ACQUIRED VERTICAL TALUS DUE TO BURN CONTRACTURES

A REPORT OF TWO CASES

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Two cases of acquired vertical talus deformity are described as late complications of burns. The abnormality is attributed to the pull of scar contractures dorsiflexing and everting the foot, to the shortening of the calf muscles, and to underdevelopment of the sustentaculum tali which is a characteristic of infancy.

A vertical talus is one feature of the rare congenital abnormality known as congenital convex pes valgus (Lamy and Weissman 1939), or rocker-foot (Hark 1950). Two cases of vertical talus deformity are described here associated with severe burn contractures. The position of the contractures suggests that the scarring is responsible for the deformities. If this is so, does the acquired abnormality throw any light on the mechanism of the congenital condition, or vice versa?

AETIOLOGY OF CONGENITAL VERTICAL TALUS

The first English-language review of congenital vertical talus was by Lamy and Weissman (1939), and the pathological anatomy of the condition was subsequently described by Patterson, Fitz and Smith (1968). Several surgeons have described their own collected cases and operative treatments (Hark 1950; Osmond-Clarke 1956; Lloyd-Roberts and Spence 1958; Herndon and Heyman 1963; Eyre-Brook 1967; Harrold 1967; Silk and Wainwright 1967).

Lamy and Weissman noted the hereditary influence in some cases; the mother of one of their patients presented the same marked deformity. Other authors noticed the abnormality in a father and son, in two brothers and in identical twins. The condition was recognised as one of the many defects associated with autosomal trisomy, occurring with trisomy 13-15 and with trisomy 18 (Townes *et al.* 1962; Uchida *et al.* 1962). Herndon and Heyman (1963) considered that the abnormality was probably related to an embryological fault during the first trimester of pregnancy. Other congenital malformations may coexist, but the condition is more often seen as an isolated abnormality in otherwise normal children.

Sharrard (1971) considered that the lesion was usually secondary to paralysis of spinal origin, and that it arose when there was innervation of the muscles below

the knee by the fourth and fifth lumbar and first sacral segments but paralysis of the second and third sacral segments. He thought that strong activity in the dorsiflexors of the forefoot and toes led to calcaneovalgus deformity of the foot with dislocation of the talonavicular joint, whereas strong activity in the peronei and weak action in the triceps surae caused equinovalgus deformity of the hind foot.

Silk and Wainwright (1967) believed the condition was due to disparity of growth between the muscles and bones of the leg. There was no evidence, they thought, of agenesis or lack of growth potential in the bones themselves: if they were placed in the correct position without undue soft-tissue tension they would grow normally. The problem, therefore, seemed to them to be one of shortness of the musculotendinous units.

The pathological anatomy, described by Patterson *et al.* (1968) after dissecting the deformity in a six-week-old infant, showed that basically the forefoot was dorsiflexed and abducted, while the heel was in equinus and valgus. The talus was vertical because of its attachment to the calcaneus which was directed plantar-wards by the tight tendo calcaneus, and the head of the talus produced a lump on the medial side of the sole. The apparent medial deviation of the long axis of the talus was really produced by lateral deviation of the long axis of the calcaneus which paralleled the long axis of the foot: both were abducted from the long axis of the talus. The navicular was dislocated onto the front of the neck of the talus. Changes in bone morphology included flattening and pointing of the head of the talus. The posterior and middle facets of the subtalar joint were misshapen and the anterior facet was absent. The musculotendinous units were tight and contracted. The tight tendo calcaneus maintained the heel in equinus, and it was not until the tight tibialis anterior, extensor hallucis, extensor digitorum longus and peroneus brevis tendons were divided that the navicular could be

reduced onto the head of the talus. Patterson *et al.* considered that it was the tight soft tissues that produced the bone and joint abnormalities, rather than vice versa.

TWO CASES OF ACQUIRED VERTICAL TALUS

Case 1. A baby girl, nine months old, received burns to 75 per cent of her body surface when her bedclothes caught alight from an electric fire, 60 per cent of the body surface suffering full thickness destruction of the skin. During the next three and a half months she had four skin-grafting operations to heal her burns; twenty-two operations were carried out over the next ten years to correct all the contractures

Fig. 1

Case 1. The left leg suffered destruction of the full thickness of the skin from knee to toes, and the toes were lost.

and restore function. There was no history of congenital abnormalities in the family and the feet had been normal.

