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From the Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland.
(Head: Professor A. Langenskiöld, M. D.).

TRAUMATIC PREMATURE CLOSURE OF THE DISTAL TIBIAL EPIPHYSEAL PLATE

By

A. LANGENSKIÖLD

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In his book on fractures in children *Blount* wrote (p. 181): "The distal tibial epiphysis is the most prone of any in the body to the type of injury that causes damage to the epiphyseal plate and subsequent angular deformity and/or shortening." The same opinion was expressed by *Salter & Harris* in 1963. *Bergenfeldt* (1933) also pointed out the relatively high frequence of epiphyseal injuries in the ankle region. In 1957 *Bartl* stated that growth disturbance is seldom seen after adequate treatment of closed epiphyseal injuries in the ankle. *Carothers & Crenshaw* found a high incidence of permanent damage to the epiphysis in adduction injuries of the ankle. However, the number of articles dealing with the treatment of manifest growth disturbance after injury to the distal tibial epiphyseal plate is very small.

In an article on traumatic arrest of epiphyseal growth at the lower end of the tibia, *MacFarland* (1931) described the type of osteotomy which is indicated by varus deformity of the ankle after skeletal growth is completed. About the possibilities of preventing deformity in this type of injury he wrote (p. 80): "Attempts have been made, as one could expect, to prevent the recurrence or progression of the deformity. These have not been definitely successful." *Aitken* in 1936 also expressed a pessimistic view as to the possibilities of preventing deformity after severe injury to the distal tibial epiphyseal plate.

McFarland wrote his article two years before *Phemister* published his work on the operative arrest of growth. Today epiphyseodesis is a safe method of preventing any angulation deformity provoked by partial closure of an epiphyseal plate. Osteotomy with over-correction

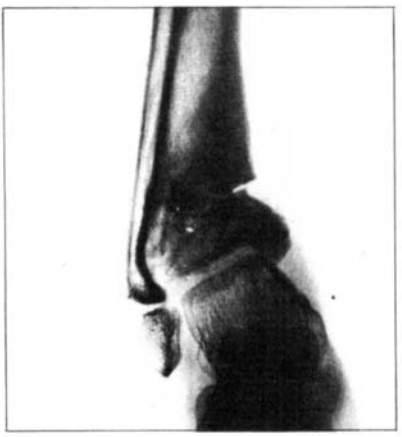


Figure 1. Case 1. Age seven years and three months. Varus deformity of the ankle two years and four months after injury.

or repeated osteotomies are, especially in young children, alternatives which might give a possibility of gaining some length of the extremity.

In the four cases described below, severe traumatic growth disturbance of the lower end of the tibia indicated several operations to correct and prevent varus deformity and discrepancy of leg length.

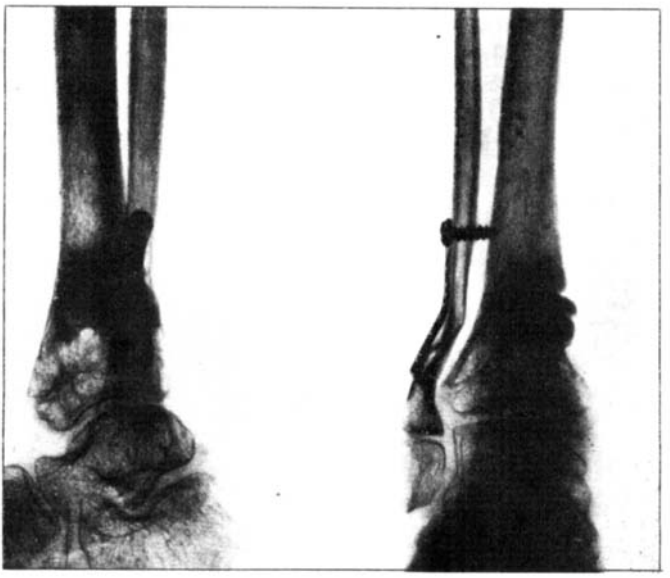


Figure 2. Case 1. The right ankle three months after supramalleolar osteotomy of the tibia and the fibula.

