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Tarsometatarsal fracture-dislocation

Closed and open treatment were compared in 12 cases of tarsometatarsal dislocation. When the dislocation involved the lateral component only, good results were observed in one of three cases treated closed and six of seven cases treated open. It is essential to reduce and stabilize the dislocation which is often overlooked unless carefully analyzed clinically and radiographically.

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Dislocation of the tarsometatarsal Lisfranc joint, with or without accompanying fracture, is a rare injury (Aitken & Poulson 1963, Hardcastle et al. 1982) associated with diagnostic and therapeutic problems due to difficulties of mechanical and anatomical interpretation. Although the traumatic mechanism has been described in detail (Jeffreys 1963, Wilson 1972) and several classifications have been based on these descriptions (Quénu & Küss 1909, Jeffreys 1963, Wilson 1972, Hardcastle et al. 1982), this has not led to uniform, simple and effective management of the lesion. On the basis of a review of the anatomy in relation to our own observations in 12 cases, we wish to lay stress on a correct diagnostic interpretation which will lead, together with a simple classification, to an appropriate therapy of traumatic tarsometatarsal dislocation.

Anatomy

The bony architecture of the tarsometatarsal joint shows that the base of the second metatarsal occupies a special position. It is anchored in the mortise formed by the three cuneiform bones, which give it a certain stability which the other metatarsals do not have (Figure 1). The transverse ligaments between the bases of the lateral four metatarsals ensure a connection between these bones. These connections are found plantarly as well as dorsally, the plantar ligaments being the stronger ones. A striking fact is that ligaments of this kind are not found between the first and the second metatarsal. Instead there is one strong ligament, the ligament of Lisfranc, which connects the base of the second metatarsal to the medial cuneiform bone (Figure 1). At the same time, tarsal-metatarsal ligaments extend in the longitudinal direction.

Considering the stability of the tarsometatarsal joint, the lateral four metatarsals form a unit in which the second metatarsal has a key position; the lateral stability of the other three metatarsals is totally dependent on the second metatarsal. The first metatarsal has its own independent ligamentous connections and, so far as stability is concerned, constitutes a unit by itself.

The second metatarsal also occupies a very important position in the frontal plane, due to its wedge-shaped architecture (Figure 2). Together with the wedge-shaped base of the third metatarsal, it forms a stable bridge, supported by the short muscles of the foot, the plantar aponeurosis, and the long peroneus muscle.

The practical consequence of this anatomy is that a fracture or a rupture at the base of the second metatarsal can lead to "en bloc" dislocation of the lateral four or the lateral three metatarsals (Figure 3).

Traumatic mechanism

On the basis of experimental work (Jeffreys 1963, Wilson 1972), the traumatic mechanism of tarsometatarsal dislocation is now well understood. Two types can be distinguished: direct and indirect trauma.

Direct trauma involves a crushing injury which, depending on the nature of the force, can lead to dislocation and/or fracture in the tarsometatarsal region (Wiley 1971). It is believed that direct trauma is the only force able

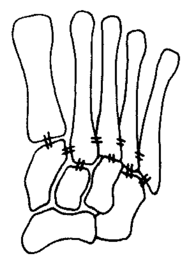

Figure 1 (top). The osseous configuration and ligamentous attachments of the tarsometatarsal joint. Note that there is no ligamentous connection between the bases of the first and the second metatarsals.

Figure 2 (bottom). The transverse Roman arch at the level of the tarsometatarsal joint with wedge-shaped second and third metatarsals.

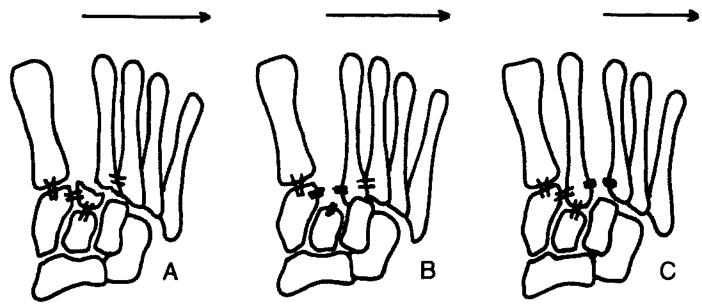

Figure 3 . The consequences of fracture or rupture at the base of the second metatarsal.
A. Instability of the lateral four metatarsals due to a fracture at the base of the second metatarsal. Dislocation "en bloc" will occur.
B. Dislocation "en bloc" of the lateral four metatarsals without an accompanying fracture at the base of the second metatarsal. This is only possible after rupture of the ligaments at the base of the second metatarsal.
C. Instability and dislocation "en bloc" of the lateral three metatarsals due to a rupture of the connecting ligament between the second and third metatarsals.

to dislocate the metatarsals in the plantar direction (Lenczner et al. 1974).

