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CONGENITAL VERTICAL TALUS

Reevaluation of Early Manipulative Treatment

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Vertical talus is a rare congenital foot deformity. It is generally agreed that it is difficult to obtain satisfactory correction by non-operative treatment. In the evaluation of different methods of conservative treatment Lloyd-Roberts & Spence (1958) emphasized that: "they have in common an unsatisfactory outcome, because the deformity was neither corrected nor significantly improved in any instance, even when treatment started within the first few weeks of life".

In a clinic with extensive experience with manipulative treatment of congenital club foot, we have made observations concerning early manipulative treatment of vertical talus indicating new possibilities for the conservative form of treatment. Thus we feel justified in reporting our preliminary results.

M A T E R I A L

In a special clinic for congenital foot deformities, a total of 648 patients (1053 feet) were seen in the years 1963-1972. Among these 226 cases (341 feet) were idiopathic congenital club feet and only 19 cases (28 feet) were congenital vertical talus. Until 1968 all cases of vertical talus were treated by surgical correction.

Since our initial experience in 1968 with the first case of vertical talus treated successfully by early manipulation, no infant has been submitted to open reduction, as all early cases were managed successfully by non-operative treatment.

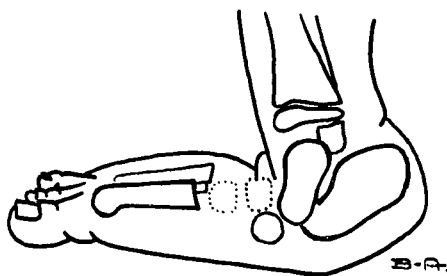
In our following report we have considered only cases of congenital idiopathic vertical talus, thus excluding all cases of myelomeningocele and arthrogryposis.

TREATMENT

The treatment was carried out on an outpatient basis, and consisted of early daily manipulations followed by fixation in a thermoplastic splint made of Plexidur®.

The initial manipulations were carried out by specially trained physiotherapists, who at the same time gave instruction to the mothers. When correction had been accomplished the mothers took over most of the manipulative treatment.

For details concerning the different steps of manipulation the reader is referred to the following.



INSTRUCTIONS FOR MANIPULATION

First the equinus factor is treated.

The infant is placed in a prone position on the table with its feet towards the physiotherapist. The ankle joint is fixed from behind by the homonymous hand, with the thumb on the lateral, and the index finger on the medial malleolus. The three ulnar fingers are placed on the medial side of the lower leg.

With the index finger of the heteronymous hand the dorsoproximal part of the calcaneus is pressed in a distal direction and at the same time the anterior part of calcaneus is pressed in dorsiflexion with the thumb.

The following steps are all carried out with the infant in a supine position.

The pronation of the hindfoot is treated as follows.

The ankle joint is fixed from in front by the homonymous hand, the thumb being placed on the medial malleolus.

The posterolateral part of the calcaneus is grasped with the third finger of the heteronymous hand and after slight traction pressed in supination—the force being increased by the lever action of the heteronymous thumb placed on the homonymous at the medial malleolus, acting as the fulcrum of this movement.

The following steps bring about a stretching of the peroneal muscles.

The ankle joint is fixed from in front with the heteronymous hand, the thumb on the lateral, the index on the medial malleolus. With the thumb of the homonymous hand placed at the level of the 5th metatarsal base, the forepart of the foot is pressed in adduction and slight supination.

Stretching of the toe extensors and foot dorsiflexors is the object of the next step. The posterior part of the foot is fixed from behind by the heteronymous hand. The index of the homonymous hand is placed across the proximal dorsum of the foot, which is pulled in plantar flexion.

The object of the final procedure is the reduction of the talonavicular dislocation.

The hindfoot is fixed from behind with the homonymous hand. The thumb is placed on the medial malleolus and calcaneus, the index and third fingers on the lateral malleolus and calcaneus.

The heteronymous hand applies slight traction by means of the index and third fingers placed on the navicular bone, the thumb being placed at the level of the head of the talus in the sole of the foot. The forefoot is pressed in plantar flexion and slight supination. At the same time the head of the talus is pressed in a dorsal direction by the thumb. During this particular step the actual reduction of the talonavicular dislocation takes place.