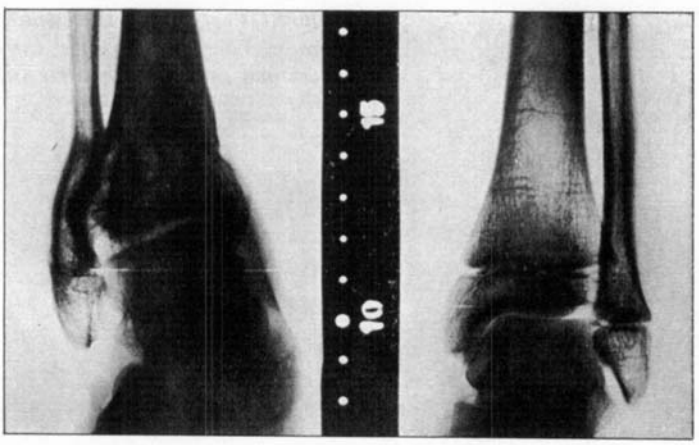


Figure 3. Case 1. Age ten years and two months. Progression of deformity had been arrested by epiphyseodesis of the lateral malleolus two years and eight months previously.

Case 1. S. M., a girl, born June 25, 1949. On June 10, 1954 a falling gravestone caused an open fracture of the distal end of the right tibia. The patient was first seen by the present author in October 1956 (Figure 1). There was marked varus deformity of the right ankle, complete growth arrest of the distal tibial epiphyseal plate and suppuration from a fistula above the medial malleolus.

Four months after revision of the fistula, supramalleolar osteotomy of the right tibia and fibula was performed (Figure 2). There was a definite tendency to recurrence of varus deformity by overgrowth of the distal end of the fibula. Three months after the osteotomy a Phemister type of epiphyseodesis of the lateral malleolus was performed (Figure 3). At that time there was a one-and-a-half centimeter shortening of the limb. From the age of eight years to the age of twelve shortening increased to three and a half centimeters. After epiphyseodesis of the upper ends of the left tibia and fibula the shortening diminished and was

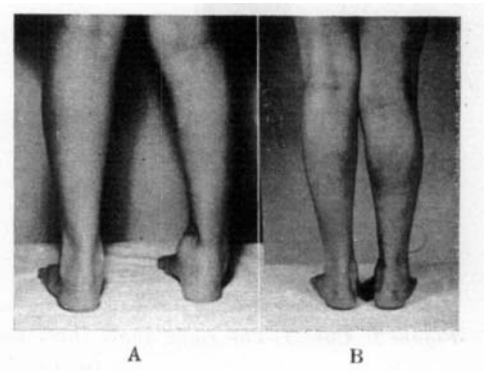


Figure 4. Case 1. **A.** *Age seven and a half years. Varus deformity of right ankle before treatment.* **B.** *Age twelve years and nine months. Very slight deformity of the right ankle.*

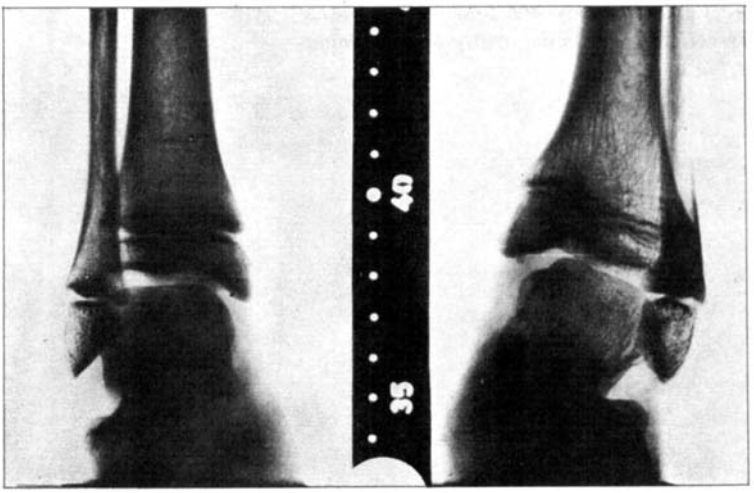


Figure 5. Case 2. Age eleven years. Varus deformity of the left ankle four years after fracture.

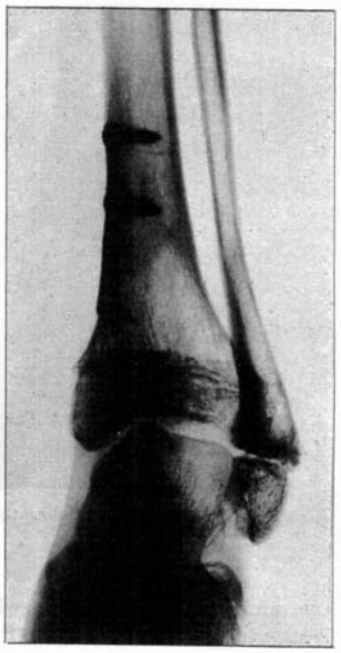
two and a half centimeters when growth was finished. A slight varus deformity remained in the right ankle (Figure 4).

