FROM THE ORTHOPEDIC HOSPITAL, AARHUS, DENMARK
(CHIEF PHYSICIAN: P. G. K. BENTZON)

CONGENITAL METATARSUS VARUS

BY

KNUD ELLEBÆK PETERSEN

Metatarsus varus is a well-defined morbid condition generally divided into a congenital and an acquired form. The latter was described first by von Mikulicz in 1884. It took 20 years more before the congenital form was described first, by Kramer in 1904, who reported a single case of this deformity and at the same time emphasized its extraordinary infrequency. In the following years, several papers were published on this subject. These publications were all reports of single cases, however, and the various authors (*e.g.*, Joachimstal; Helbing; Hirsch; Valentin; Nové-Josserand & Francillon; Froelich) all agreed that this deformity is very rare. As late as in 1921, Valentin gave a review of the literature on the subject and stated that so far a total of only 25 cases had been described by 13 authors. In 1924, however, Engel suggested that the lesion hardly might be so rare as generally assumed, as within two years he had been able to gather 13 cases. In 1926, Bergmann reported 40 cases observed within a period of 6 years, and in 1929 Schulze-Gocht presented a material of 36 cases encountered within 4 years. After this, the affection appears to have been established as a well-defined orthopedic lesion. This deformity has been described chiefly in the German and French literature; in the English literature only two papers appear to have been published on this subject (Bankhart; Peabody & Muro). In the Scandinavian literature the lesion has hardly been mentioned at all.

This scanty treatment of metatarsus varus in the literature

is rather surprising insofar as the lesion actually is of fairly frequent occurrence. The most probable explanation of this, no doubt, is that the deformity with varus position of the metatarsus is a component in the congenital club-foot, and hence it has been embodied in the club-foot material of the various orthopedic clinics. As will be pointed out more thoroughly below, metatarsus varus differs essentially from club-foot morphologically as well as prognostically so that there are very good reasons for setting up this defect as a particular affection *per se*.

As mentioned, distinction is made between a congenital and an acquired form of metatarsus varus. The latter, of course, may be due to various factors. Most often it is described as a compensatory phenomenon in knock-knee (von Mikulicz) and in rachitic crura vara. Further, it may appear as an arthrogenous form (Helbing has described a case as developing after rheumatic fever), as a traumatic deformity, and as a sequela of poliomyelitis.

The present paper is aimed to give an account of the congenital metatarsus varus material in the Orthopedic Hospital, Aarhus, as we thought it would be appropriate to present this material, partly because of the scanty material on this subject, partly because of the size of the present material as compared to those published before. This material was encountered within a little over 7 years, from the opening of this hospital in September 1936 to December 31, 1943. In this period we have seen altogether 130 cases of metatarsus varus, 7 of which had to be reckoned as representing the acquired form (of traumatic nature in 1 case, following poliomyelitis in 1 case, compensatory in knock-knee in 1 case, and compensatory in rachitic crura vara in 4 cases). In the remaining 123 cases the defect is taken to represent the congenital form. Within the period mentioned a total of 19,947 patients have been treated or examined in this hospital, that is, congenital metatarsus varus has been encountered in 0.6 % of the total patient material. The frequency of this defect in proportion to congenital club-foot is 1:3.2, as we have had 447 patients with congenital club-foot.

As to the etiology of congenital metatarsus varus, the pre-

vious authors keep within the scope usually accorded congenital deformities: intrauterine mechanical factors, and hereditary faulty anlagen—without settling the question in any way. Nové-Josserand & Francillon—think that in view of the varus position of the great toe it may possibly be a question of atavism. This is rather improbable, we think, as the abduction of the great toe is not the principal distinction between the ape foot and the human foot; the particular characteristic of the ape foot is to be found rather in the capacity of the great toe for opposition.

The present material, too, allows of no conclusion as to the etiology of the defect. It is to be mentioned, however, that a familial occurrence of the lesion has been demonstrated in strikingly many cases. On going through the case records it is found that questions about a familial disposition to the defect have been asked in 58 cases, and in no less than 11 of these the information was obtained that similar deformities were present in some near relatives. Such a familial occurrence of the defect has been found previously but in very few cases (Mettenleiter; Joachimstal; Terterianz; and Schulze-Gocht); it speaks in favour of a hereditary disposition. This is further rendered probable by the rather frequent concurrence of the defect together with other congenital hereditary deformities. A few cases of this kind have been seen too among our patients: In one patient with unilateral metatarsus varus the other foot was a club-foot; one patient also had a congenital dislocation of the hip; one patient had syndactylism; and one patient torticollis.