CASE REPORTS

Case 1. A girl with right-sided vertical talus; first seen at the age of eight days. The foot was found to have marked dorsiflexion and pronation-abduction of the forefoot and the heel was elevated. The Achilles tendon was rather tight and there was a marked contracture of the dorsiflexors and the tibialis anterior. The peroneal tendons, especially the brevis tendon, were also very tight (Figure 1.1).

The radiograph (Figure 1.2) showed typical findings in early vertical talus.

Treatment was started immediately with daily manipulations followed by fixation in a thermoplastic splint. After two weeks of treatment only moderate contractures persisted. At the age of four months the foot was completely corrected clinically, and the radiograph (Figure 1.3) verified the correction obtained. During the first year of life treatment was continued; from the age of six months the treatment was given mainly by the mother after appropriate instructions, and the result was checked at the clinic about every three months.

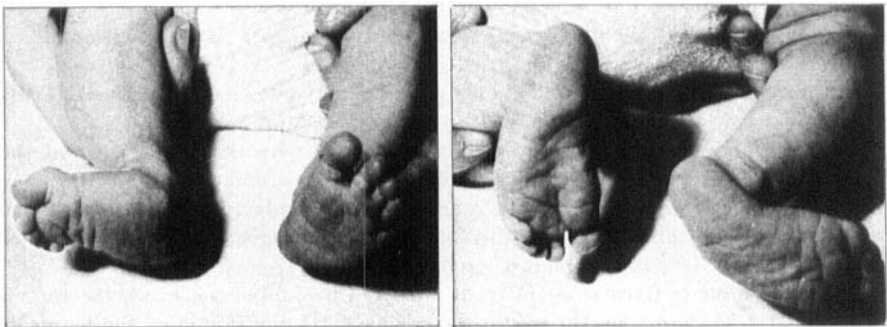


Figure 1.1. Case 1. Girl aged eight days with right-sided vertical talus and normal left foot.

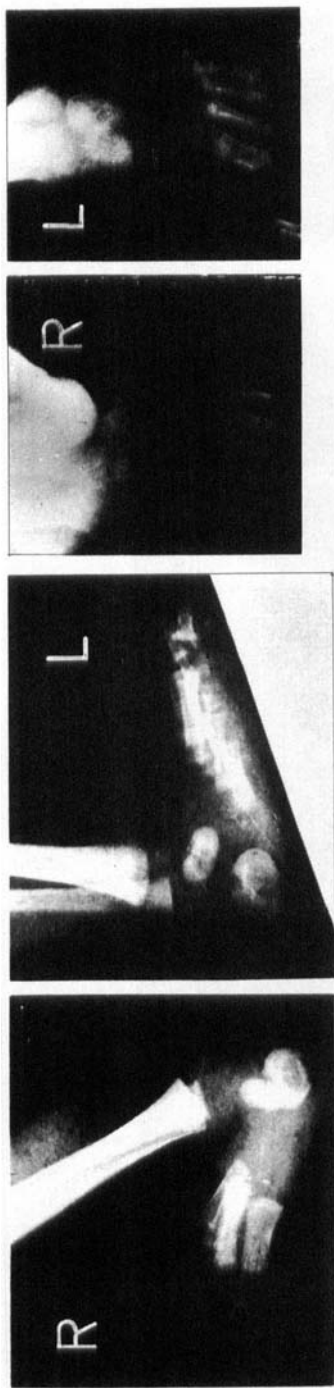


Figure 1.2. Case 1. Radiograph eight days old. The lateral view taken with the feet in non-forced dorsiflexion illustrates the early radiographic findings in vertical talus: the vertical position of talus, the equinus of the calcaneus and the extreme dorsiflexion and pronation of the forefoot. Note the slight hypoplasia of the ossification centres of the tarsal bones in comparison with the normal foot. The dorsoplantar view shows extreme abduction of the forefoot.

