

HAS EPIPHYSEODESIS IN ONE END OF A LONG BONE A GROWTH-STIMULATING EFFECT ON THE OTHER END?

An Experimental Study

By

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Increased longitudinal growth of the long bones may occur as a result of infections, tumours or mechanical traumata such as implantation of foreign bodies into the bone or detachment of the periosteum of the diaphysis. The increase is inconstant, however. According to *Blount* (1) "the acceleration will persist only while the stimulating factor operates, and then the growth will continue at a normal rate". According to him the increase in length is permanent, since no retardation occurs later. Neither does the fact that the stimulated epiphyseal line fuses some months earlier than the contralateral, result in any readjustment of the difference in length, since by this time growth in length has virtually ceased. In contrast to this opinion, *Jansen* (5) stated that "the effect appears to occur in the first few months after the procedure" (Pease-operation), "Later the gain is more or less reduced".

Speaking of the effect of surgical procedures on the epiphyseal line, *Blount* (2) suggested that the trauma which inhibited one epiphyseal line probably stimulated the other, a phenomenon which "happens routinely in children". If his surmise is correct, then this is one of many factors influencing the result of epiphyseodesis aimed at readjustment of the length of the bone. Perusing the available literature on the subject, I have not found any investigation on the subject of whether epiphyseodesis at one end of a long bone stimulates the epiphyseal line at the other end of the bone. The aim of the present investigation is to throw some light upon this matter.

MATERIAL AND METHOD

Normal curves for the contribution made by the different epiphyseal lines to longitudinal growth in man are lacking, as are also acceptable reasons for the introduction of foreign bodies into the bone (to act as visible measuring labels in radiograms) in clinical cases. For these reasons the investigation was carried out on animals. Although Blount's method, consisting of two separate procedures and the temporary introduction of foreign body (staples), might constitute a stronger stimulus, in the absence of staples suitable for the bones of young rabbits epiphyseodesis was performed according to a modification of Phemister's method.

On nine rabbits (originally 19, of which 10 died of an epizootic at ages of 1 to 3 months) small steel wire labels were introduced at the ages of 9 to 22 days, under local anaesthesia, into the diaphyses of the tibia and fibula. As I have shown earlier (4), such labelling does not have any measurable effect on the growth in length of the bone. Epiphyseodesis of the proximal epiphysis of the right tibia was carried out on four rabbits about 80 days old, on three about 110 and on two about 120 days old. Under local anaesthesia and without freeing the periosteum, the epiphyseal plate was gouged and curetted from both the medial and the lateral side. The left tibia was left untouched for control.

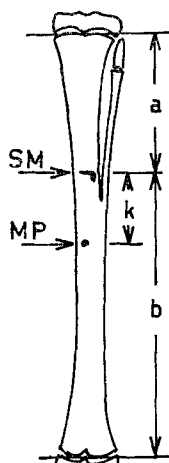


Fig. 1.

Schematic illustration of the method of measurement employed. SM = steel marker, MP = mid-point of the diaphysis, k = correction factor, $a + k$ = corrected length of the proximal part and $b - k$ = corrected length of the distal part of the tibia.

