DISLOCATIONS OF THE METATARSAL BONE AND ADJACENT TOE

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Severe injuries to the forefoot are less in the mid-twentieth century than in Lisfranc’s equestrian age. Out of 11,000 patients treated for fracture at the Royal Infirmary, Edinburgh, only twenty-four (0.2 per cent) sustained fracture-dislocations or multiple fractures involving the metatarsal bones.

These injuries are the result of combined bending, compressing and twisting forces in one or several directions to the whole or part of the forefoot, and the precise mechanism of injury has been widely discussed (Lisfranc 1840; Gissane 1951; Watson-Jones 1955; del Sel 1955; Key and Conwell 1956; Collett, Hood and Andrews 1958; Granberry and Lipscomb 1962; Aitken and Poulson 1963; Jeffreys 1963). It is not intended to undertake a further analysis at this stage but to present two similar cases of a type not previously reported, the mechanics of which seem to be pertinent in arriving at a workable classification of these injuries. The phenomenon of the linked toe in dislocations of the tarso-metatarsal joints is described in relation to these two cases and the concept of segmental injuries to the forefoot is introduced.

CASE REPORTS

Case 1—A miner of twenty-two had his left forefoot crushed between a locomotive and the wall of a tunnel. Three hours later the whole forefoot was tensely swollen. The only recognisable deformity was adduction of the first metatarsal bone, the head of which protruded through a two-inch wound over its medial side. There was a two-inch laceration under the heads of the second, third and fourth metatarsal bones. Sensation of the toes appeared to be normal but all of them were pale and pulseless. Radiographs showed dislocations of the first, fourth and fifth metatarso-phalangeal joints and of all the tarso-metatarsal joints (Fig. 1).

Operation—Under a general anaesthetic manual reduction was undertaken. Radiographs showed reduction except for the fourth metatarso-phalangeal joint and the base of the fifth metatarsal bone, and a shear fracture of the cuboid bone then became obvious (Fig. 2). After excision of the wounds a dorsal incision was made to relieve tension. At this stage attempts to reduce the dislocation of the fourth metatarso-phalangeal joint by closed manipulation and by open operation failed though there was no demonstrable tissue interposition. This reduction was postponed and attention was turned to the fracture-dislocation at the base of the fifth metatarsal bone; this was exposed and reduced by traction upon the fifth metatarsal and, because it was unstable, the base of the metatarsal was pinned to the cuboid bone with a Kirschner wire. The local incision was closed. Upon returning to the problem of the dislocation of the fourth toe it was found that traction upon this toe gave a stable reduction. The remaining wounds were left open and a padded plaster back-shell was applied (Fig. 3).

Progress—The circulation in the toes improved with elevation of the foot, and three days later the gaping decompression incision was grafted with split skin and the remaining wounds were closed. After six weeks the plaster was removed and mobilisation begun, though it was eight weeks from the date of injury before the swelling subsided sufficiently to allow weight bearing in a slipper. Joint stiffness, especially of the first metatarso-phalangeal joint, delayed the patient’s return to work.

Case 2—A labourer of sixty-five was run into by a twelve-ton road roller which struck his left foot a glancing blow. Two hours later the forefoot was tensely swollen on the dorsal and lateral aspects but there was no obvious deformity. The sensation and the circulation to the...
first toe were suspect and there was a two-inch transverse wound under the heads of the first, second and third metatarsal bones. Radiographs showed fractures of the phalanges of the first and second toes, dislocations of the third metatarso-phalangeal joint and the base of the fourth metatarsal bone, a fracture of the cuboid bone (Fig. 4) and an undisplaced fracture of the lateral malleolus.

Operation—Under a general anaesthetic and tourniquet control the wound was excised. Attempts to reduce the dislocated third metatarso-phalangeal joint by closed manipulation and by open operation through the plantar wound failed. In view of the experience with the previous case, the attempts were abandoned and the fracture-dislocation at the base of the fourth metatarsal bone was exposed and reduced by traction. The unstable fragment of the cuboid bone was fixed with a Kirschner wire; the base of the metatarsal bone was fixed to
the cuboid in the same way and the incision was closed. Then the dislocation of the third metatarso-phalangeal joint was easily reduced by traction and was found to be stable (Fig. 5). The plantar wound was closed, a padded below-knee plaster applied and the limb elevated for five days.

