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CALCANEO-NAVICULAR COALITION

Late Results of Resection

By

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INTRODUCTION

Up to 1920 calcaneo-navicular coalition was considered an unimportant anatomical variant. *Slomann* (1921) was the first to demonstrate a possible relationship between coalition and painful, fixed hindfoot. He suggested treating the condition by resection, but feared further development of the pronation deformity found in all his cases.

Badgley (1927) and *Bentzon* (1928, 1932) reported the first results of resection.

Since that time numerous authors, including *Hayd* (1949), *Webster & Roberts* (1951), *Rössler* (1956), *Hohmann* (1961), and *Mitchell & Gibson* (1967), have expressed the view that resection, alone or combined with interposition of muscular tissue or other material, was applicable for children, provided that the shape of the foot was well-preserved and that X-rays did not reveal any signs of osteoarthritis. The operation is followed by a period of immobilization. After-treatment by supports in ordinary shoes.

In adults and adolescents who show radiological signs of abnormal pressure, especially in the talonavicular joint, there is, all authors agree, indication for arthrodesis, either talo-navicular (*Bentzon* 1928) or of further joints, usually in the form of triple arthrodesis (*Badgley* 1927, *Rendu* 1928, *Seddon* 1933, *Harris & Beath* 1948, *Ernsting* 1956, *Sour* 1959, and *Heikel* 1962). Supplementary tendon transplantation is used by *Niederecker* (1955) among others.

The adherents of arthrodesis were not impressed by the results of resection, but only *Mitchell & Gibson* (1967) have submitted a resected material followed for many years. From their analysis it is apparent

that by simple resection of the bar a satisfactory result was obtained in 76 per cent of 48 treated patients. The follow-up period ranged from 4 to 13 years. The most favourable results were obtained in children younger than 14 years, if they did not have deformity of the foot or signs of adaptive joint changes at the time of operation. As regards the mobility in the subtalar joint and the incidence of recurrence of the coalition, their results are in keeping with those which will be reported below.

MATERIAL AND METHODS

The object of the present study was to assess the value of the method by a follow-up study on resected cases of calcaneo-navicular coalition.

Operative Method

Bentzon's technique (1928, 1932): dorsolateral incision over the coalition, detachment of the extensor digitorum brevis muscle from its origin. Resection of the coalition close to the navicular bone and calcaneus, interposition of the detached muscle belly into the defect left by the resection. The muscle is kept *in situ* by a pull-out wire through the sole. Plaster cast, usually for 3 weeks. After-treatment by supports in the shoes.

During the period 1936 to 1948 31 resections on a total of 25 patients (13 males and 12 females) were carried out in the Orthopaedic Hospital, Aarhus. The right foot was treated in 13 cases, the left in 18. Six patients had the operation on both feet.

Six patients (2 males and 4 females) continued to have such painful feet that triple arthrodesis was performed secondarily, in all cases on one side only, even in the 3 patients who had bilateral primary operations. Four of these patients had the arthrodesis within 2 years of the resection.

The resection series comprises 22 patients (13 males and 9 females) having a total of 25 operations, not followed by secondary arthrodesis.

The follow-up study was carried out in the years 1958 to 1960. One patient, who is a miner abroad, was not examined, but reported that he had no complaints from the foot, also not during heavy work. All the others were examined by the author. The follow-up period ranged from 10 to 22 years. In 20 cases the follow-up examination was done more than 15 years after the resection. Table 1 gives a survey of the material by side resected and by sex.

At the time of operation the patients were 11–23 years of age. Twenty had the operation before the age of 15, and only one was over 20. Half the feet had been painful for more than one year prior to the operation. The factors which elicited this pain were unknown in 25 cases. A possible occupational cause was stated by 5, while only one considered a mild injury to be responsible for the symptoms.

All presented themselves because of pain and/or fatigue in the foot and leg. No one adduced spontaneous complaints concerning the shape of the foot, and only one patient had noticed restriction of subtalar mobility. In 8 cases the complaints were so severe that the working ability was appreciably reduced.

According to the case records, physical examination showed the foot to be in

neutral position or in slight pronation in 22 cases, severe pronation in 8, and with slight cavus deformity in one. Subtalar mobility was stated to be normal in one case, distinctly reduced in 8, and abolished in 22.