Case 2. T. U., a girl, born December 6, 1945. At the age of seven years she was treated in a general hospital for a fracture of the left ankle. After this a varus deformity of the ankle gradually developed. The child was eleven years when she was first seen by the present author. There was partial arrest of epiphyseal growth in the medial part of the distal tibial epiphysis (Figure 5) and a one-and-a-half centimeter shortening of the left leg. Osteotomy of the distal ends of the left tibia and fibula was performed (Figure 6) and nine months later epiphyseodesis of the upper ends of the right tibia and fibula was carried out. The shortening increased to two centimeters and at the age of thirteen epiphyseodesis of the distal end of the right femur was performed.

When the patient was fourteen the varus deformity had recurred and the distal epiphyseal plate of the fibula was still open (Figure 7). As the skeletal age of the patient was only thirteen, at the chronologic age of fifteen and a half epiphyseodesis of the lateral malleolus was performed to prevent further progression (Figure 8). At the end of the growth period discrepancy of leg length was one centimeter. Reosteotomy of the tibia and fibula was performed, after which a satisfactory result was achieved (Figure 9).

Case 3. J. D., a boy, born November 30, 1957. In a motor accident when he was four years old he sustained an open fracture of the distal end of his right tibia and a severe crushing injury of his right foot and ankle. After plastic surgery for extensive scars it was possible to consider the treatment of a varus deformity of the right ankle (Figure 10). After osteotomy of the distal ends of the right tibia and fibula the foot was in good position (Figure 11). There was complete arrest

Figure 6. Case 2. Radiograph taken two months after correction of varus deformity by osteotomy of the tibia and fibula.



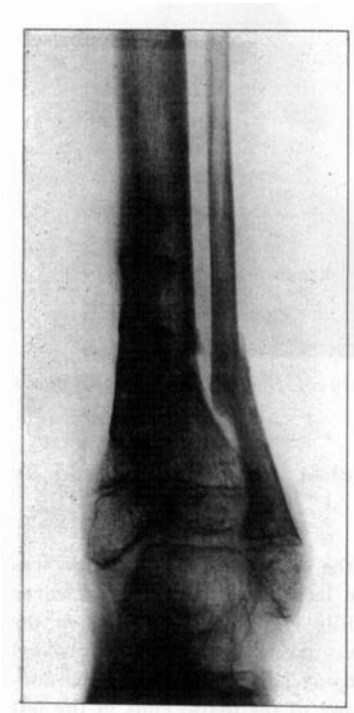


Figure 7. Case 2. Age fourteen years. Varus deformity of the left ankle progressing three years after osteotomy.

of growth of the distal tibial epiphyseal plate and overgrowth of the fibula was threatening the result of treatment (Figure 12). Thirteen months after the osteotomy epiphyseodesis of the lateral malleolus was performed and at the age of eight years a permanent and acceptable position of the ankle seemed to have been achieved (Figures 13 and 14). At the age of nine years there was a two-centimeter shortening of the right leg which will require further treatment.

Case 4. A boy, born July 22, 1950. When the boy was five years his left ankle was injured by a tractor and varus deformity of the ankle gradually developed.

The boy was first seen by the present author when he was nine. There was varus and recurvatum deformity in the left ankle and complete arrest of growth of the distal tibial epiphyseal plate (Figure 15). Osteotomy of the distal ends of the tibia and fibula, and epiphyseodesis of the lateral malleolus were carried out (Figure 16). There was a three-centimeter shortening of the left leg.

