIF is recommended. A dual incision may be necessary using a dorsomedial and dorsolateral approach. Care is taken to protect the neurovascular structures that lie in the first web space to avoid devascularisation of the remaining bone fragments. An extra-articular distractor may aid with reduction. Bone graft from the distal or proximal tibia may be necessary to fill any defects. Type 1 fractures can be treated using a 3.5 or 4 mm lag screw perpendicular to the fracture line. In type
2 fractures comminution of the plantarlateral fragment and subluxation of the dorsomedial fragment makes reduction difficult. An external distractor such as an external fixator from the talus to the first metatarsal may aid visualisation and reduction. If there is minimal comminution and

Figure 5 Sangeorzan’s classification of navicular fractures. Type 1 with dorsal fragment, type 2 with dorsomedial fragment, type 3 with central comminution.

Figure 6 Navicular fracture, Sangeorzan type 1 with dorsal displacement. Treated by ORIF.
good preservation of the joint surface a lag screw from the dorsomedial aspect to the plantar lateral fragment is inserted. If the plantar lateral fragment is too comminuted then transfixing the dorsomedial fragment to the second or third cuneiforms or cuboid with screws is recommended. If fixation is not possible, the aim is an ankylosis between the dorsomedial fragment to the cuboid or lateral cuneiform. Persistent subluxation of the talonavicular joint is addressed by placing a temporary K-wire across this joint. In type 3 fractures an attempt should be made to restore normal anatomy if possible and the fragments held by transfixation to the cuneiforms. The outcome following these injuries is poor with only one good result out of four in the series by Pinney et al. If significant joint damage exists then consideration should be given to fuse the navicular cuneiform joints primarily.

The talonavicular joint should be preserved as fusion limits subtalar movement. The medial column rarely requires a structural iliac bone graft to restore its length. Postoperatively non-weight bearing is advised for 10–12 weeks and K-wires are removed at 6 weeks. Transfixation screws should be removed at 6 months to prevent breakage. A medial arch support should be used for an additional 6–12 months.

Eichenholtz and Levine reviewed the largest series of 67 navicular fractures of which 19 were body fractures. Most were managed conservatively. Five patients subsequently required a talonavicular fusion or triple arthrodesis, resulting in one excellent, three good and one fair result. Pinney et al. reported on their results in 21 navicular fractures. Reduction was satisfactory in all type 1, 67% type 2 and 50% of type 3. Of 15 satisfactory reductions 14 had good results and one fair. Avascular necrosis was seen in two cases and partial avascular necrosis in four. Final outcome was determined by the quality of reduction and by the type of fracture.

**Stress fractures of the navicular**

Towne et al. first described stress fractures of the navicular in two boys and noted that they ‘may require special roentgenographic views and laminography for detection’. Stress fractures of the navicular were considered to be rare with an incidence of 0.7% of stress fractures in one series. Over 150 cases have been reported and Hunter stressed that these injuries were probably more common than recognised and this was supported by Khan et al. Stress fractures of the navicular are more common in men than women with an average age of 20 (range 14–45). Most occur following sports, particularly track and field events (Fig. 8). An increase in athletic activity in an unfit person who takes up jogging or in an athlete before an important event can lead to a sudden increased stress in the navicular giving rise to a stress fracture. Delay in diagnosis is common with an average of 7.2 months in one study. Patients usually present with insidious medial foot pain or a cramp like sensation. Hunter noted that standing on tip toes reproduces pain over the navicular. There is little swelling but usually tenderness on palpation. Pain often resolves with rest and most patients can jog but avoid forefoot strike. Failure to recognise these early symptoms and a delayed diagnosis may result in fracture propagation and displacement. Torg et al. found that predisposing features included a short
first metatarsal, metatarsus adductus and hyperostosis or stress fractures of the second, third or fourth metatarsal.

If a stress fracture is suspected standing AP, lateral and oblique X-rays should be performed. It should be borne in mind that the X-ray features lag symptoms by 2–3 weeks and serial X-rays may be indicated. A coned down view may be necessary and if X-rays are negative then a bone scan will show increased uptake. A CT scan will clarify the fracture pattern and whether it is partial or complete. The fracture often lies in the central one-third in the sagittal plane. An MRI scan will show a characteristic intraosseous band of low signal that is continuous with the cortex and surrounding areas of decreased signal intensity on T1 images. T2 images show high signal changes around the fracture (Fig. 8).

Stress fractures are treated by non-weight bearing for 6–8 weeks. Torg et al. treated 10 uncomplicated fractures (five partial and five complete non-displaced) by non-weight bearing for 6–8 weeks and all fractures healed and patients returned to full activity by 3.8 months (3–6 months). Fitch et al. found that 14 out of 37 treated by non-weight bearing in a cast or rest resumed sports by 10 months. Khan et al. found that 86% of cases (9/11) resumed sports after treatment with non-weight bearing compared to 26% (9/34) treated with weight-bearing. In seven out of nine cases which were treated by weight-bearing rest or walking cast a delayed or non-union resulted. If a stress fracture fails to heal after a period of weight bearing then non-weight bearing is advised for a further 6–10 weeks with 90% success. Displaced, complete, delayed unions and non-unions should be treated by ORIF and bone grafting followed by non-weight bearing until union. Fitch et al. showed that not all stress fractures heal by non-weight bearing and radiographs may reveal a complete fracture, extension of a fracture, delayed union or a medullary cyst. En bloc resection of the fracture and bone grafting without internal fixation if the fracture was stable was performed resulting in 15 out of 18 cases (80%) becoming asymptomatic and returning to pre-injury sport levels at an average of 8 months. CT scanning is usually needed to monitor healing.