Clinically, as indicated by the name, the deformity appears as a varus position of the metatarsal bones so that the entire distal part of the foot is adducted (Fig. 1). This is the esential feature of the deformity. Naturally the degree of the deformity is subject to wide variation, all sorts of transitions being encountered—from a slight and insignificant varus position to monstrous forms, in which the angle between the anterior and posterior parts of the foot may measure up to 60-70°. Most often the first metatarsus deviates somewhat more medially than the others. The adduction of the anterior part of the foot is often

associated with supination and plantar flexion, resulting in a moderate degree of hollow foot formation. With regard to the posterior part of the foot, it is to be pointed out that its position is either normal or, most often, in valgus position. This feature, which was strongly emphasized already by Cramer, has to be looked upon as something very essential, as it indicates decisively the fundamental difference between metatarsus varus and

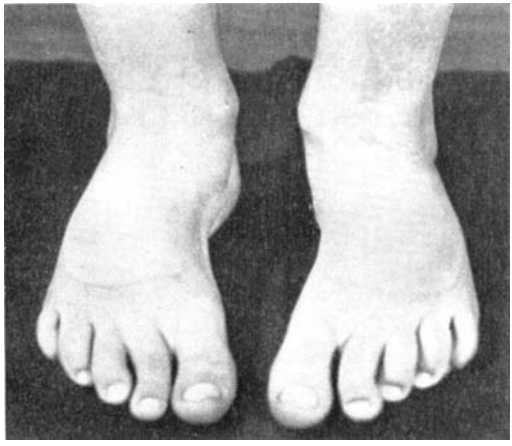


Fig. 1.
Case of pronounced metatarsus varus in a girl, 4 years old (patient B. 15350).

congenital club-foot. In addition, it will be appropriate to emphasize that equinus position is never seen in metatarsus varus.

Roentgenologically the varus position of the metatarsal bones is the most conspicuous feature (Fig. 3). Often the 2', 3' and 4' metatarsal bones are somewhat curved, dorsally and laterally convex, lying over each other partially; but this is no constant feature. Cramer thinks that according to the roentgenographic findings it would be proper to set up two nosographic pictures: metatarsus varus and metatarsus adductus. For the former term, he insists, the above-mentioned 3 metatarsal bones must present a varus curvature besides the varus position of all the metatarsal bones, whereas this curvature is absent in metatarsus adductus.

This differentiation has given rise to a rather lively discussion, as several authors (*e.g.,* Hirsch; Valentin; Kuh; Peabody & Muro) agree with Cramer that they are two essentially different deformities—and Peabody & Muro have even suggested that this difference is of significance to the treatment. Other authors (*e.g.,* Helbing; Engel; Bergmann and Schulze-Gocht) have not been able to acknowledge this differentiation, which, we likewise

