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SUBASTRAGALAR TRIARTICULAR ARTHRODESIS FOR CONGENITAL CLUB FOOT IN CHILDREN AGED 2½-15 YEARS

By

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Intractable club foot in older children, which seems uncorrectable by conservative treatment and operations to the soft tissues is a troublesome problem. Whether early operation by triarticular arthrodesis in these patients can achieve a lasting functional and trouble-free foot is a matter for discussion.

COMPOSITION OF MATERIAL

From 1948 to 1960 863 cases of congenital club foot were treated at the Karolinska Institute's orthopaedic clinic. About half were primary, untreated, newborn cases, and the rest were previously treated elsewhere, and had received quite inadequate treatment. The material is thus loaded with an unfavourable selection.

Of these 863 patients, 44 patients with 55 club feet were treated by triarticular subtalar arthrodesis from the ages of 2½ to 15 years because a satisfactory position of the feet could not be obtained by conservative treatment (manipulation, plaster, night splints and braces) together with other different operations. Of the feet treated by subtalar arthrodesis, 34 had never been fully corrected, and 21 had had recurrences. All had a cavus-adductus-equinovarus deformity except one, who had an over-corrected plano-valgus foot. 14 patients had also other congenital deformities, among them four congenital dislocations of the hip, five congenital hand contractions and deformities, two meningoceles with hydrocephaly, one cleft palate, and two others with multiple deformities. Moreover, apart from club foot and these abnormalities, a number also suffered from mental retardation. Hereditarily afflicted cases are strongly under-represented in the operated material. Only five patients showed any heredity, and only in one case could more cases of club foot be found among relatives. Classification by sex reveals 24 boys and 20 girls. Before the arthrodesis 34 (77 per cent) were obliged to use orthopaedic shoes or braces. For distribution with regard to age, see Table 1. In the absence of a careful preoperative classification of the feet, the operated patients may be reckoned to be among the so-called severe club feet.

TABLE 1
Primary Results at the End of the Postoperative Immobilization Period.

Age at operation	Number of patients	Number of feet	Appearance of the foot (clinical examination)		Healing of the arthrodesis (X-ray examination)		
			Good + fair	Poor	Union	Partial union	Non union
2- 7 years	12	16	75%	25%	6%	63%	31%
			12	4	1	10	5
			100%	—	48%	43%	9%
7-12 years	19	23	23	0	11	10	2
			88%	12%	63%	31%	16%
12-15 years	13	16	14	2	10	5	
No X-ray examination							
			89%	11%	40%	45%	15%
Total	44	55	49	6	22	25	7

METHOD OF OPERATION AND AFTER-CARE

All the patients reported here were operated upon by a triarticular subastragalar arthrodesis (T-arthrodesis) with wedge resection of the joint surface between the calcaneum and talus, the talus-navicular, and calcaneo-cuboid. Six achilles and three posterior tibialis tendon lengthenings were performed together with the bone operation. Post-operatively, twelve cases of minor skin necrosis occurred in and one case, a major skin necrosis combined with a moderate wound infection, which, however, did not delay recovery. Time of immobilization in plaster varied from 6 to 24 weeks, and was in the main 12 to 14 weeks.

PRIMARY RESULTS

In Table 1 is shown the primary result at the end of the period in plaster. By good and fair result is meant that the foot was straight and had a satisfactory appearance. Good and fair are taken together, as a more careful discrimination is not possible from the information provided by the case notes. By poor result is meant that the foot still showed a significant deviation from the normal position.

On X-ray, bony bridging of the arthrodesis was seen as early as 6 weeks in one 12 year-old patient, but usually after 12 to 16 weeks. The incidence of radiological healing by the end of the period in plaster is shown in Table 1 for the different age groups. By partial union is meant here that only a part of the whole arthrodesis showed radiographic evidence of bony bridging.

TABLE 2
Follow-Up of Operated Patients.

Age at operation	Number of patients	Number of feet	Average period of follow up	Average age at follow up	Use of orthopaedic shoes or appliances	Subjective results			Objective results			Remarks
						Good	Fair	Poor	Good	Fair	Poor	
2-7 years	10	14	7.1 years	12.6 years	14%	36%	64%		21%	50%	29%	(3 recurrences)
					2	5	9		3	7	4	
7-12 years	13	16	9.4 years	19.2 years	31%	56%	19%	25%	25%	50%	25%	(4 recurrences)
					5	9	3	4	4	8	4	
12-15 years	10	12	11.3 years	25.4 years	-	25%	58%	17%	25%	53½%	17%	
					0	3	7	2	3	7	2	
Total	33	42	9.2 years	19 years	21%	41%	45%	14%	24%	52%	24%	
					7	17	19	6	10	22	10	

Percentages are related to the number of feet.