Indirect trauma is usually a combination of rotation movements such as inversion-supination or eversion-pronation, the former being the most frequent. If strong enough, a force "piling up", beginning laterally, may cause a fracture and/or rupture at the base of the second metatarsal. Consequently, the lateral metatarsals will dislocate en bloc. If the force is still active, then the medial unit, i.e. the first metatarsal, will also give way.

An eversion-pronation force leads to medial dislocation of the first metatarsal, eventually followed by dorso-lateral dislocation of the other four metatarsals.

Classification

Treatment should aim at reconstruction of the bony architecture and restoration of the stability of the two anatomical components, the lateral unit (the four lateral metatarsals) and the medial unit (the first metatarsal). Every injury of the tarsometatarsal region can then be classified into one or both of these independent entities so far as stability is concerned, and immediate treatment is necessary to restore the stability of both parts independently of each other.

Patients and methods

During the period 1975–1981, 12 dislocations of the tarsometatarsal joint were seen and treated in nine males and two females; in one patient both feet were involved. The mean age at the time of accident was 42 (18–63) years and the mean follow-up period was 4.2 years. In four patients the diagnosis was missed at presentation but established within 24 h by routine radiographic review. In seven cases it was clear that the mechanism of injury was indirect. Dislocation or fracture-dislocation of the lateral component was seen 11 times and of the medial component twice, including a combination of both components in one patient.

In three cases closed reduction and stabilization was effected with a below-the-knee plaster cast. In all other cases open reduction was performed under general anaesthesia, with stabilization using Kirschner wires in most cases (Table 1). Subsequent management in a plaster cast for 8 weeks allowed full weight bearing 4 weeks after injury.

Table 1. Twelve cases of tarso-metatarsal dislocation

Case	Age/sex	Type of trauma	Radiographic findings	Treatment	Follow-up years	Radiographic findings	Result
1	46/M	I	II–V, Ac	C	7	Partial redisplacement + mild degenerative changes	Fair
2	43/M	I	II–V	C	6.5	Normal	Good
3	18/M	I	III–V	O	5.5	Normal	Good
4	32/M	?	II–V[a], Ac	O	5	Normal	Good
5	63/M	I	II–V[a], Ac	C	4.5	Partial redisplacement + mild degenerative changes	Fair
6	34/M	I	II–V, Ac	O	4	Normal	Good
7	56/F	D	II–V[a]	O	4	Mild degenerative changes	Fair
8	52/M	I	III–V	O	3.5	Normal	Good
9	38/M	?	I[a]	O	3	Normal	Good
10	same	?	I[a], II–V	O	3	No optimal reduction + mild degenerative changes	Poor
11	45/F	I	II–V, Ac	O	2.5	Normal	Good
12	39/M	D	II–V[a], Ac	O	2	Normal	Good

D = direct.
I = indirect.
Ac = avulsion of cuboid.
I–V = metatarsal bones.
a = metatarsal fracture. In fracture dislocation of the lateral component the fracture was always located at the base of the second metatarsal.
C = closed.
O = open reduction and fixation with Kirschner wire(s). In Case 10, also AO mini-screws.