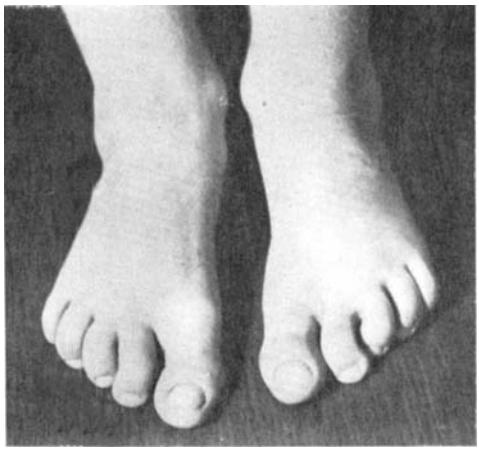
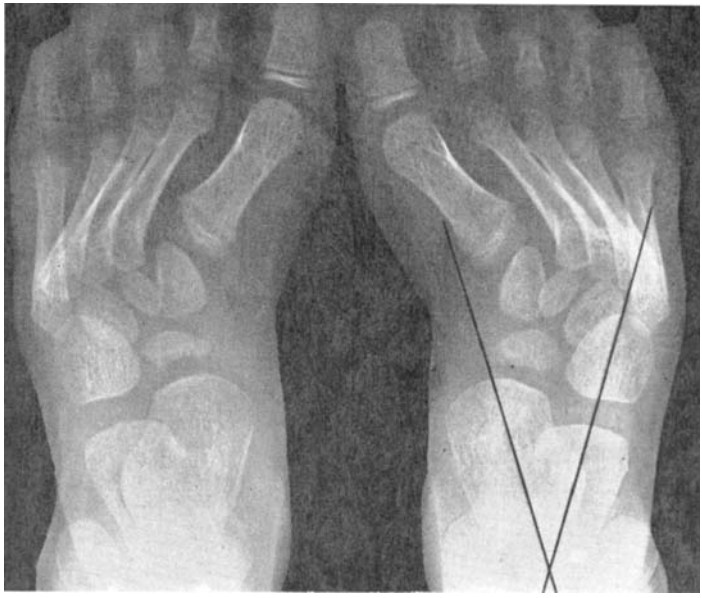
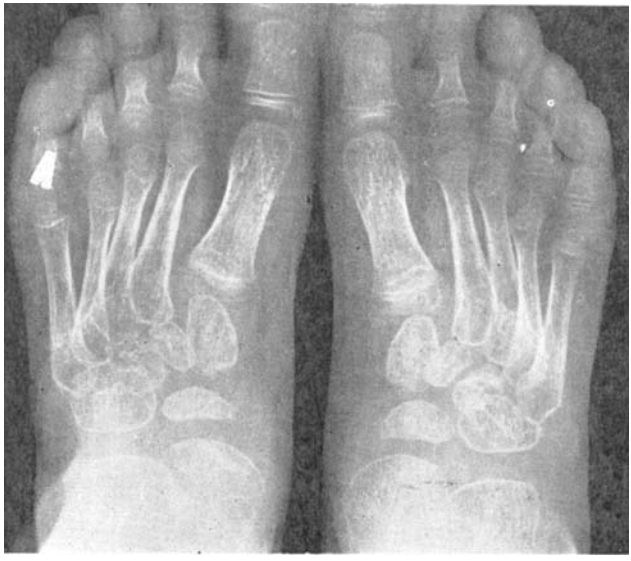


Fig. 2.
Same patient as in Fig. 1, after operative treatment.

think, is hardly justifiable. For the above-mentioned curvature of the three metatarsal bones is not seen in infants, appearing only when a weight is put on the feet. So Cramer cannot be right when he considers the curvature congenital. It is rather to be interpreted as a compensatory curvature. It is never seen to involve the 1' and 5' metatarsal bones—which would be rather peculiar if it were a primary curvature. At any rate, as claimed by Peabody & Muro, this differentiation is of no practical importance.

Of other characteristics in the X-ray picture, one will notice that Lisfranc's line often takes a very oblique course, its endpoint being more distal medially and more proximal laterally than normally. The relation between the talus and calcaneus is





Figs. 3 and 4.

Same patient as in Fig. 1, before and after operative treatment. Besides the varus position and the varus curvature of the metatarsal bone, Fig. 3 illustrates subluxation of the navicular bone.

of interest. Wisburn (1932) has called attention to the fact that the angle between the talus and the calcaneus is variable, being smaller in club-foot, greater in pes valgus, while normally it is 35-40°. On going through our X-ray pictures of metatarsus varus we never found a decrease in this angle, but often an increase—in keeping with the fact that the deformity most often is complicated by valgus position of the tarsus. As to the other tarsal bones, the findings are somewhat variable. In infants, in whom the nuclei of ossification cannot yet be made out, of course, no information may be obtained on this point. In somewhat older children, varying changes are seen not infrequently. The navicular may be subluxated outwards (Fig. 3) and undergo structural changes. But this is far from being a constant phenomenon, as has been claimed by Kuh. Normal navicular bones are seen just as often. Mau has described a case of bilateral metatarsus varus with concurrent adherence of Köhler's disease on one side, and he thinks that this is no accidental coincidence when the two lesions are encountered together, but assumes that there is a primary connection between this localization and the increased mechanical demands made on the tarsus. Also Weil has seen a similar case, but otherwise such cases have not been reported by previous authors and we have not seen any. Of other changes, the cuneiform bones have been reported to present structural changes and disturbances of the ossification. Changes in the form of the bone are often seen in the 1' cuneiform, the distal joint surface of which is very oblique so as to give rise to an abnormal articulation with the 1' metatarsal bone, which looks as if it had slipped down from the cuneiform, as the latter has a long forward projection laterally.