In patients using orthopaedic shoes and appliances they are related to the number of patients.

FOLLOW-UP EXAMINATION

Of the 44 patients in the series, 33 patients (42 feet) were followed up after 2 to 14 years, on average 9.3 years. Two patients had died, two had emigrated, and the rest could not be followed up for one reason or another. Nine patients had bilateral club feet, both of which had undergone triple arthrodesis, seven patients had bilateral club feet only one side undergoing operation, and seventeen patients had unilateral club foot (see Tables 2 and 3).

TABLE 3

	Number of feet	Average motion range in ankle joint	Equinus	Average foot size	Average length of lower extremity	Rigidity of 1st metatarsophalangeal joint
Bilateral club foot bilaterally operated	18	16°	77% 14	--	--	50%
Bilateral club foot unilaterally operated*	7	28°	71% 5	--1.2 cm	--1.5 cm	30%
Unilateral club feet unilaterally operated	17	21°	64.5% 11	--2.5 cm	--1.7 cm	40%
Unilateral club foot not operated	20	48°	35% 7	--1.9 cm	--1 cm	0%

* The numbers are related to the operated foot.

A comparison series of 20 patients with unilateral club foot selected at random, who had undergone conservative treatment was also followed up. The average age of this group at follow-up was 20.4 years (range 10 to 29 years).

To assess *the subjective result* as good, the foot had to be painfree in normal use, but also on moderate stress. The patient had to be able to walk on uneven ground, and to wear ordinary shoes, possible with insoles. The cosmetic result had to be acceptable to both patient and parents.

Satisfactory result was adjudged to have been attained when the patient had only mild trouble with his foot in the form of tiredness, difficulty in buying shoes, inability to walk trouble-free over uneven ground, and a certain stiffness in the ankle joint, together with a less readily acceptable cosmetic result.

By poor result was meant pain in the foot on ordinary use, inability to wear conventional shoes due to foot deformities thus necessitating orthopaedic boots, and an unacceptable cosmetic result.

In the *objective assessment* of the final result, consideration was taken first of the foot's function in walking, then the anatomical result and the foot's appearance. By good result was meant plantigrade position of the foot, with good plantar thrust. A slight varus position was accepted, however, if this was the only fault, or a normal position of the foot on weight-bearing with a slight adduction of the forefoot, together with a satisfactory appearance.

By satisfactory result was meant slight and moderate valgus or varus position of the foot on walking, with poor plantar thrust of the foot, slight varus position of the heel, slight supination of the forefoot on weight-bearing, hallux rigidus, diminished function of the toe-extensors, or moderate adduction in the forefoot, and a less pleasing appearance.

A poor result consisted of marked varus of the foot with a stiff gait, varus position of the heel and marked supination of the forefoot, painful hallux rigidus, parietic toes, marked adduction of the forefoot, and pes plano-valgus. The appearance corresponded in general to the anatomical findings.

On analysis of the *subjective* troubles in the operated patients, certain typical complaints arose, which were different for the different age groups, and which did not always correspond to the objective findings. First in the older patients was a feeling of stiffness in the ankle joint, and trouble from the first metatarsophalangeal joint. On the other hand, the patients did not seem troubled by stiffness in the subtalar joints. None had pain in the foot on everyday use, but some had trouble with skin callouses. Diminished movement of the ankle joint was a considerable complaint among the female patients in the older age group, due to their subsequent inability to wear high-heeled shoes. In general, the buying of shoes was made difficult by the fact of unequal sizes of feet, and wear on shoes was very heavy. The cosmetic result was more often a source of worry, and even of inferiority complex, in the female patients than in the males, most of whom accepted it. The patients' parents were usually more pleased than the patients themselves. In selecting jobs, most chose some kind of work where they would not be impeded by their foot deformity. Many took part in sports, and one was able to clear 1.90 meters in the high jump (he had barely acceptable foot form). Skating and skiing were, for the majority, impossible, but on the other hand, many could dance freely. For the most part, the subjective results were better than the objective, except for one case of bilateral club foot in the 12-15 age group, in whom the subjective result was classified as poor, for cosmetic reasons, while

objectively is was classified as satisfactory. The patients in the younger age groups were not so troubled by the diminished movement in the ankle and first metatarso-phalangeal joint, and cosmetic considerations were of little importance in the subjective assessment. Seven out of the 33 patients (21 per cent) were still wearing orthopaedic shoes or braces, as against 77 per cent before operation (see Table 2).

