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## EXTRA-ARTICULAR SUBTALAR ARTHRODESIS, ACCORDING TO GREEN-GRICE, IN FLAT FEET

*By*

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Since *David S. Grice* (1) published in 1952 his study of "An Extra-Articular Arthrodesis of the Subastragal Joint for Correction of Paralytic Flat Feet in Children", this surgical procedure has been much utilized also for flat feet which have no paralytic condition. The use and limitation of the method with paralytic flat feet has been treated by a number of authors (1, 2, 3, 4). The corresponding evaluation of the method for non-paralytic feet has been much less detailed.

It appears from the literature that in this operation, with few exceptions, autotransplants have been used. *Grice* (2) stated in 1955 that he had used homotransplant in 4 cases. In a series of 52 operated feet resorption of the transplants occurred in one case and in this case homotransplants were used. *Oscar Malvarez* (1) reported in 1950 that he had utilized bone from the bank in 18 cases and obtained osseous ankylosis between the calcaneus and the talus in all cases.

In Sophies Minde Orthopaedic Hospital, during the period 1953 to 1960, extra-articular subtalar arthrodeses were performed on 37 flat feet without demonstrable pareses. Homotransplants were used in 34 cases. This material should therefore give a certain basis for evaluating the Green-Grice operation in non-paralytic flat feet and also for evaluating the homotransplant in this connexion.

The indication in all cases was a pronounced flat foot with functional symptoms which did not react to active dynamic and static treatment. On average the patient was treated conservatively for 3 years before operative treatment.

5 feet could not be satisfactorily redressed preoperatively and during the operation the calcaneus could not be placed in the correct position under the talus. In these cases structural changes were obviously pre-

sent. *Grice* (1) stated that in these circumstances he had undertaken capsulotomy or chiselled away bone below and lateral to the talus where it had articular surfaces facing the calcaneus. After reduction, stability is tested by means of an osteotome placed in the tarsal sinus. If instability is present, *Grice* recommends passing a screw from above through the talus head and down into the calcaneus. This modification was not used in the existing series but could presumably have been indicated in individual cases. Out of 5 cases, in which the calcaneus could not be brought into a normal position in relation to the talus, synostosis was not achieved in 4 (Table 2). In 2 of these cases, however, relations with the transplants may have played a part and this problem is further clarified in Table 3.

TABLE 1  
*Age and Sex Distribution of Patients with Flat Feet, Treated by  
Extra-Articular Subtalar Arthrodesis.*

|                                                                         |            |
|-------------------------------------------------------------------------|------------|
| No. of patients operated on .....                                       | 20         |
| Boys .....                                                              | 12         |
| Girls .....                                                             | 8          |
| No. of feet operated on .....                                           | 37         |
| Average period of treatment before operation .....                      | 3 years    |
| Average age at operation .....                                          | 9.5 years  |
| Average observation period (max. 10 years, min. 2 years) .....          | 4 years    |
| Average age at last check-up (maximum 18 years, minimum 10 years) ..... | 13.5 years |

TABLE 2  
*The Redressability of the Feet Pre-Operatively in Relation to Osseous Ankylosis  
Calcaneus-Talus Achieved (+) or not Achieved (—). The Figures in Parentheses  
State the Number of Feet Operated on where the Transplant is Considered  
to be Optimal.*

|                                                                   | No. of<br>operated feet | Osseous ankylosis<br>calcaneus-talus |       |
|-------------------------------------------------------------------|-------------------------|--------------------------------------|-------|
|                                                                   |                         | +                                    | —     |
| Malposition redressible .....                                     | 30 (15)                 | 25 (14)                              | 5 (1) |
| Short achilles, but redressable<br>with slight pointed foot ..... | 2 (2)                   | 2 (2)                                | 0 (0) |
| Full correction not achieved                                      | 5 (3)                   | 1 (1)                                | 4 (2) |
| Sum .....                                                         | 37 (20)                 | 28 (17)                              | 9 (3) |

Autotransplants were used in only 3 cases. A direct comparison between auto- and homotransplants cannot therefore be undertaken here. Within the group in which homotransplants were used, a relationship

was found between the characteristics of the transplants and the number used per operation and their ability to produce synostosis between calcaneus and talus. As Table 3 shows, 2 bone blocks were used in 17 cases. Each block consisted of cortical and cancellous bone. In 15 of these 17 cases synostosis was achieved. If we exclude 2 feet which could not be fully corrected, the result becomes even better, since the synostosis is then achieved in 14 out of 15 feet operated on (Table 3, heels in brackets).