With regard to the pathological anatomy in metatarsus varus, we have to be content with the X-ray pictures. So far autopsy has been reported only in one case (Nové-Josserand & Francillon). Apart from the varus position of the metatarsus and the valgus position of the tarsus, no particular abnormality was revealed, as the patient was an infant, 3 months old, in whom most of the tarsal nuclei of ossification had not yet developed. No information was given about the soft parts. In this

respect an observation reported by Peabody & Muro is of interest. In the case of a patient on whom they operated for metatarsus varus they found a bilateral variation in the insertion of the tendon of the tibialis anticus, which did not insert on the tarsal bones at all but continued distally in its sheath over the navicular and 1' cuneiform till it reached the body of the 1' metatarsal bone, where it turned down, spread out like a fan and inserted in the plantar fascia. A similar observation is said to have been made by Funsten; but it has not been observed by other authors. So, it is not practicable to say whether such a variation may be of any general significance to the pathogenesis of metatarsus varus, but this is hardly likely, as otherwise it undoubtedly would have been described more frequently, since several authors mention operative measures performed on the 1' metatarsal bone.

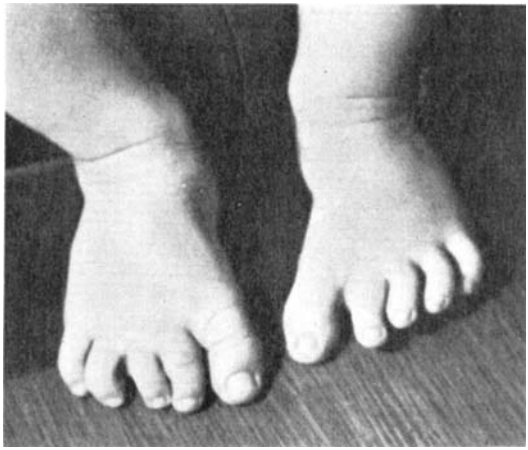
The symptoms of metatarsus varus are not particularly pronounced. Many of the patients have no complaints at all. In other cases they complain of tiredness of the feet and, sometimes, of pain while walking. Often the gait is a little unsteady. Undoubtedly their greatest inconvenience is the difficulty in obtaining suitable footwear, and this is frequently the reason why the patient seeks medical advice. In this respect, also cosmetic considerations play some role. As the lesion is congenital, many of the patients are referred to the orthopedist shortly after birth, but more frequently not until they commence walking. The parents say that although they realized that the child's feet were not normal, they did not pay particular attention to the deformity till the child commenced to walk, the varus position being most conspicuous when weight is placed on the foot. A great majority of our patients were little children; only 10 were over 15 years. As to the sex distribution of the 123 patients, 71 were males, 52 females. In this connection it may be mentioned that also Schulze-Gocht and Valentin found a considerable preponderance of male patients, whereas Bergmann and Peabody & Muro found the two sexes represented equally. In 98 patients the deformity was bilateral, though often with some difference in the degree of deformity of the two feet; in 15 cases

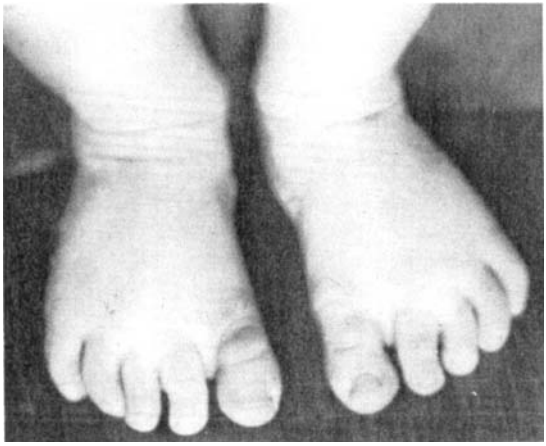
the deformity was limited to the right foot, in 10 to the left. This is in keeping with the statement by Bergmann and Schulze-Gocht, who also found the deformity bilateral in the greater majority of the patients.

Naturally the treatment of metatarsus varus has been the subject of considerable discussion. Some authors (*e.g.*, Valentin and Kuh) hold that the condition should not be treated, as they consider the deformity insignificant. Most authors agree, however, that the deformity ought to be treated actively. The most suitable treatment is claimed to be redessment over wedge, followed by plaster cast. While most authors perform this redressment as early as possible, Bergmann recommends postponement of the treatment to the end of childhood, stating that he has seen frequent relapses after redressment in early childhood. With this expectation, on the other hand, he has seen good permanent results.