The *objective* results are summarized in Table 3. It can be seen that the foot and leg on the operated side are shorter than the other. The range of movement at the ankle and the incidence of equinus are also shown. In 15 feet (35 per cent) extensor function in the big toe was absent or weakened, and in 24 feet (60 per cent) the same was found for the small toe extensors. All the operated cases had a more or less pronounced atrophy of the calf muscles.

TABLE 4
Comparison of the Muscelfunction and Malposition in 10 Best and 10 Worst Feet Following Subtalus Arthrodsis.

	Function of tibialis anterior		Function of the toe extensors		Equinus	Fore- foot adduc- tion	Fore- foot supina- tion	Varus of calca- neus
	Strong	Normal	Normal	Absent				
The worst feet (7 recurrences)	7	3	1	9	7	8	9	5
The best feet	4	6	7	3	7	3	0	3

To get an idea of the factors which affect the result, 10 feet assessed as the worst have been compared with the 10 best (Table 4). Muscle function and deformities are compared. A powerful tibialis anterior function together with absence of toe extensor function are strongly represented among the 10 worst feet. Peroneus function was not assessed. The malposition most important in unfavourable results is supination of the forefoot, and thereafter, varus position of the heel. That equinus deformity does not affect the results more unfavourably can be explained partly by the shortening of the leg present in most cases, and partly by hypermobility of the forefoot. Supination of the forefoot developed over the years after the operation in certain cases, according to the patients themselves. Approximately 50 per cent had a more or less pronounced supination. 33 per cent of patients who were operated upon between 12 and 15 years of age, had trouble with the first metatarso-phalangeal joint together with a flexion position of the big toe.

TABLE 5
Consolidation of the Arthrodesis at the Follow-Up. X-Ray Study.

Age at operation	Number of patients	Number of feet	Consolidation in the talocalcaneal joint			Talonavicular consolidation			Calcaneocuboid consolidation			Consolidation in all three joints
			Total	Partial	Not at all	Total	Partial	Not at all	Total	Partial	Not at all	
2-7 years	10	14	86%	14%	—	50%	7%	43%	100%	—	—	50%
			12	2	0	7	1	6	14	0	0	7
7-12 years	13	16	94%	6%	—	56%	25%	19%	94%	—	—	56%
			15	1	0	9	4	3	15	0	1	9
12-15 years	10	12	83%	17%	—	58%	17%	25%	92%	—	—	58%
			10	2	0	7	2	3	11	0	1	7
Total	33	42	88%	12%	—	55%	15%	30%	95%	—	—	55%
			37	5	0	23	7	12	40	0	2	23

60 per cent of the feet showed a residual varus position of the calcaneus, though in nearly all cases of a mild degree, even in patients with a recurrence.

Radiographic results concerning the incidence of ankylosis of the arthrodesis are seen in Table 5. Calcaneotalar, and calcaneo-cuboid arthrodeses ankylosed to the same extent in all age groups. Talonavicular arthrodesis shows a somewhat lower incidence of ankylosis in the lowest age group. By partial union is meant that there were signs of bony bridging but that a fissure was still visible in part of the joint. From the available radiographs, no certain signs of great alteration in skeletal growth could be seen which might be attributed to the subtalar arthrodeses. Only the os naviculare seemed in several cases to be rather small, and also deformed. In a number of cases subluxation of the naviculare in relation to the talus was found.

