SUBTALAR ARTHRODESIS BY CANCELLOUS GRAFTS AND METALLIC INTERNAL FIXATION

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A technique of subtalar arthrodesis by means of metallic internal stabilisation and autogenous cancellous bone grafting is described. Of forty-eight feet with mobile pes planus treated by this method forty-five gained union after an average of seven and a half weeks in a below-knee weight-bearing plaster, and forty-three had satisfactory correction of the deformity.

Despite the decline in poliomyelitis, there is still a need for subtalar fusion for mobile valgus hindfoot, especially in children with cerebral palsy and spina bifida. Although the indications for subtalar arthrodesis are established, technical difficulties with the operation as developed by Green and Grice (Grice 1952) are well recognised and are undoubtedly the cause of a number of the poor results (McMurray 1962; Pollock and Carrell 1964; Smith and Westin 1968; Engström, Erikson and Hjelmstedt 1974). These have led to variations in the technique, of which the most radical was that of Batchelor, who used a fibular bone peg driven through the neck of the talus into the calcaneus (Brown 1968). The use of metallic internal fixation was mentioned by Grice (1959); Engström et al. (1974) also stated that internal fixation with a screw or staple could provide a safeguard against fracture of the graft, and that the incidence of union should be improved if supplementary internal fixation was employed.

This paper reports the results obtained in a group of children with pes valgus treated by subtalar fusion using internal fixation by screw or wires and cancellous bone grafting.

TECHNIQUE OF OPERATION

An oblique incision, in the line of the skin creases, is centred over the sinus tarsi; it extends from the middle of the front of the ankle downwards and laterally to the peroneal tendons (Fig. 1). The origin of the extensor digitorum brevis, together with a pad of subcutaneous fat, is raised proximally and reflected distally to expose the sinus tarsi. The fat in the sinus tarsi is removed in one piece by sharp dissection close to the bone. With a narrow gouge, cortical bone is removed from the apex of the sinus tarsi to expose cancellous bone on both the undersurface of the neck of the talus and on the non-articular area on the upper surface of the calcaneus (Fig. 2). Cortical bone must not be removed from the outer part of the sinus tarsi in the area where the screw will pass. A depression on the superior surface of the neck of the talus is exposed by blunt dissection between the tendon of extensor digitorum longus and the neurovascular bundle. While the calcaneus is held in its corrected position, a bone awl is passed through this depression through the neck of the talus and across the sinus tarsi to enter the upper surface of the calcaneus towards the lateral side; it is driven on to pierce the cortex of the calcaneus at its infero-lateral border (Fig. 3). The awl must pass through cortical bone on both the superior and inferior surfaces of the neck of the talus and on the superior and infero-lateral surfaces of the calcaneus. The length of the awl that is within the bones is determined and a Sherman screw of the same length is inserted. The screw is tightened until the head bites into the superior surface of the talus. Chips of cancellous bone taken from the iliac crest are then packed into the apex of the sinus tarsi (Fig. 4). The extensor digitorum brevis is replaced and the skin is closed. A below-knee weight-bearing plaster is applied over padding, the plaster being well moulded around the heel. The plaster is removed after six to eight weeks.

MATERIAL AND RESULTS

From 1970 to 1975, forty-eight subtalar arthrodeses were performed in twenty-nine children between the ages of two and sixteen years (average of eight years). There were seventeen boys and twelve girls. The indication for operation in all the patients was a correctable valgus deformity of the hindfoot, due to cerebral palsy in twenty-three patients, spina bifida in four and residual congenital
club foot deformity in one. One patient had a tarsal coalition.

All the operations were performed by the same surgeon (G. E. F.) and were identical except for the method of internal fixation. Crossed Kirschner wires were used in the first four patients, and screws in the remainder (forty-one Sherman screws, one McKee lag screw and two AO cortical screws). The screw lengths ranged from forty-five to sixty-four millimetres. Cancellous bone chips were always taken from the iliac crest. Thirty-seven of the forty-five feet which fused (82 per cent) were immobilised in a below-knee weight-bearing plaster for six to eight weeks. Two feet were immobilised for ten weeks, five for twelve weeks and one for sixteen. The average time in plaster was seven and a half weeks; of the three failed fusions, two were immobilised for six, and one for eight weeks.

Forty-four feet (in twenty-seven patients) were reviewed independently by the other author (W. G. D.). The remaining two patients, who could not attend because they lived too far away, were assessed radiologically solely to establish evidence of fusion. Since it is difficult to determine the degree of correction radiologically (Lahdenranta and Pylkkänen 1972), the hindfoot position was assessed clinically. Radiographs of the feet and ankles were taken with the patient standing to assess union and to see whether a ball-and-socket ankle joint had developed (Lamb 1958). The time between operation and review was one to five and a half years, with an average of three years.