The methods recommended for operative treatment are numerous. They will be reviewed here but briefly. Helbing performs tenotomy on the flexor tendon of the great toe. Froelich recommends osteotomy on the 1' metatarsal bone together with tenotomy on the tendon of the extensor hallucis longus. Van Neck performs osteotomy on all the metatarsal bones. Jaroschky removes a wedge from the proximal part of the cuboid and inserts a bridge of tibia in the crevice resulting between the talus and the 1' cuneiform. Engel removes a wedge from the lateral part of the foot. The distal side of the wedge comprises the base of the 5' metatarsal bone and the basal part of the 4' and 3' metatarsals; the proximal side passes through the 3' and 2' cuneiform bones. Siebert employs a similar method. Contargyris removes a bone wedge that includes the entire joint of Lisfranc. Schulze-Gocht also performs a wedge resection at the lateral margin of the foot, but at the same time he also performs osteotomy on the 1' cuneiform, which he considers to be the main point of the deformity. In the medial gap resulting from this osteotomy he inserts the wedge removed from the lateral margin of the foot.

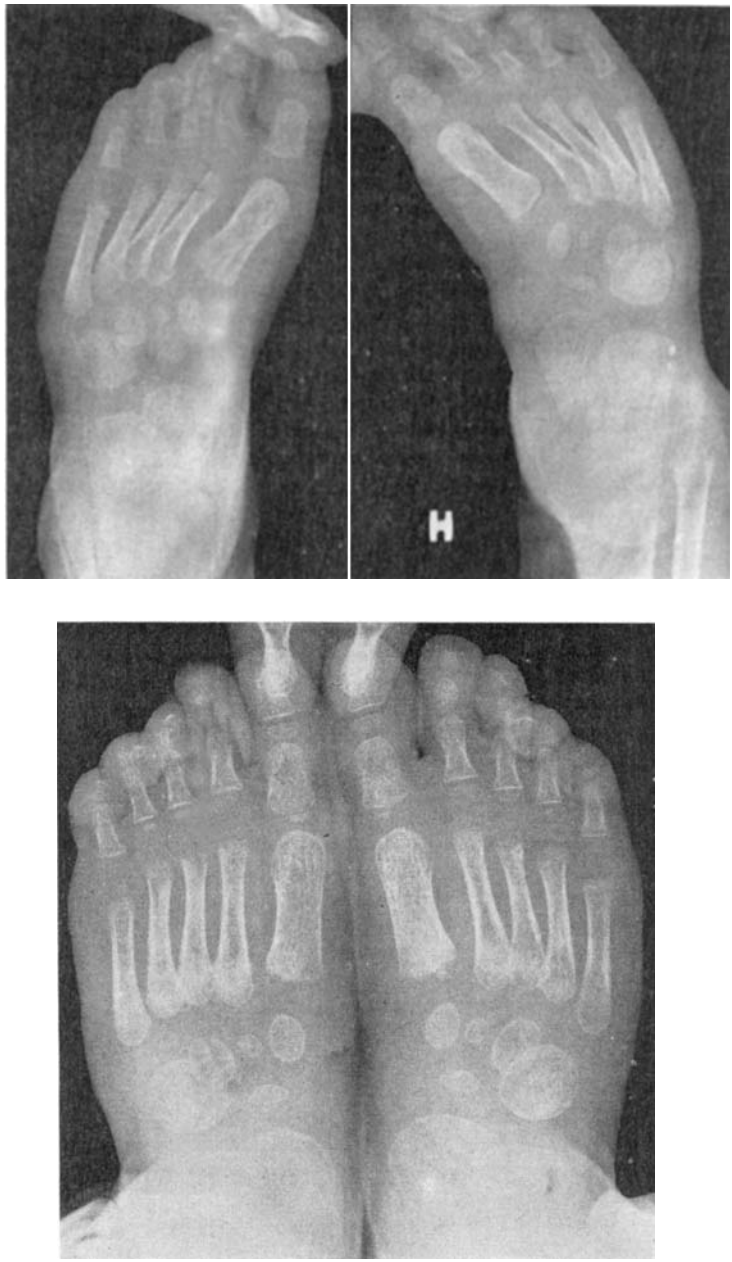
In the following an account will be given of the treatment





Figs. 5 and 6.
Case of metatarsus varus in a boy, 18 months old (patient B. 13108), before (Fig. 5) and after (Fig. 6) redressment.

of our 130 patients (the 7 cases in which the deformity was taken to be acquired are included in this total material, as therapeutically there is no difference between the acquired and the congenital forms). Whereever any active treatment was estimated to be indicated the principles of the treatment have been: In infancy, manipulations and corrective bandaging; in early