It would be of value to compare the clinical with the radiological results, and in particular, patients with recurrences and poor results have been analysed, but the numbers are too small to be able to draw certain conclusions as to the connection between radiographical union and clinical result. It should, however, be pointed out that in all cases classified as a poor result, among them seven recurrences, the calcaneotalar arthrodesis was united, at least over the greater part of the area of contact, in all cases, the calcaneo-cuboid arthrodesis in 70 per cent, but the talonavicular in only 50 per cent. There was no certain difference between age groups. On comparing the poor with the good results, one finds among the latter a higher incidence of ankylosis of the arthrodesis. Probably the absence of ankylosis in the talonavicular arthrodesis constitutes a *contributory* reason for a poor result, but not the only one, however. 40 per cent of the totally ankylosed arthrodeses showed a supination deformity of the forefoot, but one cannot exclude the possibility that some of these were not fully corrected in the first place. A strong tibialis anterior and posterior together with absence of ankylosis in the talonavicular joint can be a cause of supination deformity of the forefoot. Not unexpectedly, the two youngest patients were among the recurrences, but were subjectively troublefree, one operated upon bilaterally at $2\frac{1}{2}$ years of age, the other unilaterally at 3. Of these three feet one of the bilateral arthrodeses was completely united, the other two partly so. The other patients in the $2\frac{1}{2}$ –7 age group were operated upon from 5 years of age upwards, and the results in these do not differ markedly from those in the older age groups.

One group of patients is particularly to be noted, i.e. those with other

TABLE 6
Follow-Up Examination of Operated Patients with other Congenital Anomalies and Debilities.

Age at operation	Number of patients	Number of feet	Subjective results			Objective results		
			Good	Fair	Poor	Good	Fair	Poor
2½-7 years	4	7	14%	86%	-	14%	57%	29%
			1	6	0	1	4	2
7-12 years	4	6	17%	17%	66%	-	34%	66%
			1	1	4	0	2	4
12-15 years	1	2	-	-	100%	-	100%	-
			0	0	2	0	2	0
Total	9	15	13%	47%	40%	7%	53%	40%
			2	7	6	1	8	6

congenital deformities, and some mentally retarded patients. Nine such patients with 15 club feet were followed up as described earlier. The results in this group are outstandingly bad. Only one out of 15 feet could be classified as a good result. All four recurrences in the 7-12 age group, two recurrences in the 2½-7 age group, and one other poor result in the same age group are to be found among these patients. The two recurrences in the youngest age group were both in the 2½ year-old child. Five of the seven still using orthopaedic shoes or braces belong also to this group, though in some cases these are necessitated by the other congenital deformities.

On comparing the primary result with the final result, the following observations are prominent. The primarily good results, best in the 7-12 age group, deteriorated clearly later on. The incidence of radiological union rose, however, most strikingly in the youngest age group (cf. Tables 1, 2 and 5). On the other hand, the four primarily unsatisfactory cases in the youngest age group are found unaltered in the final results.

THE CONTROL GROUP

These were uncomplicated cases of unilateral club foot, the original degree of severity of which cannot be classified in retrospect. The 20 feet were treated conservatively by manipulation and plaster, and six underwent subcutaneous achilles tenotomy. No other operative measures were taken. Assessment of the final result was on the same principles as for the operated feet.

On assessment of the *subjective* result, 17 of the 20 had a good result, and the other three a satisfactory result. Three patients had a feeling of restricted movement in the ankle joint, which was not, however, disturbing. Eight had certain difficulties in buying shoes on account of different-sized feet. None had trouble from the first metatarso-phalangeal joint.

On *objective* assessment, eight patients had a good, and twelve a satisfactory result. Deterioration of the result was due in seven cases to adduction of the forefoot, in three to moderate valgus position of the heel, and in two cases, to moderate varus deformity. As is seen from Table 3 the affected feet and the leg on the affected side were shorter than their fellows. Range of movement in the ankle joint was on average 48°, and seven patients had equinus. None had weakness of the toe extensors, and all had normal movement in the first metatarso-phalangeal joint. None had any supination deformity of the forefoot. Peroneus

function was normal in 18 patients and weakened in two, powerful tibialis anterior function was found in two cases, and atrophy of the calf muscles in varying degree in all cases.

DISCUSSION

In evaluating the therapeutic effect of subtalar arthrodesis in the correction and stabilization of the equinovarus deformity in congenital club foot in children, the discussion proceeds from the premise that ankylosis of the subtalar joints is a prerequisite in preventing recurrence. Several questions which are of interest in this connection are dealt with here.

1) Can a subastragalar arthrodesis ankylosed in a primary good position always prevent recurrence and poor result?