Progress—Weight bearing in a plaster was allowed after three weeks. The plaster was removed and the foot mobilised at four weeks. The function and appearance of the foot were almost normal eight weeks from the date of injury.

DISCUSSION

Two concepts emerge from a study of these cases. The first I should like to refer to as the linked-toe dislocation of the metatarsal bone; the second, which is introduced but not discussed in detail here, is that of the segmental forefoot injury.

The linked-toe dislocation of the metatarsal bone—The fact that there is an anatomical linkage or connection between the dislocated metatarsal bone and the toe of the next medial ray becomes evident from a recapitulation of the mechanism of reduction in each of these cases. In Case 1, after the gross dislocations had been reduced, a pair of unstable injuries remained. It was found that the radiologically more obvious dislocation of the fourth metatarso-phalangeal joint could not be reduced until the fifth metatarsal had been reduced by traction and pinned to the cuboid bone. The same situation arose in Case 2 when the dislocated third metatarso-phalangeal joint remained unstable until the fourth metatarsal bone had been reduced and its base stabilised against the cuboid.

Anatomy and mechanics—The shafts of the metatarsal bones give origin to the plantar interosseous muscles which are inserted into the proximal phalanges of their own rays (Fig. 6).
More significantly, their dorsal interossei are inserted into the proximal phalanges of the adjacent toes medial to them (Jamieson 1950), the usual arrangement being shown in Figure 7.

When a metatarsal bone is dislocated at its base, tension is put upon its associated dorsal interosseous muscle and this, by virtue of its insertion, tends to cause any co-existent dislocation of the adjacent toe on the medial side to persist. Combinations which have been observed are the base of the fifth metatarsal bone and the fourth toe (Fig. 8), and the base of the fourth metatarsal bone and the third toe (Fig. 9). The second toe seems more likely to be stable in association with dislocations of the metatarsal bones on either side of it, since it has interosseous muscular attachments to both of its neighbouring metatarsal shafts (Fig. 7).

Treatment—Since reduction of the metatarso-phalangeal joint of the adjacent toe is dependent upon accurate maintenance of the fracture-dislocation at the base of the metatarsal, it is clear that the treatment of the more proximal injury is of primary importance. In these cases in which there was a fracture of the cuboid bone, stability could not have been achieved by external plaster fixation alone; in any case such a method would be excluded as a primary procedure by the presence of doubtful circulation and severe swelling.

Internal fixation was the obvious method of choice and Kirschner wire was the most suitable material. As a point of surgical finesse, it may be necessary only to fix the fracture of the cuboid bone which is the cause of instability at the tarso-metatarsal joint, but in these cases the joint itself was fixed. It seems preferable to fix the metatarsal to the tarsus rather than to a neighbouring metatarsal bone whose own stability may be in doubt. Open reduction of the fracture-dislocation was preferred in these cases for accuracy. Blind percutaneous wire fixation of the tarso-metatarsal joints, but not of the small cuboid fragments, is a possible alternative. Continuous skin or skeletal traction to the toes, with its relative clumsiness, insecurity of reduction, discomfort, joint stiffness and skin problems, seems an outmoded method.

Segmental forefoot injury—The above pairs of dislocations are two parts of the same lesion, and not, as one may think when looking at the radiographs, isolated injuries caused by the same violence. Between the two radiological defects there is a linear fault along which soft-tissue injury has occurred, and which is demonstrated clinically by the intervening swelling, tenderness and vascular involvement. They represent only one example of a group of injuries.
in which a segment or quadrant of the forefoot is broken, twisted or sheared off from the rest along an oblique or longitudinal line.

This concept of segmental injury can be applied to other combinations of fractures and fracture-dislocations of the forefoot which, hitherto, have defied a practical classification. One's attention is drawn particularly to such a concept by these two cases because they demonstrate clearly that the adjacent dislocated toe is attached to and is part of the mobile segment.

SUMMARY

1. Two cases of an unusual forefoot injury are recorded in which dislocation of the base of a metatarsal bone is associated with, and tends to perpetuate, dislocation of the metatarsophalangeal joint of the adjacent toe.
2. The anatomical and mechanical relationships between these linked dislocations are discussed, as are the principles of treatment.
3. The concept of segmental injuries to the forefoot is introduced.

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REFERENCES