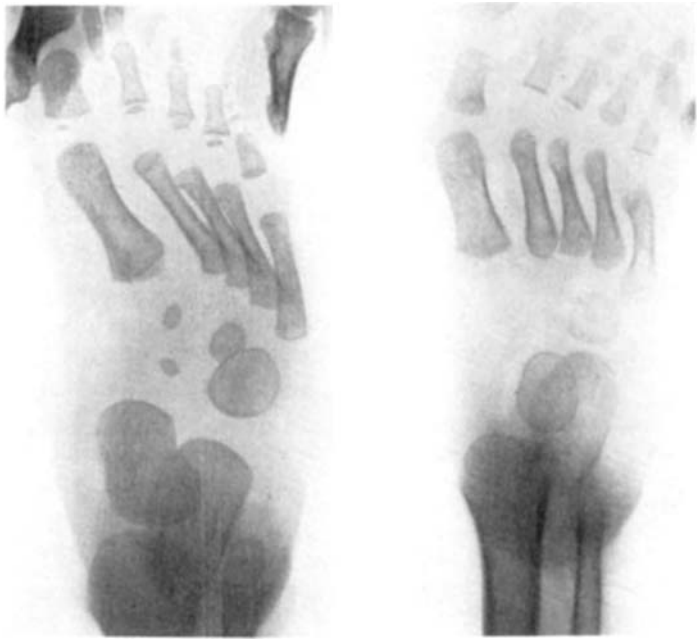
Figs. 7 and 8.
Example of metatarsus varus in a boy, 2 years old (patient B. 18522) before (Fig. 7) and after (Fig. 8) redressment.
Note the relatively large angle between the talus and calcaneus.

childhood redressment and plaster cast; in older children and in relapse after redressment, operative treatment in the form of wedge-shaped tarsectomy.

In 16 patients the deformity was pronounced so little that it was judged to require no treatment. In 9 patients under 6 months manipulations were combined with corrective bandaging. In 4 of these cases such treatment has proved sufficient, no additional treatment being required later on. In 3 of these cases redressment was performed later on. 2 patients died from other cause shortly after the discharge from the hospital.

In 66 cases redressment was performed—twice in one of them. The age of the patients treated in this way was between 1 and 6 years, most often about 2 years. Redressment was performed under ether anesthesia over wedge. The redressment was followed by application of the plaster casts in overcorrection. This bandage was removed after 5-6 weeks, and then the patients were discharged, often provided with a correcting night bandage and suitable foot-wear. As to the result of this treatment, we have exact information about 44 patient for whom the observation period is from 1 to 7 years. The data on these patients come partly from reexamination, partly from questionaries, and the results may be classified as follows: In 12 patients the form of the foot is perfectly normal and these patients are all symptom-free (Figs. 5-8 illustrate the metatarsus before and after redressment). In 25 patients there still remains a slight rest of the metatarsus varus position, but the patients are symptom-free and use ordinary footwear. In 3 patients there is a remnant of metatarsus varus and complaints of tiredness and pain in the feet. Pronounced relapse occurred in 4 patients, in 3 of whom tarsectomy has been performed later on, while 1 is to be submitted to this operation subsequently. As to the remaining 22 patients, 5 failed to answer the questionaries sent them, and for the rest the observation period is less than one year, on which account they are not included in this classification. It is to be mentioned, however, that at the discharge of these patients from the hospital there remained at any rate not more than a slight suggestion of metatarsus varus.

Operative treatment was performed on 8 patients, bilaterally in 5 of them. Of these 8 patients, 5 had previously been treated with redressment—here or in some other clinic. The age of the operated patients has been between 4 and 6 years. The operation



Figs. 9 and 10.

Fig. 9 shows metatarsus varus in a girl, 18 months old (patient B. 9013). For comparison, Fig. 10 shows pes equino-varus in a girl, 18 months old (patient B. 6809). The pictures are taken in dorsoplantar direction. In Fig. 9 the longitudinal axes of the talus and calcaneus form an angle of about 50°, corresponding to the fact that the metatarsus varus position is combined with valgus position of the tarsus. In Fig. 10 the same angle is seen to be only about 15°—in keeping with the fact that here the entire foot is supinated.

is performed as a wedge-shaped tarsectomy in which the wedge comprises parts of the cuboid and navicular. After this the patients have been kept in plaster casts for 4 weeks and were then discharged with walking bandage, which has been removed after

about 6 weeks, and then the patients have been provided with suitable footwear. For 6 of these patients the observation period has been from 1 to 6 years, for 2 it is less than 1 year. In 1 the form of the foot is perfectly normal, in 6 there is an insignificant remnant of metatarsus varus, and in 1 the metatarsus varus is still pronounced (Figs. 1-4 are examples of metatarsus varus before and after tarsectomy). In all these patients the function of the foot is normal, and there are no complaints; 4 now use ordinary footwear, while 4 have to get their footwear made to order.