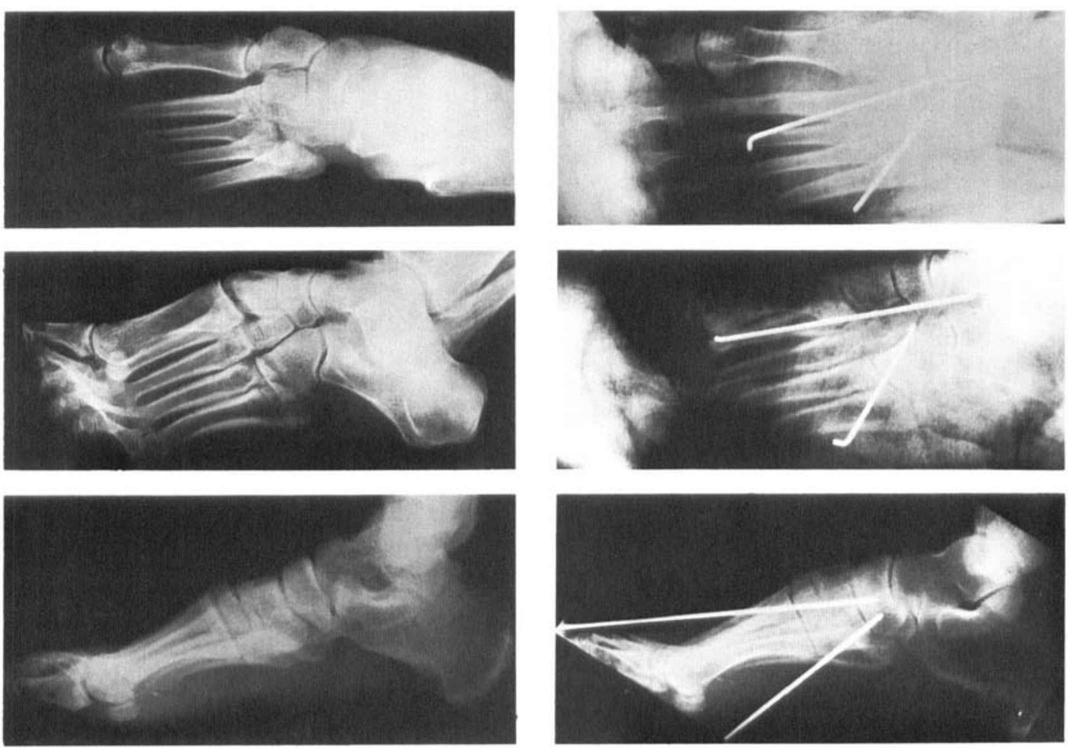

Figure 4. Radiograms of the left foot in Case 6, before and after open reduction of dislocation of the lateral unit of the tarsometatarsal joint.

Results

We graded the results at follow-up according to Hardcastle et al. (1982) as good, fair or poor on the basis of residual pain, function, deformity and radiographic features (Table 1).

In dislocation of the lateral component, 6 of 7 cases treated by open reduction were good whereas 2 of 3 cases treated closed had gradual loss of reposition and became fair only. The poor result in the patient with the combined lateral and medial type of injury was mostly due to massive soft tissue lesions of the foot and heel, which required plastic reconstruction (Case 10).

Case report

Case 6. A 34-year-old man fell from a chair and sustained a lateral-dorsal dislocation of the lateral four metatarsals and an avulsion of the lateral border of the cuboid (Figure 4), presumably due to an inversion-supination trauma-mechanism. There were no open wounds. Within 6 h an open reduction was performed with a short axial incision over the base of the second metatarsal and stabilized with two Kirschner wires. One wire was inserted through the second metatarsal into the middle cuneiform and an additional wire obliquely through the fifth metatarsal into the cuboid. A short leg cast was applied for 4 weeks, after which time the wires were removed. For 4 more weeks the patient was allowed weight-bearing with a walking cast. The patient, a truck-driver, returned to full work after 11 weeks. At his last evaluation 4 years later, his foot was painless with no loss of function and no radiographic signs of degeneration.

Discussion

Although injuries of the tarsometatarsal joint are relatively rare, both the frequency and the complexity of injuries has increased (Wilson 1972, Seiler & Olinger 1981).

A good understanding of the anatomy of the tarsometatarsal joint and of the traumatic mechanism is essential for adequate therapy. Earlier classifications were based on traumatic mechanisms but gave relatively poor information on therapy. Hardcastle et al. (1982) recognized this and proposed a more therapy-directed classification, which was based on the already well-known classification described by Quénu & Küss (1909) and later by Lenczner et al. (1974). It divides the injuries into three groups: type A (total incongruity), type B (partial incongruity: medial or lateral component) and type C (divergent). In our opinion, however, simply distinguishing a lateral and a medial component seems relevant both anatomically and therapeutically.

We wish to emphasize the importance of correct interpretation of the radiographs, including antero-posterior, oblique and lateral projections. Lateral dislocation en bloc is obvious on the AP-radiograph. After disruption of the tarsometatarsal joint, a dorsal dislocation can often be seen in the lateral view. Misinterpretation is sometimes due to spontaneous partial or complete reduction of the dislocation by the time the radiograph is taken. However, the lesion should be suspected if the radiographs show an avulsion fragment at the medial side of the base of the second metatarsal and/or avulsion and crushing of the lateral-distal side of the cuboid.

Like Wilson (1972), Wilppula (1973) and Seiler & Olinger (1981), we found that closed treatment gives unsatisfactory results; malposition remains or redislocation occurs.

The role of the soft tissues should not be underestimated and is of paramount importance for the final result. Distortion and bruising of muscular and ligamentous structures may be accompanied by bleeding from arterial injury. Two arteries may be involved: the dorsal pedic artery and its branches and the perforating metatarsal artery. The latter extends along the base of the second metatarsal and connects the dorsal with the plantar circulation. Edema and swelling may lead to occlusion of the posterior tibial artery and its branches. The risk of progressive ischemia and necrosis should be borne in mind (Gissane 1951).

In conclusion, we recommend exact open reduction and stabilization with minimal osteosynthesis, preferably using Kirschner wires. To obtain optimal results it seems important to operate early. Primary arthrodesis, advocated by Granberry & Lipscomb (1962) and Steinhäuser (1975), can then be reserved for selected cases with a very bad prognosis.

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