Table 1. Cases of calcaneo-navicular coalition treated by resection.

	Males		Females		Total
	Right	Left	Right	Left	
Resection, after-examined	4	8	6	6	24
Primary resection, secondary triple arthrodesis, after-examined	2	0	1	3	6
Resection, not after-examined	0	1	0	0	1
	6	9	7	9	31

Postoperatively one patient went into mild shock, and one developed negligible infection in the wound, while all other operations were uncomplicated.

After the plaster cast removed, about 3 weeks after the operation, all the patients used supports in the shoes, at least for a few months.

The period off work after the operation was in most cases only weeks to a few months. However, 2 patients were off work for more than 6 months because of persisting pain in the foot. Three males and one female had to change their occupation because of the foot. This change of occupation became permanent only in the case of 2 of the males.

Prior to the operation all the patients were X-rayed with special regard to calcaneo-navicular coalition (*Slomann* 1926). In 15 cases exposures were made also in the dorsoplantar and lateral views. Signs of osteoarthritis, in the form of marginal exostoses, narrowing of the joint space, or subchondral sclerosis, were demonstrated in 4 cases in the talo-navicular joint and in one case also in the subtalar joints. Six feet exhibited more or less marked halisteresis of the areas adjacent to the coalition, while only one case had diffuse halisteresis of the entire foot.

The bar presented itself in 4 cases as a solid bridge between the navicular bone and calcaneus. All others were divided by a distinct gap, in half the cases in the middle of the bar. Among the other half, an equal number had the gap closer to the calcaneus and closer to the navicular bone. In one foot there was a tiny secondary os calcis in the gap.

FOLLOW-UP

Data concerning the history and social factors were recorded at the time of the physical examination of the lower limbs. X-rays were obtained of the ankle joint and foot, including a special coalition projection, and the talo-crural articulation was tested for instability.

The *resection material* comprises 24 feet.

Nine patients (9 operated feet) reported pain in the tarsus. In 7 the

pain was slight and negligible, and only 2 patients had more severe pain. Eight complained of a tendency to fatigue in the operated leg One patient found the subtalar mobility to be inconveniently restricted. When asked about the appearance of the foot, 4 patients complained that it was too flat, and three—all women—had problems in getting ready-made shoes that would fit them.

Five patients had done their military service after the operation, but 2 of them had done only light service.

All the patients were working, 21 under conditions where they stood or walked a lot, 8 often on rough ground. All considered their earning capacity to be normal, but 2 men felt that the foot was somewhat annoying in their work.

A total of 13 patients stated that they had no complaints at all on account of the foot, no matter what they did; 9 felt discomfort from the foot upon special, unaccustomed efforts, while 2 patients were annoyed by pain in the foot.

At follow-up the patients ranged in age from 24 to 39 years.

In 19 unilaterally operated cases there was atrophy of the lower leg, amounting to 1 and 2 cm in 4 cases, and to more than 2 cm in 2. The shape of the foot was normal or there was slight pronation in 19 cases, considerable pronation in 5.

Movement in the ankle joint, judged by the axis through the lower leg and a plane through the sole, varied from 35 to 65°, average 42°. This must be considered normal as tested by this technique. Subtalar mobility, determined as an estimated percentage of the normal excursions, was found to be abolished in 4, reduced in 9, and normal in 11 cases. This was a distinct improvement compared with the preoperative condition.

None of the patients walked with a limp when wearing shoes. Only one foot proved tender at the site of the subtalar joints.