The accident destroyed the toes and all the skin of the left foot and ankle (Fig. 1). Three months later the skin grafts were healed and the child began to stand when she was about one year old. During the next six months the left foot became deformed: the forefoot dorsiflexed and everted (Figs. 2 and 3) and the radiograph confirmed a vertical talus (Fig. 4). Just before she went to school, four years after the burn, a modified Syme's amputation was carried out in consultation with the prosthetist. At ten years of age the artificial limb remained satisfactory, taking pressure on the tibial condyles without end-bearing; she was remarkably active at school.

Between five and seven years old the right foot began to *invert* due to growth of the leg and the pull of a band of scar tissue from the knee to the medial side of the heel. This band was partially corrected with multiple Z-plasties, and subsequently by excision of the scar over the tendo calcaneus, accompanied by tendon lengthening and regrafting. This permitted 10 degrees of dorsiflexion of the ankle, and she was still able to stand on the toes of this foot with the other off the ground. No vertical talus deformity occurred in this inverted foot although the tendo calcaneus had been tight.

Case 2. A baby girl, seven months old, received 12 per cent burns of her legs when her carrying cot rolled off a settee and tipped her into the fire. The lateral side of her right thigh and leg were deeply charred. Most of the toes sloughed off, the raw areas were grafted and she was sent home, healed, after two months.

During the next three years she developed recurrent skin shortage on the back and lateral side of the knee, and on the front and lateral side of the ankle. Four operations were needed during this time to let in further skin at the level of the knee, the middle of the leg and the ankle. In other words, there was an obstinate tendency for the foot to be drawn into dorsiflexion and eversion by the scar contracture. The first radiograph, taken three years after burning (Fig. 5), showed the talus already pointing downwards and medially. There was no history of any congenital abnormalities and both feet were considered to be normal before the accident.

The clinical and radiological appearances of the foot at six years of age are shown in Figures 6 to 9. In addition to the development of vertical talus, the burned foot and leg failed to grow as fast as the normal side. At six years old, the burned foot took a shoe three sizes smaller than the other (Fig. 10), and at eight years old there was half an inch (1.25 centimetres) of shortening of the burned leg.

No appreciable disability accompanied the deformity until she was nine years old. Then she began to complain of some tenderness over the head of the talus and to limp a little. Operative correction of

Fig. 2

Fig. 3

Fig. 4

Case 1. Figure 2—The medial side of the foot, twenty-one months after burning, with the palpable head of the talus marked in ink. Figure 3—The sole of the foot. Figure 4—Lateral radiograph showing vertical talus.

Fig. 5

Case 2. The first radiograph, three years after injury, shows the head of the talus pointing medially.

the vertical talus was undertaken by my colleague, Henry Proctor. The navicular was reduced onto the head of the talus and fixed with a pin, but it was not possible to reduce the calcaneus under the talus, perhaps due to the tight evverting tendo calcaneus. The foot was therefore left in plantar flexion with a second pin through the lateral malleolus into the talus to stabilise the ankle, while a cross-leg flap was used to close the skin defect on the front of the ankle and the lateral side of the foot. Lengthening of the tendo calcaneus by a Z-plasty was carried out four weeks later.

Three months after operation she seemed to be walking on the calcaneus and no longer on the talus. Two years after operation she was free of pain and playing netball at school. She had a stiff foot which was one and a half inches (3.8 centimetres) shorter than the other: it had a good plantar surface which was thought unlikely to cause further trouble by increasing deformity. Two years later, her only expressed concern was to obtain more fashionable shoes.

Fig. 6

Fig. 7

Fig. 8

Case 2. Figures 6 to 8—Views of the foot six years after injury, showing flattening of the arch with valgus and eversion of the foot.

Fig. 9

Case 2. Lateral radiograph at six years showing vertical talus with left foot for comparison.

Fig. 10

Case 2. The shoe on the burned foot was three sizes smaller than the other.

DISCUSSION

The chromosome and spinal cord abnormalities associated with congenital vertical talus are, of course, irrelevant to the acquired deformity. Three other factors, however, may be causative.

Scar contractures from healed burns in both our cases pulled the forefoot into dorsiflexion, eversion and a valgus position. In Case 1 this was not treated because

amputation was anticipated from an early stage, although it was delayed until the child was five years old. In Case 2 free grafts were used early and repeatedly to correct the shortage of skin: a skin flap was not considered until after the vertical talus deformity was diagnosed, three years after the injury.