Epiphyseodesis of the upper ends of the right tibia and fibula was performed at the age of eleven and of the distal ends of the right tibia and fibula at the age of

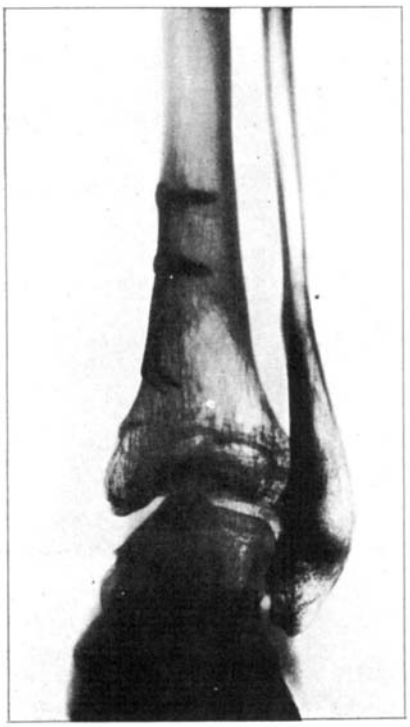


Figure 8. Case 2. Age sixteen years and eleven months. Progression of varus deformity arrested by epiphyseodesis of the lateral malleolus at the age of fifteen and a half years, skeletal age being thirteen years.

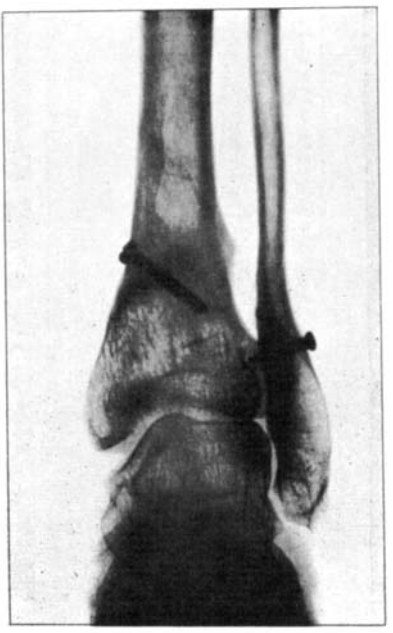


Figure 9. Case 2. Final position of the left ankle after reosteotomy.

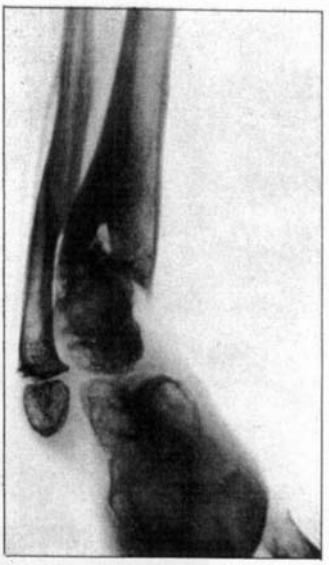
twelve and a half years. When growth was finished there was a one centimeter shortening of the left leg and the position of the left ankle had remained good (Figures 17 and 18).

DISCUSSION

In case 1, there was complete arrest of growth in the distal end of the tibia when correction by osteotomy was performed (Figures 2 and 3). The ankle would have remained in a better position if epiphyseodesis of the lateral malleolus had not been delayed but carried out in connection with the osteotomy.

In case 2, varus deformity recurred from continued growth of the distal end of the fibula and the lateral part of the distal tibial epiphysis. Very little leg length was gained from repeated osteotomy. When a

Figure 10. Case 3. Age five years and ten months. Varus deformity of the right ankle one year after injury.



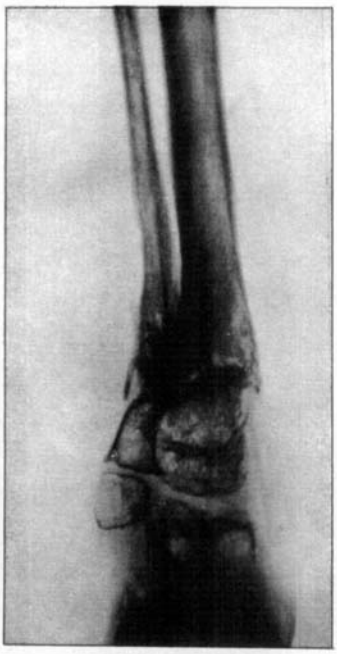


Figure 11. Case 3. Age six years and six months. Radiograph taken two months after correction of varus deformity by osteotomy of the right tibia and fibula.

large bony bridge connects the medial part of the distal tibial epiphysis to the metaphysis, epiphyseodesis of the distal ends of both bones should be considered as an alternative to the acceptance of recurrence of deformity and subsequent repeated osteotomy. In this case the recurrence unnecessarily caused added irregularity of the ankle joint.

In case 3, the degree of growth disturbance in the distal end of the tibia could not be judged with certainty at the time of correction by osteotomy (Figure 11). Follow up examination disclosed the risk of recurrence of deformity from overgrowth of the lower end of the fibula, and epiphyseodesis of the lateral malleolus could be carried out in time to prevent it.