Besides the above-mentioned patients who either were treated as mentioned or not treated at all, there is still a group of patients in whom the deformity was so slight that radical treatment did not seem indicated, and who were provided with special footwear, especially when the valgus position of the tarsus was the predominant feature. Finally, the adult patients are to be mentioned therapeutically. In these patients we did not think the deformity would be accessible to redressing treatment, and hence they were provided with footwear made to order.

The prognosis of metatarsus varus is generally stated to be good. Even when untreated this deformity has not the same marked tendency to aggravation as applies to the club-foot. In this respect, it may be of interest to look upon the few untreated adults included in our material. As mentioned, 10 patients are over 15 years. Of these patients 4 are fully able to work and symptom-free, while 6 are considerably inconvenienced by the deformity and their working capacity is somewhat hampered, even though none of them is disabled, and they are fairly able to work if they are provided with footwear made to order. So there can hardly be any doubt that untreated metatarsus varus may give the patients not inconsiderable inconvenience, and for this reason it will be justified to treat this deformity as early as possible. Of course, these few cases of untreated adult patients are of no value as a basis for comparison with our treated patients; and no comparative material proper is obtainable. One might perhaps wonder that so few adults are encountered with this affection, when it is relatively frequent in children. But,

as mentioned in the introduction, it is very likely that several patients with metatarsus varus have been concealed in the club-foot material and that these patients thus have been treated as club-foot patients.

SUMMARY

A brief review is given of the previous literature on congenital metatarsus varus, which was described first by Cramer in 1904 and long considered a very rare deformity. Subsequently this view has changed, and it is now realized that the deformity is of rather frequent occurrence in an orthopedic patient material. Still, the literature on the subject is very scanty yet. In several clinics presumably metatarsus varus is still reckoned as belonging to the club-foot material.

The writer emphasizes that morphologically as well as prognostically there is a considerable difference between the two deformities. The most important morphological differences are pointed out to be: 1) in metatarsus varus the tarsus is most often found in valgus position, never in varus; 2) equinus position is never seen in metatarsus varus.

The writer presents a material from the Orthopedic Hospital in Aarhus, comprising 123 cases of congenital metatarsus varus from a period of a little over 7 years. This material makes 0.6 % of the total patient material of the hospital. The deformity was bilateral in 98 cases. Of the patients 71 were males, 52 we females. A great majority of the patients were little children. Familial occurrence was demonstrated in 11 ouf of 58 cases investigated.

The treatment consisted partly in manipulation, partly in redressment, and partly in operating treatment in the form of wedge-shaped tarsectomy. Among 9 patients treated with manipulations redressment had to be performed subsequently in 3 cases. 66 patients were treated with redressment, in 4 of whom a subsequent recurrence was so pronounced as to constitute an indication for operative treatment. Tarsectomy was performed on 8 patients. In one of these cases, a state of pronounced meta-

tarsus varus still persists in spite of the operative treatment. The function is good in all the cases.

In contrast to club-foot the prognosis of untreated metatarsus varus is considered good. Still, it is taken as most likely that, if the patients are not treated actively, they later will have considerable inconvenience from their deformity even if they do not become disabled. Among 10 untreated adult patients 6 were greatly troubled with their deformity.

ZUSAMMENFASSUNG

Es wird ein kurzer Überblick über die frühere Literatur in Betreff des Metatarsus varus congenitus gegeben; derselbe wurde zum ersten Male 1904 von *Cramer* beschrieben und lange als eine sehr seltene Deformität betrachtet. Dieser Gesichtspunkt hat sich indessen später geändert, und man ist sich darüber klar geworden, dass die Deformität in einem orthopädischen Patientenmaterial recht häufig vorkommt. Die Literatur über das Thema ist jedoch immer noch sehr spärlich. Es ist zu vermuten, dass Metatarsus varus an mehreren Orten in das Klumpfussmaterial einbezogen wird. Es wird betont, dass sowohl morphologisch wie prognostisch zwischen den beiden Deformitäten ein wesentlicher Unterschied besteht. Als wichtigste morphologische Unterschiede werden folgende hervorgehoben: Dass bei Metatarsus varus der hintere Teil des Fusses meist im Valgus, nie im Varus steht, — ferner, dass bei Metatarsus varus niemals Equinusstellung beobachtet wird.