Of the completely ankylosed arthrodesis, approximately 40 per cent showed a supination deformity of the forefoot. Among the cases with complete radiological union on taking off the plaster post-operatively, and therewith good clinical result, are found two recurrences. Deterioration of primarily good operation results has been reported by several authors, and in arthrodeses in paralytic equinovarus feet among others (3, 7). Information concerning the incidence of ankylosis in recurrences is, however, scarce.

The question may therefore be answered thus: An apparently ankylosed arthrodesis of the subtalar joints cannot prevent the occurrence of a malposition affecting the forepart of the foot. The risk of recurrence may be judged to be greater in primarily unsatisfactory corrections of the foot.

2) What factors may cause recurrence and poor results in united arthrodeses?

Here we must differentiate between primarily unsatisfactory position of the foot due to insufficient correction at operation, and changes occurring secondarily. The great value of primary full correction, in particular of the calcaneus' position, has been mentioned by several authors. Weak and contracted toes significantly worsen the functional result, and seem, moreover, to contribute to the appearance of secondary deformities. The most common cause of recurrence probably consists of muscle imbalance which finds expression also in this series (Table 4). Patients with powerful tibialis anterior function and absent or weak toe extensor function are obviously liable to recurrence, and deformity of the forefoot. Furthermore, uncorrected adductus deformity of the

forefoot is a factor in impairing the result. In patients with multiple congenital abnormalities, and mental retardation, where these prevent the foot from bearing weight in the normal way, contractures can further contribute to the occurrence of deformities.

The answer to the question is thus:

Residual muscle imbalance, decreased toe extensor function hallux flexus and hallux rigidus, insufficient primary correction with continued varus affliction of the foot, uncorrected adduction of the forefoot, and also alterations in bone growth can be reasons for a deterioration in a primarily good operation result.

3) From what age can one count on ankylosis of the arthrodesis, and a good clinical result?

This question has been the object of great differences of opinion. *Michel* (1930) (19) reported 12 good results in 14 children operated from 3½–6 years of age, and 11 of these with total ankylosis; the observation time was 4 months to 3½ years, average 1½ years. *Hopf* (1954) (12) reported five poor results in 43 feet, and was of the opinion that the earliest age was between 8 and 12 years. *Morris* (1933) (20) set 7 years, and *McAusland* (1929) (18) and *Jones* (1908) (14) 10 years as the lowest age limit. *Roetzer* (1948) (24) reported 35 feet operated upon between 3 and 15 years of age, of which 62.7 per cent had poor, 31.5 per cent satisfactory, and 5.8 per cent good results.

On comparison of the age groups in this series, no certain difference is found between ages. If one removes the two youngest patients, 2½ and 3 years old, from the youngest age group, the incidence of ankylosis of the whole arthrodesis is about the same for the remainder as for the two older age groups, i.e. 55–60 per cent. The clinical results in the 3 age groups are likewise alike, approximately 25 per cent good, 50 per cent satisfactory, and 25 per cent poor results. Comparing the results of subtalar arthrodeses performed over the age of 15, one finds here also 25 per cent unsatisfactory cases. It is, however, difficult to compare the different series, due to often insufficiently specific information.

In any case, it can be said that 75 per cent of the operated patients have attained a material subjective and objective improvement compared with their condition before operation. The patients forced to wear orthopaedic boots decreased from 77 per cent before, to 22 per cent after operation.

The question may therefore be answered thus:

If there is no therapy other than arthrodesis which can correct and

stabilise an intractable club foot, then the operation may be performed from 5-6 years of age, except in the cases of patients with multiple congenital deformities and/or mental retardation, in whom the age limit should be set higher, preferably nearer puberty.

4) Is correction and stabilisation of the hindfoot of use to the patient even if only part of the arthrodesis unites?

As can be seen from Table 5, the arthrodesis between calcaneum and talus united in all cases. Stabilising of the hindfoot is considered to be of decisive importance in the treatment of club foot, provided that full correction of the deformity can be achieved at operation.

The question can thus be answered in the affirmative.

5) Does the arthrodesis operation give rise to secondary deformities in the tarsus as a cosequence of alterations in bone growth?

Radiological examination has given grounds for believing that certain secondary changes in the pedal skeleton may be due, in some few cases, to changes in growth. These are principally localised to the navicular, which also shows subluxation in some cases. In most cases, however, no material changes could be observed. Evaluation of these changes could not be made from the information available from this series.