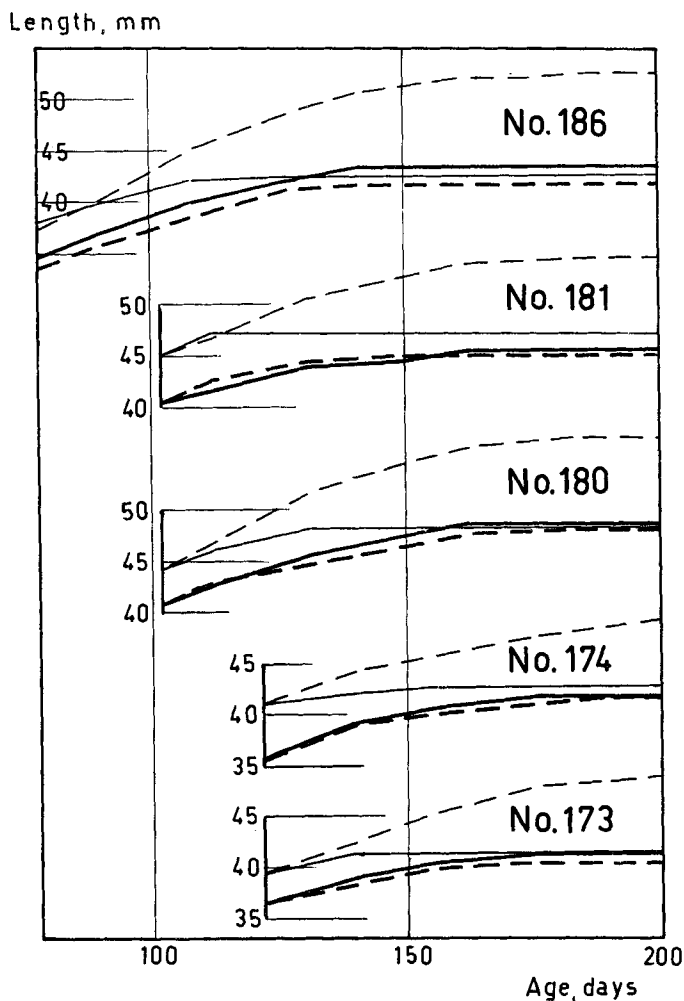


Fig. 2.

Growth curves of the tibias of rabbits nos. 173, 174, 180, 181 and 186.

- = distal epiphysis of right tibia.
- = distal epiphysis of left tibia.
- = proximal epiphysis of right tibia.
- . - . - = proximal epiphysis of left tibia.

Three animals died before the end of the growth period and in one the label became detached from the tibia; thus only five animals could be included in the series. The animals were radiographed at 1- or 3-weekly intervals and at a constant focal distance (96 cm.). The measurement of the length in the radiograms was accurate to within 0.5 mm.

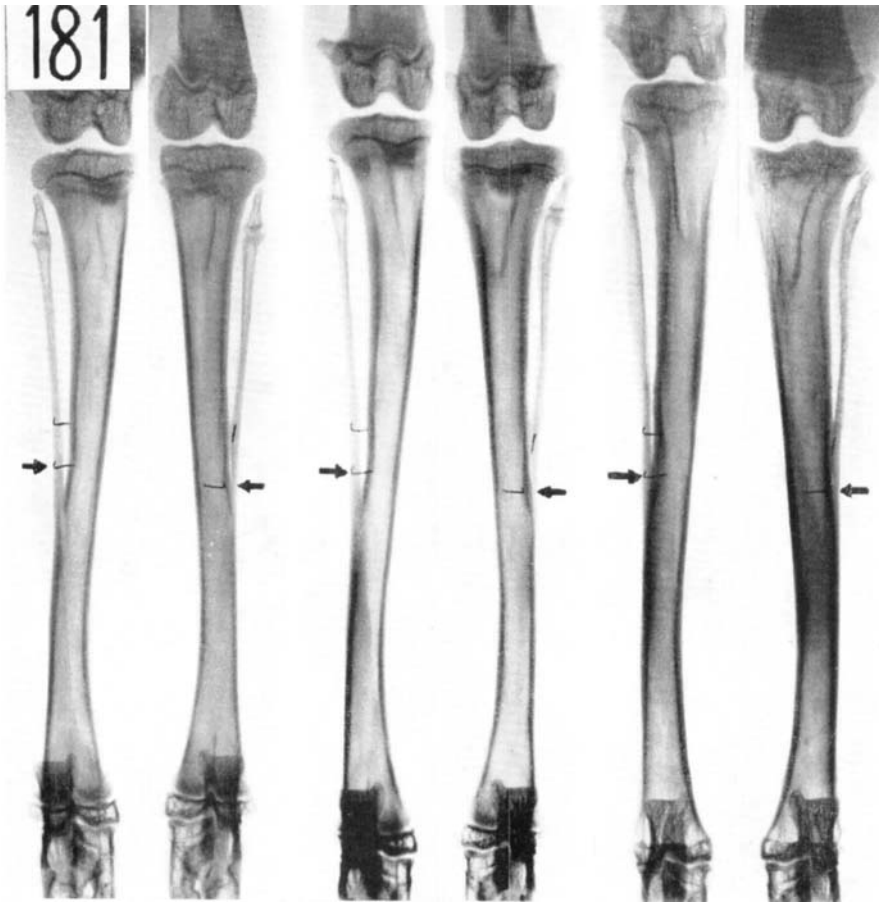


Fig. 3.