Es wird ein Material aus dem Orthopädischen Hospital zu Aarhus vorgelegt, das aus 123 Fällen von Metatarsus varus congenitus aus einer Periode von etwas über 7 Jahren besteht. Es macht dies 0,6 % vom gesamten Patientenmaterial aus. In 98 Fällen war die Deformität doppeltseitig. 71 Patienten waren männlichen, 52 weiblichen Geschlechte. Weitaus die meisten Patienten waren kleinere Kinder. In 11 von 58 Fällen ist familiäres Auftreten nachgewiesen.

Die Behandlung bestand teils in Manipulationen, teils in Redressement und teils in operativen Eingriffen in Gestalt keil-

förmiger Tarsectomie. 9 Patienten wurden mit Manipulationen behandelt; an dreien derselben ist später Redressement vorgenommen worden. 66 Patienten wurden mit Redressement behandelt. Bei vieren von diesen trat ein so ausgesprochenes Recidiv ein, dass operative Behandlung indiziert war. Tarsectomie wurde an 8 Patienten vorgenommen. In einem dieser Fälle besteht trotz der Operation immer noch ausgesprochener Metatarsus varus. Die Funktion ist in sämtlichen Fällen gut.

Die Prognose für den nicht behandelten Metatarsus varus wird im Gegensatz zu der Prognose für den Klumpfuss als günstig angesehen. Es muss doch als wahrscheinlich betrachtet werden, dass den Patienten aus der Derfomität, sofern diese nicht behandelt wird, erhebliche Beschwerden erwachsen werden, obwohl keine eigentliche Invalidierung eintritt. Von 10 unbehandelten Erwachsenen fühlten sich 6 durch die Deformität sehr beeinträchtigt.

RÉSUMÉ

Il est donné un aperçu sommaire de la littérature publiée sur le métatarse varus congénital, décrit pour la première fois en 1904 par Cramer et que l'on a considéré pendant longtemps comme une déformité très rare. Ce point de vue s'est cependant modifié plus tard et l'on s'est rendu compte que cette déformité est assez souvent observée chez les malades souffrant de maladies orthopédiques. La littérature publiée sur ce sujet est cependant encore assez parcimonieuse. Il faut croire qu'en beaucoup d'endroits on range le métatarse varus parmi les observations sur le pied bot varus. Il est relevé qu'il y a une différence essentielle entre ces deux déformités, tant au point de vue morphologique que prognostique. Comme principales différences morphologiques, on signale que dans le métartarse varus la partie arrière du pied est souvent en position de valgus, jamais en varus et qu'on ne trouve jamais la position du pied équin dans le métatarse varus.

L'auteur présente 123 cas de métatarse varus congénital, observés à l'Hôpital Orthopédique d'Aarhus (Danemark), pen-

dant une période d'un peu plus de sept ans. Ces cas représentent 0,6 % du nombre total des observations de l'Hôpital durant cette même période. Dans 98 cas, la déformité était bilatérale. 71 des malades appartenaient au sexe masculin, 52 au sexe féminin. De loin la plus grande partie des malades étaient de petits enfants. On a constaté la manifestation familiale de cette anomalie dans 11 cas sur 58.

Les malades ont été traités soit par des manoeuvres d'assouplissement, soit par le redressement, soit par une opération sous forme de tarsectomie en forme de coin. 9 malades ont été traités par des manoeuvres d'assouplissement. Chez 3 d'entre eux on a pratiqué plus tard le redressement. 66 malades ont été traités par le redressement. Chez 4 de ceux-ci il y a eu une récidive si prononcée que le traitement opératoire était indiqué. On a pratiqué la tarsectomie chez 8 malades. Dans ces derniers cas, il y a d'ailleurs toujours un métatarse varus prononcé, malgré l'opération. Dans tous les cas la fonction est bonne.

On considère que la prognose du métatarse varus non traité est bonne, contrairement à celle du pied bot. Il est cependant probable que si cette déformité n'est pas soignée, elle peut entraîner de graves inconvénients pour le malade, sans être invalidisante. Chez 10 adultes qui n'avaient pas été mis en traitement, 6 souffraient beaucoup de leur déformité.

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