All 24 feet and ankle joints were X-rayed at follow-up. The ankle joints showed osteoarthritis, in the form of slight marginal exostoses on the anterior edge of the tibia in 2 cases. The ankle joints were examined for instability by manual supination and pronation pressure upon the hindfoot in relation to the lower leg. The angle between the joint surfaces of the tibia and talus was measured. Total instability is stated as the sum of the supination and pronation tilting of the talus in relation to the tibia. In 17 ankle joints there was instability of 1° or less, in 3 ankle joints of 2°, in 2 ankle joints of 3°, while 1 ankle joint tilted 4° and 1 tilted 5°. This distribution cannot be considered abnor-

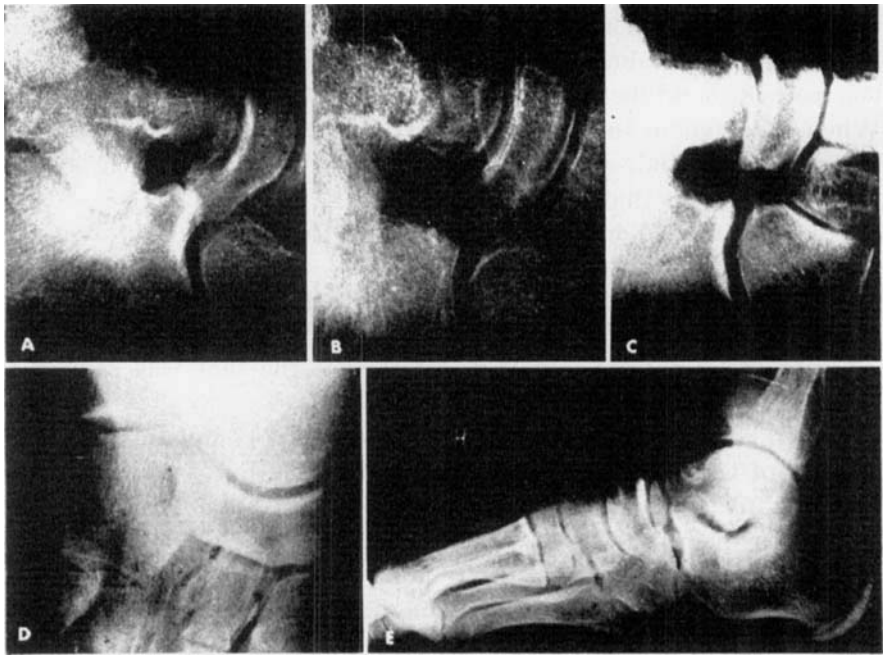

Figure 1. Calcaneo-navicular coalition. Male, born in 1922, resection in 1937. Follow-up 1958: Painless foot, free subtalar mobility, but signs of osteoarthitis in Chopart's joint, (a) before operation, (b) after operation, (c), (d), and (e) at follow-up.

mal. No relationship was found between subtalar fixation and reduced stability in the ankle joint. The tilting of the talus was always in the direction of supination.

Recurrence of the bar was demonstrated, in a more or less marked degree, in 16 cases, *i.e.* 67 per cent. At least in 6 of these cases the resection had been technically perfect judging by the postoperative X-rays.

Osteoarthritic changes, of the type described above, were found—frequently quite pronounced—in the subtalar joints of 11 patients, in the talo-navicular joint of 19, and between the calcaneus and cuboid bone in 19 patients (cf. Figure 1). Only one case was considered to have no radiological changes in the examined joints.

The *arthrodesis series* comprises 6 feet in 6 patients. Originally, resection of coalition had been performed on both feet in three of these patients.

Four patients had been relieved of pain, 2 had mild pain, 3 complained of increased fatigue in the leg. None had any complaints on

account of the subtalar fixation, and none had a feeling of instability in the ankle joint.

Two stated that they had no complaints of any kind, whatever use they made of the foot, while 4 said that occasionally they had discomfort in the operated foot after unaccustomed efforts.

X-rays of the foot were obtained in 5 of the 6 patients. All the arthrodeses had healed. In one case there was mild osteoarthritis of the ankle joint. Instability of the ankle joint into the direction of supination was found in 4 cases. Tilting of the talus was 7°, 9°, 10°, and 11°. No foot showed instability of the ankle joint into the direction of pronation. There was no instance of talar necrosis.

DISCUSSION

An attempt was made to assess the value of resection in the treatment of painful calcaneo-navicular coalition by a follow-up study on operated patients, but the material did not afford a consistent answer.

Out of the 31 resected patients 30 were after-examined. Six had undergone secondary operation (triple arthrodesis) because of persisting pain in the foot. Another 2 feet were causing such severe complaints at follow-up that this operation ought to be performed.