TABLE 3

*The Type of Transplant (Auto-Homo), its Characteristics (Cortical-Cancellous Bone), and the Number per Operated Foot, are Demonstrated for Comparison with Osseous Ankylosis Achieved (+) and not Achieved (—) between Calcaneus and Talus. The Figures in Parentheses State the Number of Feet where the Malposition Could be Fully Corrected.*

|                                                                                | No. of<br>operated feet | Osseous ankylosis<br>calcaneus-talus |       |
|--------------------------------------------------------------------------------|-------------------------|--------------------------------------|-------|
|                                                                                |                         | +                                    | —     |
| Autotransplant consisting of                                                   |                         |                                      |       |
| 2 bone blocks .....                                                            | 3 (2)                   | 3                                    | 0     |
| Homotransplant .....                                                           | 34 (29)                 | 25 (24)                              | 9 (5) |
| 2 bone blocks, each consist-<br>ing of cortical and can-<br>cellous bone ..... | 17 (15)                 | 15 (14)                              | 2 (1) |
| 1 cortical bone block + can-<br>cellous bone .....                             | 11 (10)                 | 7 (7)                                | 4 (3) |
| 1 thick bone plug .....                                                        | 6 (4)                   | 3 (3)                                | 3 (1) |

In another group of feet 1 bone block was used, fundamentally cortical bone, together with cancellous bone fundamentally as bone chips. Here synostosis was only obtained in 7 out of 11 feet. This tendency towards decline is somewhat improved, however, if the one not reducible foot in this group is excluded.

In a third group in which 1 thick bone plug was used, most often taken from an ulna, there was also found a considerable tendency towards a decline. Lasting ankylosis was achieved in 3 out of 6 feet operated on. If, however, the not reducible feet are also excluded here, lasting ankylosis was achieved in 3 out of 4 operated on.

No complications occurred in any case in connection with the operation. Each case was treated in plaster for 12 weeks. The majority commenced gradual weight-bearing from 8 weeks.

As Table 2 shows, lasting osseous ankylosis was obtained in 28 out

of 37 operated feet. However, a synostosis between calcaneus and talus does not automatically mean that the result of the operation is satisfactory in all respects. Nor does absence of synostosis mean that the treatment was a failure (Table 4). 2 feet improved decisively and 1 foot was fully satisfactory after treatment, although there was no synostosis formation. The functional result of the slightly under-corrected feet was very good, while 2 of the 4 over-corrected feet showed symptoms owing to the varus position, even if this was moderate. This point is in agreement with general experience that the valgus position is much less productive of symptoms than varus. During the operation it is necessary to overcorrect the malposition between the calcaneus and talus when the transplants are to be positioned, but when these are in place, the heel should take up a O-position or slight valgus. In all the 4 cases with overcorrection, this was recognized at the conclusion of the operation and the foot was encased in plaster in this position which was later to emerge as permanent. Thus, we can draw the conclusion that under no circumstances out of fear of valgus recurrence, must we be led into approving a varus position.

TABLE 4  
*Results of Extra-Articular Subtalar Arthrodesis in Flat Feet.*

|                                                                                                                                                                                                                                                                   | No. of feet |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Osseous ankylosis calcaneus-talus achieved with both in a normal position in relation to each other. The result is optimal both functionally and cosmetically .....                                                                                               | 21          |
| Osseous ankylosis achieved but with the valgus position insufficiently corrected. Functionally a good result, but cosmetically not quite satisfactory .....                                                                                                       | 3           |
| Osseous ankylosis achieved, but with a slightly overcorrected position with slight varus sequelae. 2 in this group have slight discomfort in jumping and with greater exertions. Wedge osteotomy on the calcaneus is contemplated. 2 are quite symptom-free ..... | 4           |
| Osseous ankylosis not achieved, but the condition improved both functionally and cosmetically. Used arched soles .....                                                                                                                                            | 2           |
| Osseous ankylosis not achieved and the condition remains the same as before the operation both functionally and cosmetically .....                                                                                                                                | 6           |
| Osseous ankylosis not achieved, but the calcaneus and the talus maintained a normal position after operation. Subjectively and objectively the patient is symptom-free. Good mobility in the subtalar joints ...                                                  | 1           |
| Total No. of feet operated on .....                                                                                                                                                                                                                               | 37          |

At the follow-up examination particular care was taken to bring to light possible subsidiary effects of the operative treatment such as:

1. growth disturbances in the affected bones,
2. functional disturbances as a result of the lack of mobility in the subtalar joints and
3. possible changes as a result of this in the talo-crural and Chopart's joint.

In my opinion I found definite growth disturbance in one case. Compared with the non-operated foot, the talus was obviously of lesser size and the trochlea was flattened. X-rays taken before the operation do not show this. The patient had no subjective symptoms.