In case 4, complete arrest of growth of the distal tibial epiphyseal plate clearly indicated epiphyseodesis of the lateral malleolus at the time of osteotomy. This case is also the only one in which the present

Figure 12. Case 3. Age seven years and five months. Recurrence of varus deformity by overgrowth of the fibula threatening.

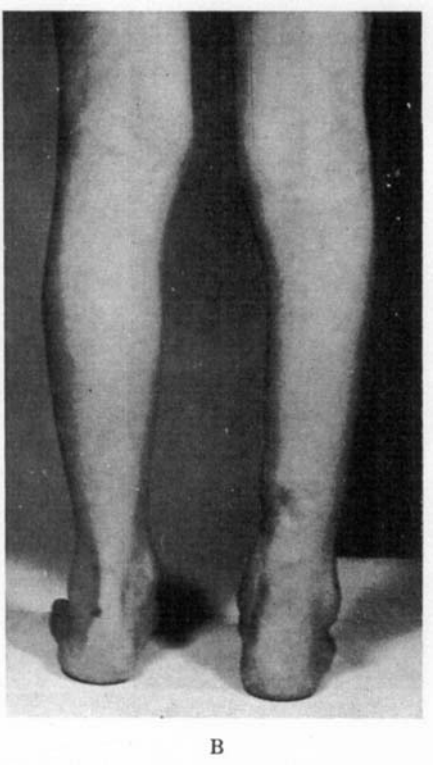
Figure 13. Case 3. Age eight years and five months. Radiograph taken eleven months after epiphyseodesis of the lateral malleolus.

author has performed epiphyseodesis of the distal ends of the tibia and the fibula in the sound leg.

SUMMARY AND CONCLUSIONS

In four cases of traumatic arrest of growth in the distal epiphyseal plate of the tibia, epiphyseodesis of the distal end of the fibula was indicated in addition to corrective osteotomy of the tibia and the fibula. Epiphyseodesis of the lateral malleolus should always be carried out when complete premature arrest of growth of the distal end of the tibia is diagnosed and the distal end of the fistula is still growing. When a large bony bridge connects the medial part of the distal epiphysis of the tibia to the metaphysis, epiphyseodesis of the distal ends of both tibia and fibula should be considered as an alternative to the acceptance

A



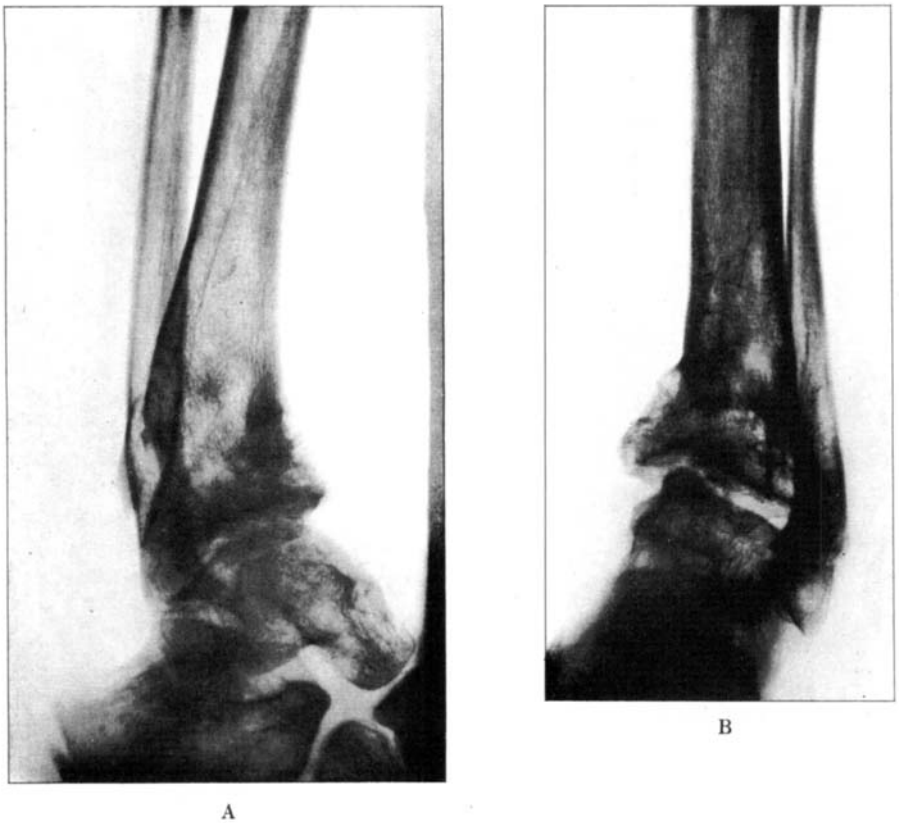
B

Figure 14. Case 3. A. *Age six years. Varus deformity of the right ankle before treatment.* B. *Age seven and a half years. The condition after operative treatment of the right ankle.*