One patient, who could not be examined at follow-up, has reported that he is symptom free.

Resection gave a subjectively perfect result in 13 out of the 30 operated patients followed for up to 22 years after the treatment. Nine have slight complaints which do not interfere with their work. Thus, 22 out of 30 cases or 73 per cent must be characterized as subjectively satisfactory. This is entirely consistent with the statements of *Mitchell & Gibson* (1967).

What makes me uneasy about the results is the development of osteoarthritis, especially in Chopart's joint.

On the basis of the present material it is not possible to state which patients are likely to obtain satisfactory late results from resection therapy. Neither age, shape of the foot, degree of subtalar fixation, duration of the disease, the X-ray appearances, nor the technical quality of the operation could give any prognostic information.

Items in favour of resection: Relatively simple operation, short period of bandaging, short period off work, on the whole a well-preserved shape of the foot, preserved mobility and stability in the ankle joint, and often restoration of subtalar mobility. In addition, the results are

subjectively satisfactory in more than two-thirds of the cases 10–22 years after the operation. Alternative arthrodesis does not always result in a painless foot.

Items against resection: Secondary arthrodesis may be needed. The bar often recurs. However, the most serious objection is that 23 out of the 24 operated patients had, sometimes severe, osteoarthritic changes, especially in Chopart's joint, even before the age of 40. Thus, pain may still develop in spite of, or as a consequence of, the resection. Indeed, it has been the practice in this Department through the past 20 years to employ triple arthrodesis in cases of calcaneo-navicular coalitions which require treatment.

SUMMARY

After a follow-up period of 10–22 years 31 feet, treated primarily by resection of calcaneo-navicular coalition, were examined.

In 6 instances triple arthrodesis had been performed secondarily. The results of the resections were subjectively good in 13 cases, while 9 patients still had mild complaints and 2 had severe pain. One patient was not seen, but reported that he had no complaints at all.

Objective examination revealed a well-preserved shape of the foot, good mobility in the ankle joint, and often restoration of subtalar mobility. However, X-rays revealed recurrence of the coalition in two-thirds of the feet, and 23 out of 24 exhibited definite osteoarthritis, especially of Chopart's joint, even before the patients had reached the age of 40.

Accordingly, I feel that resection cannot be recommended, as it is in most cases followed by osteoarthritis. Triple arthrodesis must be considered safer.

RESUME

Après une période d'observation de 10 à 22 ans, 31 pieds traités primairement par résection d'une coalition calcanéo-naviculaire ont été réexaminés.

Dans 6 cas une triple arthrodese a été pratiquée secondairement.

Les résultats de la résection ont été subjectivement bons dans 13 cas, alors que 9 malades avaient encore de légères complaintes et 2 de graves douleurs. Un malade n'a pas été réexaminé, mais il a été rapporté qu'il n'avait aucune complainte à formuler.

L'examen objectif a révélé une forme bien préservée du pied, une bonne mobilité de l'articulation de la cheville et souvent une restaura-

tion de la mobilité sub-talaire. Néanmoins, les radiographies ont montré le retour d'une coalition dans les deux tiers des pieds, et dans 23 sur 24 une ostéoarthrite déterminée dans l'articulation du tarse dite Chopart, même avant que les malades aient atteint l'âge de 40 ans.

Dans ces conditions, j'ai l'impression que la résection ne peut pas être recommandée puisque dans la plupart des cas elle est suivie d'ostéoarthrite. Une triple arthrodese doit être considérée comme étant plus sûre.

ZUSAMMENFASSUNG

Nach einer Zeitspanne von 10–22 Jahren wurden 31 Füsse, die ursprünglich mittels Resektion einer Coalitio calcaneonavicularis behandelt worden waren, nachuntersucht.

In 6 Fällen war eine Tripelarthrodese sekundär ausgeführt worden. Die Ergebnisse der Resektion waren subjektiv in 13 Fällen gut, während 9 Patienten noch leichtere Beschwerden und 2 starke Schmerzen hatten. Ein Patient wurde nicht gesehen, berichtete aber dass er keinerlei Beschwerden hatte.