The passive and active mobility in the talo-crural and Chopart's joint was not found to be reduced in any case when compared with the pre-operative period. Nor could any instability in the ankle joint be demonstrated. The patient's ability to balance on the operated foot was found throughout, however, to be somewhat reduced. The gliding lateral movement in the subtalar joints which serves to adjust the balance more finely, was replaced by clumsier movements of the body in other respects. In all cases with osseous ankylosis between calcaneus and talus, the patient had the impression that the function of the foot was normal in respect to balance. The subjective evaluation of the patient must here be seen against the background of the condition of the foot before operation.

In the majority an inversion of the heel was recorded when the patient weightbearing with 4 cms. underneath the heel, but in no case was this so marked that it could be said to have a functional significance at the examination.

Signs of arthrosis in the talo-crural or Chopart's joint were not revealed in any case.

#### DISCUSSION

The cases of flat feet in children treated here by extra-articular subtalar arthrodesis according to *Grice* form a unique group. The material does not comprise typical cases of congenital flat feet nor cases with recognized pareses of the tibial musculature or peroneal spasm. In all cases the deformity was severe and showed no signs of improvement in spite of lengthy active dynamic and static treatment. We must conclude that these patients would have incurred, without operative treatment, a permanent foot deformity, with increasing structural changes in the bones, capsules and ligaments.

It must be now considered as an established fact that the extra-articular arthrodesis affects the growth of the bones concerned to a very little extent. Where the result of the operation is a solid bone bridge between calcaneus and talus, and these are in a normal position, there are grounds for considering the treatment as completed and that no later articular arthrodesis will become necessary.

The series shows that the expectation of achieving a solid extra-articular arthrodesis will decrease to some extent with any increase in structural changes and that this may indicate modifications of the original surgical method.

Bone transplants must be selected with care. Grice's method, using 2 bone blocks, each consisting of cortical and cancellous bone, placed parallel with the cancellous aspects facing each other, should not be departed from. When these conditions are satisfied, this series does not provide any grounds for assuming that we can achieve better results with auto- than with homotransplants. Moreover, there is the considerable advantage in using homotransplants that an osteotomy on the upper part of the tibia is avoided. If, however, the bone bank does not contain fully suitable material, there should be no hesitation in utilizing autotransplants.

By means of the extra-articular arthrodesis we succeed in improving the function of a foot with severe flat foot position, but the function does not become normal. What significance this altered function in the long run will prove to have for the talo-crural and Chopart's joint is still an open question. This makes a critical indication position particularly justified in the case of flat feet.

#### S U M M A R Y

A series of 37 flat feet, treated with extra-articular subtalar arthrodesis according to *Grice*, were followed-up.

In each case the operative indication was a pronounced foot deformity with functional symptoms and showing no sign of improvement after active dynamic and static treatment.

After an average observation period of 4 years the results of the surgical treatment were satisfactory in 78 per cent. The causes of unsatisfactory results in the remainder are clarified.

As far as extra-articular subtalar arthrodesis is concerned, the necessity of a critical indication position with the simple flat foot deformity is emphasized.

## RESUME

Une série de 37 pieds plats, traités par arthrodèse subtalaire extra-articulaire selon la méthode de Grice a été réexaminée.

Dans chaque cas l'indication de l'intervention chirurgicale avait été une déformité prononcée du pied avec symptômes fonctionnels, dans lesquels on n'avait pas observé d'amélioration après traitement actif, dynamique et statique.

Avec une période moyenne d'observation de 4 ans, les résultats du traitement chirurgical ont été satisfaisants dans 78 pour cent des cas. Les causes de résultats non satisfaisants chez le reste des malades ont été clarifiées.

En ce qui concerne l'arthrodèse subtalaire extra-articulaire, il est insisté sur la nécessité d'une indication critique de position par rapport à la déformité du simple pied plat.

## ZUSAMMENFASSUNG

Eine Reihenfolge von 37 Plattfüssen, die mittels extraartikulärer subtalarer Arthrodese nach der Methode von Grice behandelt worden waren, wurde nachuntersucht.

In jedem Falle war die Operationsanzeige eine ausgesprochene Fussverbildung mit funktionellen Symptomen und keinerlei Zeichen von Verbesserung nach aktiver statischer und dynamischer Behandlung.

Nach einem durchschnittlichen Zeitraum von 4 Jahren waren die Ergebnisse der chirurgischen Behandlung in 78 Prozent zufriedenstellend. Die Ursachen der unbefriedigten Ergebnisse bei den Übrigen werden klargelegt.

Was die extra-artikuläre, subtalare Arthrodese anbelangt, wird die Notwendigkeit einer kritischen Stellungnahme bei der Indikation in Fällen von einfacher Plattfussverbildung hervorgehoben.

## REFERENCES

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