of progression or recurrence of deformity and subsequent correction by osteotomy.

RESUME

Dans quatre cas d'arrêt traumatique de la croissance de la plaque epiphysaire distale du tibia, une épiphyseodèse de l'extrémité distale du péroné était indiquée en plus de l'ostéotomie corrective du tibia et du péroné. Il convient aussi de pratiquer l'épiphyseodèse de la malléole externe lorsqu'un arrêt prématuré de la croissance de l'extrémité distale du tibia est diagnostiqué et que la croissance de l'extrémité distale du péroné continue. Lorsqu'un large pont osseux unit la partie médiane de l'épiphyse distale du titbia à la métaphyse, l'épiphyseodèse des extrémités distales du tibia et du péroné peut être considérée comme une alternative à la progression ou à la récidive de la déformité susceptible de nécessiter une correction par ostéotomie.



A B

Figure 15. Case 4. A *and* B. *Age nine years. Varus deformity of the left ankle developed after open fracture at the age af five years.*

ZUSAMMENFASSUNG

In vier Fällen von traumatischer Schliessung der Epiphysenfuge im distalen Ende der Tibia war eine Epiphyseodese des distalen Endes der Fibula indiziert ausser der Osteotomie der Tibia und der Fibula. Eine Epiphyseodese des lateralen Malleolus sollte immer ausgeführt werden, wenn eine vorzeitige Schliessung der distalen Epiphysenfuge der Tibia vorhanden ist, und das distale Ende der Fibula noch weiter wächst. Wenn eine grosse knöcherne Brücke den distalen Epiphysenkern und die Metaphyse vereinigt, sollte eine Epiphyseodese des distalen Endes der Tibia und der Fibula in betracht gezogen werden als Alternativ zum Acceptieren einer Progression oder des Rezidivierens der Deformität und einer späteren Korrektion durch Osteotomie.

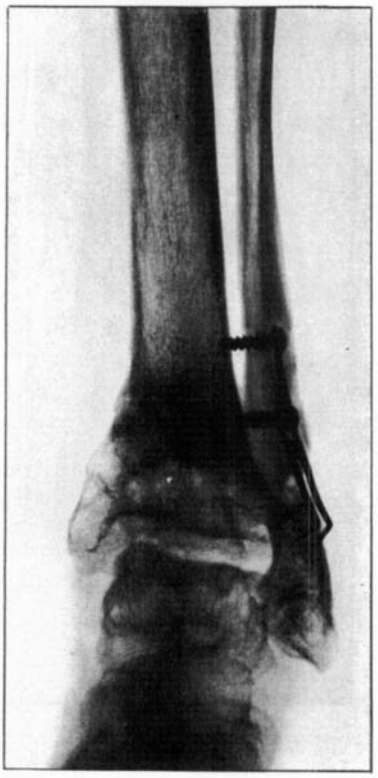
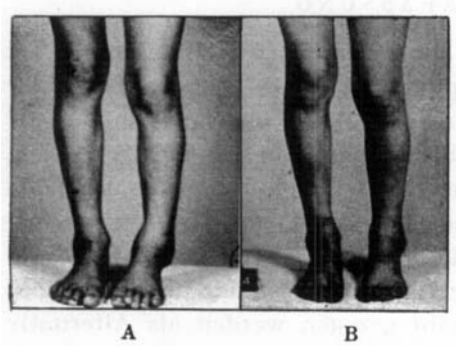


Figure 16. Case 4. Left ankle seven months after osteotomy of tibia and fibula and epiphyseodesis of the lateral malleolus.

Figure 17. Case 4. The left ankle at the age of fifteen and a half years.



A B

Figure 18. Case 4. A. Age nine years. Varus deformity of the left ankle before treatment. B. Age eleven years and eight months. Improved appearance of the left ankle after operation.

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