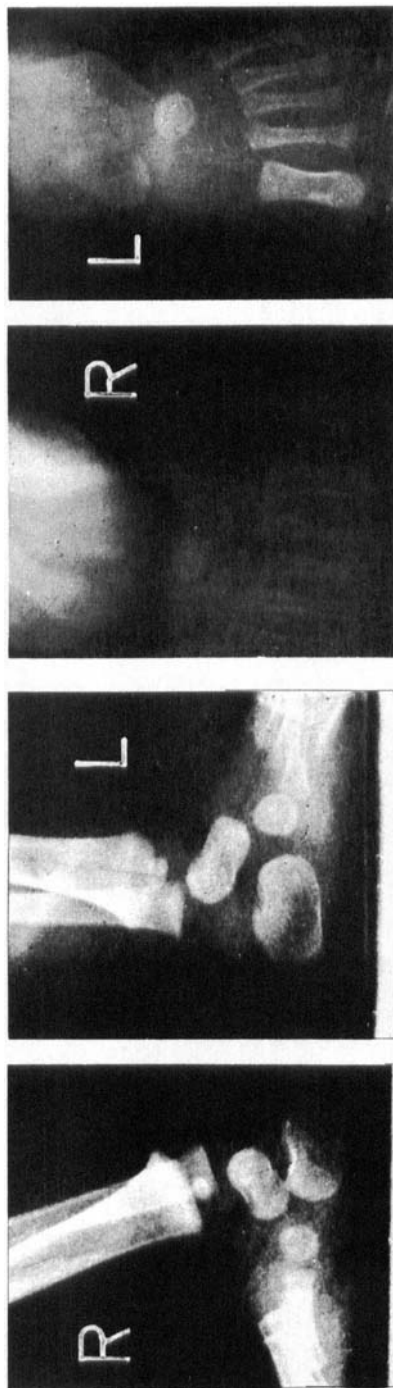


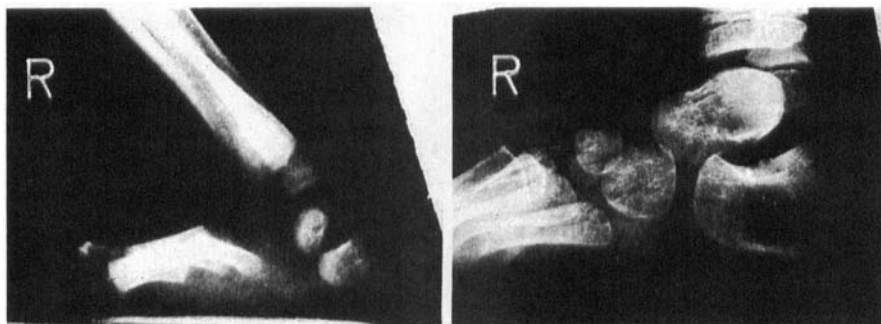
Figure 1.3. Same case at the age of four months. The lateral view shows complete correction: the equinus of talus and calcaneus is corrected and normal relation between the axis of the forefoot and the talar axis is established. The dorsoplantar view shows correction of the forefoot.



Figure 1.4. Same case at the age of 14 months. Lateral view of the right vertical talus. From left to right the foot is seen without, with weightbearing and during weightbearing in boots. A slight equinus of talus is seen during weightbearing, but disappears in boots.



Figure 1.5. Same case. Lateral view of the left normal foot. Notice the same degree of equinus of talus during weightbearing.



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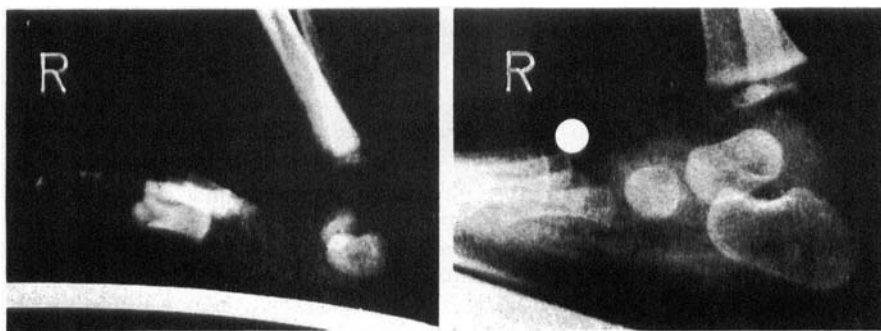
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Figure 2.1. Case 2. Boy at the age of eight days. Radiograph, lateral view of right-sided vertical talus illustrates typical findings with equinus of talus and calcaneus as well as marked dorsiflexion and pronation of the forefoot.

Figure 2.2. Same case at the age of $3^{10}/_{12}$ years shows complete correction.

It has been of special interest to see that the correction was maintained during weightbearing, as seen on radiographs at the age of 14 months (Figures 1.4 and 1.5). The patient was last seen at the age of 15 months and the foot was still found to be completely corrected. There was no restriction of mobility in the ankle joint or the subtalar joint.