Figure 8 17-year old female cross country runner with a navicular stress fracture, treated by ORIF and autologous bone grafting.
New modalities of treatment include external electromagnetic or ultrasonic therapy or implantable electrodes. The long-term efficacy is not yet known.

Untreated stress fractures may progress to a complete non-union with subsequent deformity. A talonavicular or triple arthrodesis with structural bone grafting can be used as a salvage procedure.

### Cuboid fractures

The cuboid is an important bone as it maintains the lateral column of the foot and articulates with both the calcaneus, fourth and fifth metatarsal and in some cases the navicular. The position of the cuboid is such that isolated fractures of the cuboid are rare. Avulsion of ligament and capsule is the most common cause of cuboid fractures, with fracture dislocation, compression, stress fracture, and toddler’s fractures also seen.\(^\text{28,29}\) Avulsion fracture and compression ‘nutcracker’ fracture result from indirect forces which may be associated with a midfoot injury.\(^\text{8–10}\) These injuries need to be recognised and treated as described before. Fractures are commonly seen following a road traffic accident or a fall. Isolated fractures of the cuboid are rare but mal-union is likely to lead to restricted movement.\(^\text{30,31}\)

Clinically the patients present following an injury which may be a direct force to the lateral border of the foot or following a fall with a twisting element. Pain is localised over the cuboid and careful examination should exclude a medial Chopart injury.

Undisplaced fractures can be treated in a below knee walking cast for 6–8 weeks. The treatment of displaced cuboid fractures is controversial. Hermel and Gerson-Cohen\(^\text{32}\) recommended that early arthrodesis in a comminuted fracture would decrease the period of morbidity. In contrast others have recommended accurate anatomical reduction and fixation to maintain the lateral column length and mobility.\(^\text{30}\) Cuboid fractures treated by conservative methods resulted in only fair or poor results in the series by Main and Jowett\(^\text{7}\) and all required a triple arthrodesis later. Despite comminution of the joint articular surface the anatomy can be restored and if necessary bone graft used with satisfactory results obtained.\(^\text{30}\) The surgical incision should spare the stabilising ligaments of the calcaneocuboid joint and the distal tarsometatarsal ligaments. A small distractor may aid exposure of the joint to assist reduction and a buttress or H-plate applied to maintain reduction. Occasionally with marked comminution a plate can extend from the calcaneus to the fifth metatarsal and allow an ankylosis to form with preservation of lateral column length. Postoperatively the foot is kept non-weight bearing until union. The plate is removed at 6 months. Late symptoms or signs with degenerative changes can be treated with an arthrodesis.

Stress fractures of the cuboid are rare. Stress fractures in the foot usually involve the navicular (see above), calcaneus and metatarsals. The mechanism of stress fracture of the cuboid is not known with any certainty as it forms part of the lateral column which is flexible compared to the medial column and therefore protected from repetitive stresses. Beaman and Saltzman et al.\(^\text{33}\) reported on two cases in college athletes who were treated by immobilisation and activity modification. This led to the resolution of symptoms in both cases.

### Cuneiform fractures

As with injuries to the cuboid, fractures of the cuneiforms are rare. The mechanism of injury is usually direct trauma and displacement is uncommon. Indirect force may result in a cuneiform fracture but these are often associated with a Chopart and/or Lisfranc injury and are treated as such. Isolated fractures of the cuneiform are rare. Patterson\(^\text{34}\) reported on an isolated fracture of the medial cuneiform following a motorcycle accident. The patient was asymptomatic at 3 months following anatomical reduction and fixation. Cuneiform fracture-dislocations have been reported and are relatively uncommon. Closed-reduction of the medial cuneiform may be prevented by interposition of the tibialis anterior tendon and will then require an open reduction.\(^\text{35}\) Small avulsion injuries can be treated conservatively in a wooden sole shoe or walking cast. Displaced fractures will require good quality X-rays or a CT scan to exclude a Chopart or Lisfranc injury. Displaced fractures will require anatomical reduction and internal fixation followed by a period of non-weight bearing in a plaster cast for 6 weeks (Fig. 9). If associated ligament injury is present then protection for a further 4–6 weeks is recommended. In comminuted fractures stabilisation with K-wires may be necessary and these can be removed at 6 weeks.

### Key points

- Midfoot injuries are rare and often subtle
- They often present as small avulsion fractures
A more complex ligamentous injury should be suspected
Appropriate treatment can prevent long term disability
Salvage procedures often result in an unsatisfactory outcome.

References


Figure 9 23-year old woman, sustained cuneiform fractures in an RTA. Treated by ORIF and NWB 8 weeks.