Shortening of the calf muscles is a common complication of extensive deep burns of the legs, and is due to prolonged plantar flexion of the ankles. Constant attention is usually required over many weeks to maintain dorsiflexion of the ankles, using plaster casts until the burn is healed. Occasionally, however, wasting and shortening of the calf muscles may be severe, and in these cases there may be other causative factors such as ischaemic necrosis of the calf muscles from the pressure of the leg resting on the bed, or increased tension due to oedema beneath the deep fascia. Whatever the cause, we can say from our own experience that marked wasting of the calf and shortening of the calf muscles can occur after burns of skin and fat only. We are not sure whether thick, tight scarring of the skin over a foot or the whole limb can sometimes restrict growth. We have had to lengthen the tendo calcaneus on several occasions to regain sufficient dorsiflexion for walking.

In Case 1, shortening of the tendo calcaneus associated with inversion did not produce a vertical talus deformity in the good right leg.

Case 2 developed obvious muscle wasting, impairment of bone growth and shortening of the calf muscles, but these were not extreme and not really appreciated until *after* the vertical talus had been diagnosed.

The sustentaculum tali is the bony prominence that prevents downward-dislocation of the head of the talus. In infancy, the sustentaculum tali is displaced backward and laterally (Harrold 1967); it is "blunted, offering no support to the head of the talus" (Tachdjian 1972), making it easier for the head of the talus to dislocate onto the medial side of the calcaneus.

The two cases reported in this paper were baby girls, injured at nine and seven months of age, and vertical talus was diagnosed at one and a half and three and a half years respectively. The first two predisposing factors, scar contractures and shortening of the calf muscles, are commonplace at all ages: the underdeveloped sustentaculum tali is peculiar to the foetus and the first year or two of life, and this may be responsible for the deformity occurring at this age.

In comparing congenital and acquired vertical talus, different forces applied to the forefoot have to be considered: muscle imbalance in the congenital type and scar contracture in the acquired. In both conditions the talocalcaneal complex may be anchored in equinus by a tight tendo calcaneus, and dislocation of the head of the talus is facilitated by the rudimentary sustentaculum tali which is present in the first year or two of life.

In the treatment of burns, the risk of this deformity should be appreciated in a child under two if there is a contracture dorsiflexing and everting the foot and ankle, together with shortening of the calf muscles. Early correction of the contracture and lengthening of the tendo calcaneus might prevent development of this complication.

I gratefully acknowledge the advice and treatment given in these cases by my colleague Mr Henry Proctor, and my thanks are also due to Mr N. R. Gill for the photographs and Miss Sandra Miles for her secretarial assistance.

REFERENCES

- Eyre-Brook, A. L. (1967) Congenital vertical talus. *Journal of Bone and Joint Surgery*, **49-B**, 618-627.
- Hark, F. W. (1950) Rocker-foot due to congenital subluxation of the talus. *Journal of Bone and Joint Surgery*, **32-A**, 344-350.
- Harrold, A. J. (1967) Congenital vertical talus in infancy. *Journal of Bone and Joint Surgery*, **49-B**, 634-643.
- Herndon, C. H., and Heyman, C. H. (1963) Problems in the recognition and treatment of congenital convex pes valgus. *Journal of Bone and Joint Surgery*, **45-A**, 413-429.
- Lamy, L., and Weissman, L. (1939) Congenital convex pes valgus. *Journal of Bone and Joint Surgery*, **21**, 79-91.
- Lloyd-Roberts, G. C., and Spence, A. J. (1958) Congenital vertical talus. *Journal of Bone and Joint Surgery*, **40-B**, 33-41.
- Osmond-Clarke, H. (1956) Congenital vertical talus. *Journal of Bone and Joint Surgery*, **38-B**, 334-341.
- Patterson, W. R., Fitz, D. A., and Smith, W. S. (1968) The pathologic anatomy of congenital convex pes valgus. *Journal of Bone and Joint Surgery*, **50-A**, 458-466.
- Sharrard, W. J. W. (1971) *Paediatric Orthopaedics and Fractures*, pp. 252, 673. Oxford: Blackwell Scientific Publications.
- Silk, F. F., and Wainwright, D. (1967) The recognition and treatment of congenital flat foot in infancy. *Journal of Bone and Joint Surgery*, **49-B**, 628-633.
- Tachdjian, M. O. (1972) *Pediatric Orthopaedics*, pp. 1359-1361. Toronto: W. B. Saunders Co.
- Townes, P. L., De Hart, G. K., Jun., Hecht, F., and Manning, J. A. (1962) Trisomy 13-15 in a male infant. *Journal of Pediatrics*, **60**, 528-532.
- Uchida, I. A., Lewis, A. J., Bowman, J. M., and Wang, H. C. (1962) A case of double trisomy: trisomy No. 18 and triplo-X. *Journal of Pediatrics*, **60**, 498-502.