A DANGEROUS TYPE OF FRACTURE OF THE FOOT

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The Lisfranc fracture-dislocation of the foot will always be associated with some degree of arterial damage; the gross tearing of soft tissues between the first and second metatarsals, shown by the characteristic wide separation between these bones (Fig. 1), must mean damage or division of the terminal part of the dorsalis pedis artery as it joins the plantar arterial arch. When the arterial damage is confined to this site the life of the foot is not in jeopardy. There are, however, further degrees of displacement of this fracture in which associated arterial injury may be great, and in addition to the division of the dorsalis pedis artery, the posterior tibial at the ankle or the main lateral vessel, or both, may be injured.

During the last ten years we have treated three Lisfranc fractures, with very gross displacement, by recognised conservative methods for the treatment of grossly swollen limbs—that is, elevation, bed rest, cold packs and back splints—and each has ended in a
below-knee amputation. The last foot so treated was subjected to detailed dissection and, in consequence of this, we have reviewed our methods and base a new approach on what we believe to be the anatomy of this injury.

ANATOMY OF THE INJURY

It is submitted that the complicated closed wound known as the Lisfranc fracture is caused by excessive lateral rotation violence to the forefoot and not by direct crushing force, for the following reasons: 1) These fractures even in their most extreme forms of displacement are seldom open and, when they are, the skin wound has been caused by a force from within and not by a direct crushing violence. 2) At the examination of the dissected foot it was found that lateral rotation or pronation of the forefoot increased the bone and soft tissue displacements and obviously placed a heavy torsion strain on the lateral plantar vessel; and that medial rotation or supination of the forefoot corrected the bone and soft tissue displacement and released torsion on the main vessels.

Evidence that damage to the vessels can extend at least as high as the posterior tibial artery at the ankle was demonstrated in a patient submitted to decompression of his foot on the fourth day after injury. At the operation the posterior tibial artery was exposed behind the medial malleolus and found to be in spasm, which was unrelieved by the evacuation of a large haematoma from the dorsum and sole of the foot and by local treatment of the vessel. In this patient the dorsalis pedis artery had also been divided at the first metatarsal space and the combination of these arterial injuries resulted in the death of the foot.

During the last year we have not received a patient with the more severe and dangerous displacements and cannot submit evidence that our new approach to this fracture will be successful. In an attempt, however, to reconstruct the soft tissue and bone displacements and so regain a better functional foot in the lesser degrees of displacement, two patients have been subjected to the emergency open reduction we plan to use for the major displacements.

TECHNIQUE OF OPERATION

A medial incision is centred over the first metatarsal and medial cuneiform. This allows exploration of the dorsal aspect of the base of the first metatarsal space and plantar aspect of the foot, the latter being already dissected by the forces causing the injury. Through this approach blood clot is evacuated from both surfaces of the foot and any bleeding vessels are tied. Fragments displaced plantarwards from the dorsal surface of the medial cuneiform or the first metatarsal are retrieved through the dorsal aspect of the approach and replaced in their normal position; this we believe is the "key" to the reduction of the displacements, and one of the reasons why open reduction is essential (the other and perhaps more important need for open reduction in the major displacements is to release tension). The reduction of the "key" bone displacements has so far been remarkably easy, but the internal fixation still remains a problem. In the first patient (Figs. 2 to 4) a screw was used to fix the first to the second metatarsal and this held the reduction of the associated fracture of the medial cuneiform (Figs. 2 and 3). After the "key" mechanism is fixed the forefoot is supinated (rotated medially) to correct the deformity of the transverse tarsal arch and close the gap in the torn plantar ligaments. If secondary fractures of the metatarsal necks are present these are manipulated to a stable reduction by longitudinal traction on the foot (Fig. 4). Continuous traction to maintain reduction of the fractures of the metatarsal necks was not used. The final result in this patient was a normal foot. In the second patient (Figs. 5 and 6) the reduction of the "key" displacement was again easy, the second and first metatarsals were drilled and a stout silk mattress suture used to maintain the displaced metatarsals over to the more stable first metatarsal. The rest of the procedure followed that outlined in the first case.
Case 1. Figure 2—Lisfranc fracture with minor displacement. At operation rupture of the dorsalis pedis artery in the first space was found. Figure 3 (radiograph during operation)—The "key" displacement corrected and the fragments held by a screw, before reduction of the metatarsal fractures by longitudinal traction and pronation. Figure 4—Final result. Normal function was regained.
Case 2. Figure 5—Original displacement was of minor degree, but the dorsalis pedis artery was ruptured. Figure 6—"Key" bony displacements held by silk mattress suture between second metatarsal and more stable first metatarsal. Radiograph taken after the forefoot had been pronated and immobilised in plaster. Six months later the function of the foot was almost normal.

DISCUSSION

The purpose of this paper is to stress the real danger to the blood supply of the foot in the more severe types of Lisfranc fracture and to suggest that the damage is due to twisting of the main vessels of the foot. On rare occasions the same twisting of main vessels is responsible for irreparable damage to the blood supply of the foot in gross lateral rotation types of ankle fracture and in spiral fractures of the tibia and fibula. Transverse rotations around the long axis of the lower limb are physiological movements in normal locomotion (National Research Council report 1947). Excessive rotation of the various elements of the lower limb is the most common cause of lower limb fractures. Very rarely this twisting violence is so excessive that blood vessels at the site of bone injury, or proximal to it, are subjected to excessive and dangerous twisting that may cause their division or such damage as to threaten the life of the limb. This matter has a medico-legal significance, particularly when such injuries are reduced by closed methods and the limbs are immobilised in unpadded plaster.

REFERENCE