Case 2. A boy with right-sided vertical talus; first seen at the age of eight days. The foot had the typical appearance of vertical talus with rocker bottom deformity, pronounced dorsiflexion-pronation of the forefoot and elevation of the heel; the radiograph (Figure 2.1) confirmed the diagnosis. Conservative treatment by manipulations and splinting was started immediately. During the first two weeks of

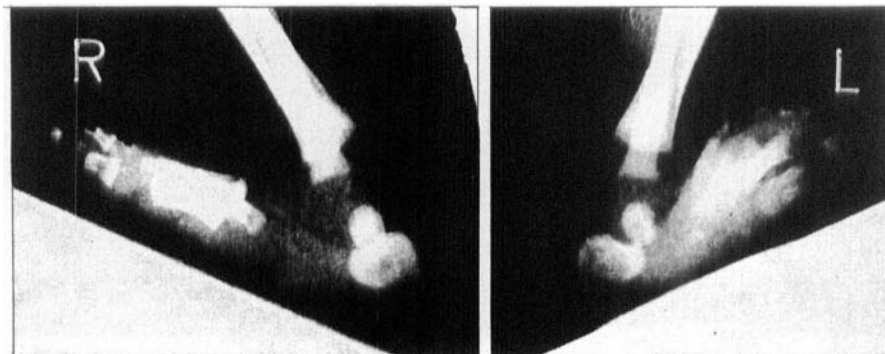


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Figure 3.1. Case 3. Boy at the age of four days. Radiograph lateral view of right-sided vertical talus. There is a marked equinus of the talus, some equinus of the calcaneus and a marked dorsiflexion and pronation of the forefoot.

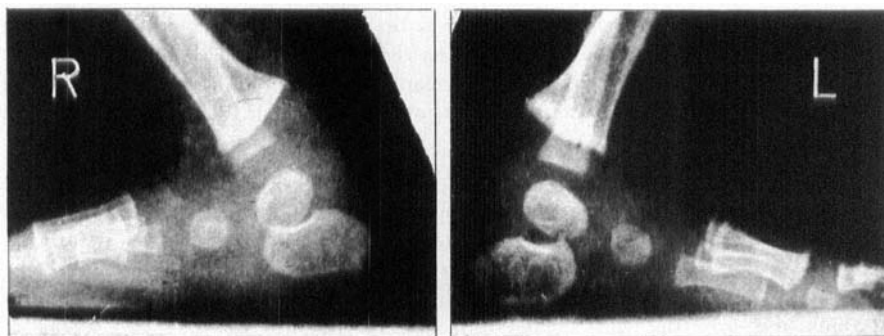
Figure 3.2. Same case. Age nine months, shows complete correction.



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Figures 4.1 & 4.2. Case 4. Boy at the age of three days. Radiograph of bilateral vertical talus in lateral view (4.1 right and 4.2 left). Extreme equinus of talus and calcaneus as well as marked dorsiflexion of the forefoot is seen.



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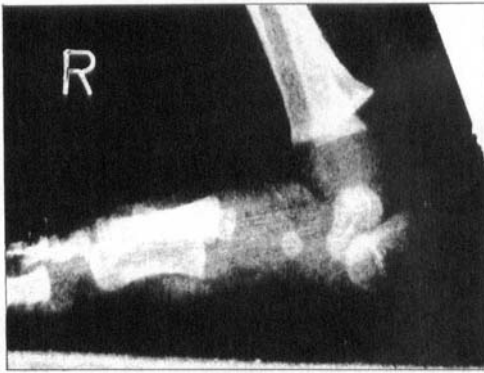
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Figures 4.3 & 4.4. Same case at the age of three months. (4.3 right and 4.4 left). Complete correction is seen on both sides.

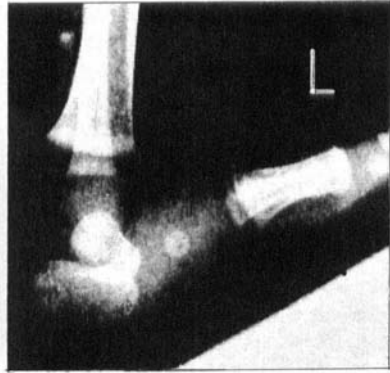
treatment a pronounced improvement of the foot was seen though the correction was still incomplete. At the age of three months the foot was completely corrected clinically as well as radiologically; it was noticed that no tightening of the Achilles tendon persisted. During the first year of life correction was maintained by night splint and occasional manipulations given by the mother. No recurrence was seen during weightbearing and at the age of 16 months the foot was found to be so stable that the night splint was discontinued.