Forty-five of the forty-eight feet (93·7 per cent) had bony fusion; in the remaining three there was a pseudarthrosis. The position of the hindfoot after fusion was found to be neutral in twenty-nine feet, but seven showed 5 degrees and five showed 10 degrees of valgus; 5 degrees of varus were found in two feet. One foot was fused in the unsatisfactory position of 15 degrees of valgus. No ball-and-socket ankle joint was found.

A single superficial infection occurred which resolved without antibiotics. Five feet developed problems related to the internal fixation. In four crossed Kirschner wires had been used, and although fusion occurred, the wires migrated and had to be removed. One AO screw was removed after six weeks because its large head protruded above the neck of the talus and would have impinged on the front of the lower tibia during dorsiflexion.

**DISCUSSION**

Since the description by Grice (1952, 1955, 1959) of extraarticular talo-calcaneal arthrodesis, the operation has been accepted as a useful method in the treatment of
valgus flat foot in children. Although Grice (1959) stated that "the operative technique is quite simple", many surgeons have not found this so, and several variations have been developed in the attempt to overcome the problems which can arise both during and after the operation (Brown 1968; Seymour and Evans 1968; Tohen, Carmona, Chow and Rosas 1969; Alban, Alban and Fixler 1975).

With the Grice-Green technique, a cortical bone graft is used as a strut both to hold the calcaneus in its corrected position under the talus and to stimulate bony union between the two bones. Grafted cortical bone fulfils neither of these functions particularly well; it is liable to fracture, with consequent loss of position, and is a poor stimulus to bony union. Technical problems arise because the graft must be cut to the correct size to give the required correction, and it must be firmly slotted between the two bones to prevent it from slipping. As the cortical graft is only slowly incorporated, it is usual to immobilise the foot in a non-weight-bearing below-knee plaster for six weeks and in a weight-bearing plaster for a further six weeks. Despite this long period of immobilisation, delayed union and stress fractures of the graft are not uncommon (Pollock and Carrell 1964; Paluska and Blount 1968).

The Batchelor technique (Brown 1968) employs a fibular graft placed as a peg through the neck of the talus, across the sinus tarsi and into the calcaneus. A peg used in this way is a mechanically unsound means of resisting the compression force which is trying to re-

![Fig. 5](image1.png)
Lateral radiograph before operation.

![Fig. 6](image2.png)
Lateral radiograph three years after operation.

![Fig. 7](image3.png)
Photograph showing the hindfoot deformities before operation.

![Fig. 8](image4.png)
Photograph taken four years after operation.

establish the deformity; the fibular graft is mainly of cortical bone, and it has the same disadvantages as the cortical graft used in the Grice-Green technique, in that it is both slow to unite and liable to fracture (Seymour and Evans 1968). This technique can also result in a late valgus deformity of the ankle which can develop even if the fibula has been resected subperiosteally (Paluska and Blount 1968; Hsu, Yau, O'Brien and Hodgson 1972; Wiltse 1972).

The present technique is a modification of the Batchelor operation but uses a metal screw instead of a bone peg to maintain the corrected position and a cancellous graft instead of cortical bone to stimulate union. The technical problem of obtaining a satisfactory position
of the hindfoot is less because the position of the hindfoot can be assessed after insertion of the bone awl, and if unsatisfactory it can be adjusted. Once a satisfactory position has been obtained the screw acts as a strut and there is no danger of losing the position provided that the screw passes through cortical bone on both surfaces of the neck of the talus, and on the superior surface of the calcaneus, and extends down to the infero-lateral surface. A Sherman screw has proved satisfactory in most children (Figs. 5 and 6) but in the older child the use of a heavier screw should be considered, with care to ensure that the head of the screw is not so large that it protrudes and strikes the lower tibia during dorsiflexion of the ankle. With a screw holding the hindfoot in its correct position there is no longer any need to use a cortical bone graft, and the more satisfactory cancellous bone can be used to stimulate bony union. With the better internal fixation and more rapid bony consolidation it has been necessary to keep most of the patients in a below-knee weight-bearing plaster for only six to eight weeks.

The aims of any technique of subtalar arthrodesis are accurate correction of the deformity, maintenance of this correction and rapid fusion (Figs. 7 and 8). By using a combination of metallic internal fixation with a cancellous bone graft 90 per cent of the feet had a satisfactory correction of the deformity and bony union was obtained in 94 per cent of the feet, which were immobilised for an average of seven and a half weeks in a below-knee weight-bearing plaster.

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REFERENCES