Die objektive Untersuchung zeigte eine gut erhaltene Form des Fusses, gute Beweglichkeit im Knöchelgelenk, und oft Wiederherstellung der subtalaren Beweglichkeit. Röntgenbilder zeigten jedoch ein Wiederauftreten der Coalitio bei zwei Dritteln der Füsse und 23 von 24 Füssen wiesen eine ausgesprochene Osteoarthitis, besonders des Chopart-Gelenkes auf, selbst ehe die Patienten das Alter von 40 Jahren erreicht hatten.

Deshalb meine ich, dass die Resektion nicht anzubefehlen ist, da sie in den meisten Fällen von einer Osteoathritis gefolgt wird. Tripelarthrodese müss als das sichere Vorgehen angesehen werden.

REFERENCES

Badgley, Carl E. (1927) Coalition of the Calcaneus and the Navicular. *Arch. Surg.* **14**, 75–88.

Bentzon, P. G. K. (1928) Coalitio calcaneonavicularis, mit besonderer Bezugnahme auf die operative Behandlung des durch diese Anomalie bedingten Plattfusses. *Verh. dtsch. orthop. Ges.* 23. Kongress, 269.

Bentzon, P. G. K. (1932) Spätere Resultate der operativen Behandlung der durch Coalitic calcaneo-navicularis bedingten Plattfusses. *Verh. dtsch. orthop. Ges. Beilagsheft Z. orthop. Chir.* **55**, 374–375.

Ernsting, Gertrolf (1956) Zur klinischen Bedeutung der Coalitio calcaneo-navicularis. *Arch. orthop. Unfall-Chir.* **48**, 433–457.

Harris, R. I. & Beath, Thomas (1948) Etiology of peroneal spastic Flatfoot. Special reference to talocalcaneal bridge. *J. Bone Jt Surg.* **30** B, 624–634.

Hayd, F. W. (1949) Die Coalitio calcaneo-navicularis und ihre klinische Bedeutung. *Z. orthop. Chir.* **78**, 292–303.

Heikel, Henrik V. A. (1962) Coalitio calcaneonavicularis and calcaneus secundarius. *Acta orthop. scand.* **32**, 72–84.

Hohmann, G. (1961) Coalitio calcaneo-navicularis. Handbuch der Orthopädie. Georg Thieme, Stuttgart.

Mitchell, G. P. & Gibson, J. M. C. (1967) Excision of calcaneo-navicular bar for painful spasmodic flatfoot. *J. Bone Jt Surg.* **49** B, 281–287.

Niederecker, Kaspar (1955) Erfahrungen bei operativer Behandlung des Plattfusses. *Arch. orthop. Unfall-Chir.* **47**, 522–544.

Rendu, André (1928) Traitment de la tarsalgie avec pied plat occasionnée par la synostose calcanéo-scaphoïdienne. *Rev. Orthop.* **15**, 672–673.

Rössler, H. (1956) Erfahrungen und Gedanken über die Fusskontrakturen bei Jugendlichen. *Z. Orthop.* **87**, 555–570.

Seddon, H. J. (1933) Calcaneo-scaphoid coalition. *Proc. roy. Soc. Med.* **26**, 419–424.

Slomann, H. C. (1921) On coalitio calcaneo-navicularis. *J. orthop. Surg.* **19**, 586–602.

Slomann, H. C. (1926) On the Demonstration and Analysis of calconeo-navicular coalition by Roentgen Examination. *Acta radiol.* **5**, 304–312.

Sour, Robert (1959) Le pied plat contracturé. *Rev. Chir. orthop.* **45**, 817–835.

Webster, F. S. & Roberts, W. M. (1951) Tarsal Anomalies and Peroneal spastic Flatfoot. *J. Amer. med. Ass.* **146**, 1099–1104.

ERRATA

We regret a few errors in the article,

ANTERIOR RECURRENT DISLOCATION OF SHOULDER
by *A. K. Saha*, vol. 38, 479–493.

Page 482, line 3 should read:

"when the relative antetorsion of the upper end of the humerus is *maximum, is* taken over by the infraspinatus . . ."

Page 484, line 15 should read:

". . . Eden-Hybbinette operation is *the method of* choice . . ."