The patient was last seen at the age of 3 years 10 months; the foot was clinically normal, and the radiograph (Figure 2.2) showed complete correction.

Case 3. A boy with right-sided vertical talus; first seen in the age of four days. A typical rocker bottom deformity with a marked plantar prominence of the head of the talus was seen. The dorsiflexed and abducted forefoot was touching the



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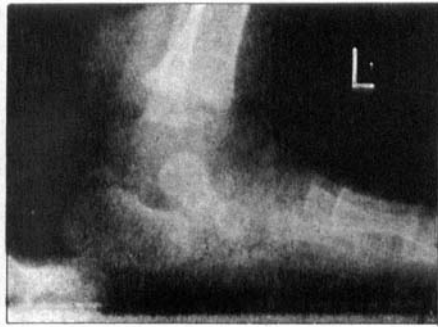


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Figures 5.1 & 5.2. Case 5. Boy at the age of 3½ months. Radiograph of bilateral vertical talus. Lateral view (5.1 right and 5.2 left). On both sides a marked equinus of talus and calcaneus is seen.



3.



4.

Figures 5.3 & 5.4. Same case at the age of seven months. (5.3 right and 5.4 left). Notice the moderate equinus of talus and calcaneus, indicating slight talo-navicular subluxation in spite of normal T-C angles.

anterior tibia. The radiograph (Figure 3.1) confirmed the diagnosis. During the first week of manipulation a marked improvement was obtained, a normal talo-navicular relation was palpated and a distinct medial arcus was seen. At the age of 3 weeks it was observed that the calcaneus was in a normal position without tightening of the Achilles tendon. A radiograph at the age of three months verified the clinical impression of complete correction (Figure 3.2).

On the last examination at the age of nine months no signs of a recurrence were seen.

Case 4. A boy with bilateral vertical talus; first seen at the age of three days. There was a marked bilateral rocker bottom deformity. On both sides the head of the talus was prominent in the sole of the foot, the forefeet were dorsiflexed-pronated and

the heels were elevated. Radiographs (Figures 4.1 and 4.2) confirmed the diagnosis of severe vertical talus. After two weeks both feet could be manipulated into complete correction, though a slight abduction-pronation of the forefoot persisted.

The patient was last seen at the age of three months; both feet were completely corrected without elevation of the heels, with a distinct medial arch and normal joint mobility. Radiographs (Figures 4.3 and 4.4) verified the correction.

Case 5. A boy with bilateral vertical talus; first seen at the age of 3½ months. On physical examination the elevation of the heels was the most obvious finding whereas the talar prominence in planta was less pronounced. The forefeet were seen to be in dorsiflexion with a corresponding tightening of the dorsiflexors. Radiographs (Figures 5.1 and 5.2) showed the typical findings of vertical talus. After five weeks of treatment some elevation of the heels persisted due to tightening of the Achilles tendon.

The patient was last seen at the age of seven months. A distinct medial arch was seen to be in dorsiflexion with a corresponding tightening of the dorsiflexors. There was also a slight talo-navicular subluxation. In accordance with this the supination was restricted. Radiographs (Figures 5.3 and 5.4) confirmed the clinical findings.

DISCUSSION AND CONCLUSION

The treatment of vertical talus is difficult and open reduction is considered necessary in most cases to obtain satisfactory and stable correction (Osmond-Clarke 1956, Lloyd-Roberts & Spence 1958, Herndon & Heymann 1963).

If, however, the condition is diagnosed in the first weeks of life, correction can be obtained by conservative methods. A few cases of successful correction by reduction and treatment with plaster of Paris have been reported (Stören 1967, Harrold 1967, Silk & Wainwright 1967).

The early clinical diagnosis seems to be difficult and especially the differential diagnosis between this condition and congenital calcaneo-valgus. In both conditions the forefoot is found in dorsiflexion. The medial arch is not very well defined in infants, and only in more pronounced cases of vertical talus an obvious prominence of the talus is seen in the planta. In our experience the elevated calcaneus is the most prominent finding, as this is not seen in any of the foot deformities with which vertical talus is likely to be confused.