A notable point is that none of the patients had pain in the foot on weight-bearing, attributable to the absence of ankylosis in the subtalar joints. The subjective troubles could be attributed to diminished movement and/or pain in the first metatarso-phalangeal joint, hallux flexus, skin callouses, and feelings of diminished mobility in the ankle joint. The average range of movement in the tibio-talar compartment of the ankle for the operated patients was, for the different age groups, 25° for 2-7 years, 24° for 7-12 and 27° for 12-15 years. In the unoperated feet, the range of movement was 48° on average. The range of movement in the ankle is thus not influenced by the time of operation, but probably depends, among other things, upon deformation of the talus (9). Subtalar arthrodesis has no great effect upon the length of leg or size of foot. Rigidity of the first metatarso-phalangeal joint and hallux flexus occurred in 40 per cent of operated cases, but not at all in the conservatively treated feet. Nor did weakness or absence of extensor function in the big toe or the small toes occur in these latter, although found in 35 per cent and 60 per cent respectively of operated feet. The operated material cannot be fully compared with that treated conservatively, as the degree of severity of club foot is different. Hallux flexus probably depends on a contracture of the long flexor tendon to the big toe, and an operative lengthening of the tendon at an early stage

would seem to be desirable. The diminished extensor function of the toes could depend in some cases upon damage to the tendons inflicted at operation, which it should be possible to avoid by more careful operative technique. Subastragalar arthrodesis is a technically difficult operation which requires great care and practice. The foregoing series is a collection of cases operated upon by many different surgeons, so that a poor result from any one operation cannot always be blamed on the method, but may depend, in certain cases, upon defective execution.

In summary, it may be said that triple arthrodesis as a treatment for resistant club foot in childhood appears to be a method which, with adequate technique, is not as bad as has been asserted in so many quarters. One should be reluctant to use it in patients with multiple skeletal deformities, and mentally retarded patients, in whom the prognosis is significantly poorer than for others. Before deciding on triple arthrodesis, however, one should try all forms of conservative treatment, together with lengthening of the achilles tendon. Transposition of the tibialis anterior and possibly posterior tendon is reasonable, possibly together with the arthrodesis. As regards a Dwyer calcaneus osteotomy, this can be performed at even earlier ages than the subtalar arthrodesis. By performing subtalar arthrodesis relatively early, one can give the patient a chance to wear ordinary shoes. Function is usually such that the patient can play freely and take part in sports much earlier than if one waits till the age of puberty before performing definitive surgery. An early subtalar arthrodesis also spares the parents worry.

SUMMARY

From a series of 863 cases of congenital club foot, 55 feet were operated upon between the ages of $2\frac{1}{2}$ and 15 years by triarticular subastragalar arthrodesis. Of these, 33 patients with 42 club feet were followed up after 2 to 14 years, average 9 years. The subjective and anatomical results were good or satisfactory in approximately 75 per cent of cases. The youngest age at which subtalar arthrodesis can be performed with a prospect of lastingly good results is claimed to be 5-6 years.

RESUME

D'une série de 863 cas de pied bot congénital, 55 pieds ont été opérés entre l'âge de $2\frac{1}{2}$ ans et 15 ans par arthrodèse tri-articulaire sous-astragalienne. Sur ceux-ci 33 malades avec 42 pieds bots on été réexami-

nés au bout d'une période variant entre 2 et 14 ans et qui a été en moyenne de 9 ans. Les résultats subjectifs et anatomiques ont été bons ou satisfaisants dans environ 75 pour cent des cas. Le plus jeune âge auquel l'arthrodèse sous astragalienne peut être pratiquée avec la perspective de bons résultats est estimé être 5-6 ans.

ZUSAMMENFASSUNG

Aus einer Reihe von 863 Fällen von angeborenem Klumpfuß, wurden 55 Füße im Alter von 2½ bis 15 Jahren mittels einer triartikulären subtalaren Arthrodese operiert. Von diesen wurden 33 Patienten mit 42 Klumpfüßen nach 2 bis 14 Jahren, Durchschnitt 9 Jahren, nachuntersucht. Die subjektiven und anatomischen Ergebnisse waren gut oder zufriedenstellend in ungefähr 75 Prozent der Fälle. Das früheste Alter in dem die subtalare Arthrodese mit Aussicht auf ein dauernd gutes Ergebnis ausgeführt werden kann, liegt zwischen 5-6 Jahren.

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