We disagree at this point with Rigault & Pouliquen (1970), who considered the equinus position of the calcaneus an inconstant finding in vertical talus.

Table 1. Radiographic angles of the whole series.

Case no.	Age	T-C	angle	Ti-T	angle	Ti-C	angle	M-T	angle
		R	L	R	L	R	L	R	L
Case 1.									
Lateral view	8 days	70	35	140	110	110	110	90	150
	4 mths	35	30	100	110	120	100	160	175
	12 -	25	40	95	95	110	130	175	160
	14 -	30	40	110	95	100	125	170	165
	14 -	35	35	115	115	100	105	155	160
	14 -	20	20	110	110	90	90	185	195
Dorso-plantar view	8 days	25	25					100	175
	4 mths	25	30					145	160
	12 -	35	30					160	170
Case 2.									
Lateral view	8 days	50	40	130	95	105	130	110	150
	1½ mths	45		135		100		180	
	3¾ -	30	30	120	95	95	110	180	185
	12 -	40	35	135	120	85	95	170	180
	3¾ years	30	30	110	100	105	115	185	190
Dorso-plantar view	8 days	50	60					120	115
	3¾ mths	35	60					160	150
	12 -	35	35					155	160
	3¾ years	30	30					175	180
Case 3.									
Lateral view	4 days	60	45	130	100	115	130	105	150
	3 mths	40	40	90	90	130	130	170	150
	9 -	40	45	90	105	125	120	165	165
Dorso-plantar view	4 days	25	20					120	150
	3 mths	30	35					140	140
	9 -	35	20					140	160
Case 4.									
Lateral view	3 days	80	60	160	145	105	95	60	70
	3 mths	45	35	110	115	115	110	140	160
Dorso-plantar view	3 days	60	55					100	120
	3 mths	40	40					150	180

Table 1 (cont.)

Case no.	Age	T-C R	angle L	Ti-T R	angle L	Ti-C R	angle L	M-T R	angle L
Case 5.									
Lateral view	3½ mths	35	45	130	140	90	95	125	110
	6 —	40	35	120	120	100	90	140	140
	7 —	45	45	135	135	90	95	180	180
Dorso-plantar view	3½ mths	30	30					150	150
	6 —	25	35					150	140
	7 —	45	35					150	140

Vertical talus values indicated by italics

T-C angle: talo-calcaneal angle

Ti-T angle: tibio-talar angle

Ti-C angle: tibio-calcaneal angle

M-T angle: metatarso-talar angle

R: right side

L: left side

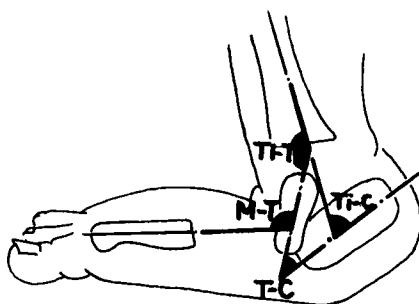


Figure 6. Diagram showing the different angles listed in Table 1.

Contrary to Osmond-Clarke (1966) we find the radiographic examination of paramount importance for the early diagnosis of this condition. In the early radiograph the vertical position of the talus, the equinus position of the calcaneus and the marked dorsiflexion of the first metatarsal bone is obvious. Some hypoplasia of the ossification centres of the tarsal bones may occur.

The present report concerns a small series of vertical talus treated by manipulations in the first weeks of life. Until 1968 we found open reduction necessary in all cases, usually performed at the age of 6 months. On the basis of our experience with early manipulative correction of club feet we have found it natural to try the possibility of this treatment also in vertical talus.

Our initial experience with case no. 2 was surprising, as the deformity was corrected during the first 2 to 3 weeks of treatment and has shown no signs of recurrence during weightbearing. At the age of 4 years we still find the foot clinically as well as radiographically normal.

During the treatment of subsequent cases we have made the following clinical observations.

All cases treated during the first week of life have been equally as easy to correct as our first case. Case no. 5, in which treatment was started at the age of 4 months, required a more intensive and longer lasting manipulation and the correction is not yet quite complete. This course emphasizes the importance of early diagnosis and treatment. Once correction has been obtained, none of our cases have shown any signs of recurrence during weightbearing.

Patterson et al. (1968) have demonstrated the secondary adaptive changes in the tarsal bones in a post mortem study of a 6 weeks old infant. The difficulty in obtaining stability of correction which is so often reported (Eyre-Brock 1967, Mead & Anast 1961, Outland & Sherk 1960) may be explained by the more pronounced adaptive bone changes after a few months. The experimental work of Ritsilä (1969) also indicates that the bone changes are adaptive.

The contractures of muscles and tendons were easy to correct compared to the contractures in club foot. This also applies to the tendo calcanei. The elongation of this tendon which has been mentioned in connection with open reduction after the age of 3 months (Silk & Wainwright 1967) has not been necessary.

These findings together with our observations of the rather moderate hypoplasia of the ossification centres of the tarsal bones seems to indicate that the dislocation seen at birth has occurred rather late in pregnancy and probably later than the changes in congenital club foot (Reimann 1967).

The radiographic examination has been valuable not only in the early diagnosis but also in the evaluation of treatment during which we have made the following observations.

Though the term vertical talus could give the impression of an increased T-C angle in lateral view, it is seen from Table 1 that the values of T-C angles are within normal and stay within this range during correction. This indicates that the relation between the talus and calcaneus is unchanged during correction. Also in dorso-plantar view the T-C angles are found to be within normal range.

During treatment a decrease of the tibio-talar (Ti-T) angle and an

increase of the tibio-calcaneal (Ti-C) angle would be expected. The values of these angles are influenced by the degree of dorsiflexion in the ankle joint. This probably explains the variation seen in these values in Table 1.

The vertical position of the talus for this reason should be evaluated in relation to the bones distal to the midtarsal joint. As seen in the table the metatarso-talar (M-T) angle gives a clear expression of the marked changes during the reduction of the talonavicular dislocation. The M-T angles increase from values of about 90 degrees before to about 180 degrees after correction.

As the ossification centre of the cuboid bone is not seen in radiographs in very early cases the relation of the talar axis to this centre is not recorded in the table.

Radiographs during weightbearing have verified the clinical impression of stable correction. As seen in Figure 1.4 there is a slight equinus of the talus during weightbearing, but comparison with Figure 1.5 shows the same findings in the unaffected foot. It should be emphasized that no equinus of the calcaneus is seen during weightbearing. The talus equinus during weightbearing will be seen to be even more marked in the hypermobile valgus foot (Templeton et al. 1965).

As seen in Figures 1.4 and 1.5 the equinus tendency of the talus disappears during weightbearing in boots.

No radiographic evidence of bone damage caused by the manipulative treatment was observed in this small series. We agree with Fjeldborg (1971) that it is essential that manipulation is performed without violence.

It is concluded that it has been possible to obtain stable correction of the idiopathic congenital vertical talus by manipulative treatment without anaesthesia if treatment is started during the first weeks of life. The protracted course of one case in which treatment was started at the age of 4 months clearly indicates that reduction and stability is more easily obtained when treatment is started as early as possible.

SUMMARY

Early diagnosis and early institution of treatment allow the possibility of correction of the congenital vertical talus by non-operative methods.

The early clinical diagnosis may be difficult. The main differential

diagnosis is the congenital calcaneo-valgus. It is emphasized that elevation of the heel is an important physical finding, but radiographic examination is considered necessary to verify the diagnosis.

Based on experience from manipulative treatment of the congenital club foot, a manipulative technique for the correction of the vertical talus has been developed. Details of the technique are described.

Since 1968 this technique has been applied to all cases with an ensuing reduction. There has been no sign of recurrence during weight-bearing; five cases (7 vertical talus feet) are reported.

Radiographic evaluation of the changes during correction shows that the angle between the longitudinal axis of talus and calcaneus is of no value in early diagnosis and in evaluation of correction. The equinus of the talus is best seen in relation to the bones distal to the midtarsal joint, and in early cases it is best expressed by the angles between the longitudinal axis of the first metatarsal bone and the talar axis (M-T angle).

The nature of the contracture seen at birth and the rather moderate hypoplasia of the ossific nuclei indicates that the talonavicular dislocation has occurred rather late in pregnancy.

The difficulty in obtaining stable correction must be seen in relation to the amount of adaptive secondary bone changes developed between the time of the intrauterine dislocation and the commencement of treatment.

It is concluded that it is possible by early institution of manipulative treatment to obtain complete and stable correction of congenital vertical talus.

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