Rabbit No. 181. The hind legs immediately, one month and four months after epiphyseodesis of the proximal epiphysis of the right tibia. The arrows indicate the position of the steel markers inserted in the diaphysis.

On each radiogram the following measurements were made: (see Fig. 1) the distance from the label in the diaphysis (SM) to the proximal epiphyseal line of the tibia = a , and to the distal epiphyseal line of the tibia = b . The distance between SM and the midpoint of the tibial diaphysis (MP) was measured on the radiogram made immediately after labelling. This distance k , which is constant, was added to the distance a and subtracted from b in all radiograms of the same tibia. Thus a common starting point was obtained for the growth

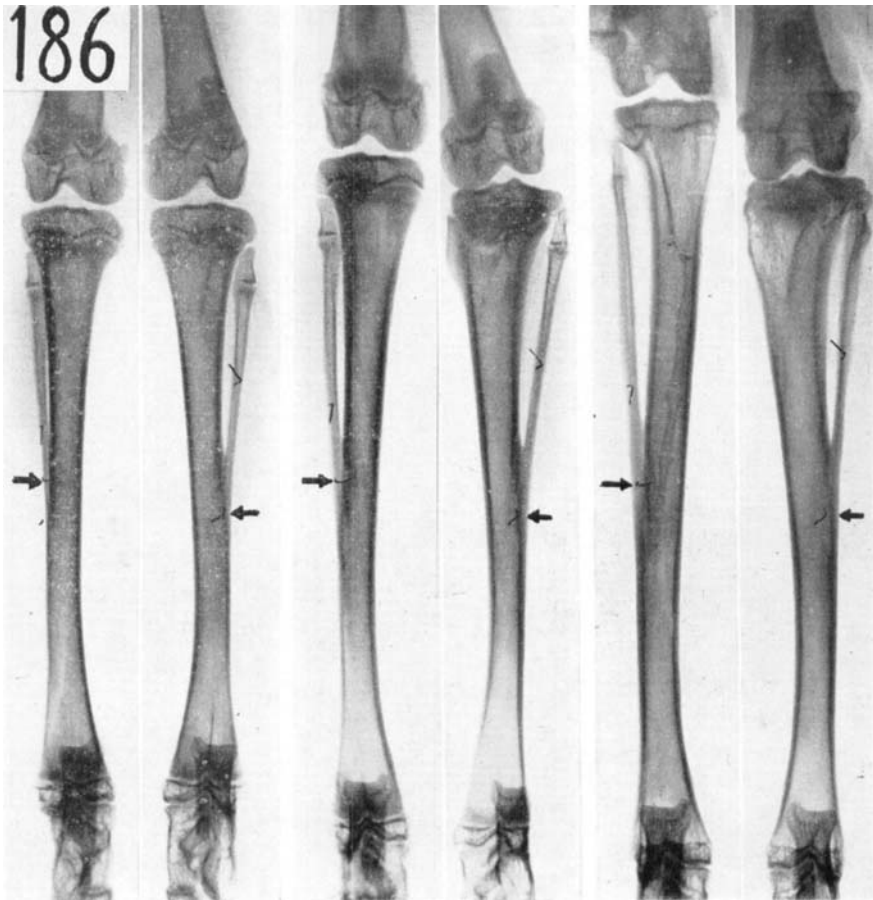


Fig. 4.

Rabbit No. 186. The hind legs immediately, one month and five months after epiphyseodesis of the proximal epiphysis of the right tibia. The arrows indicate the position of the steel markers inserted in the diaphysis.

curves of the proximal and distal epiphyseal lines, the curves being drawn on the basis of the values thus corrected. (Fig. 2).

OBSERVATIONS

1. The longitudinal growth in the proximal end of the right tibia ceased within 10 to 30 days after epiphyseodesis.
2. The longitudinal growth in the proximal end of the left tibia (the control) was normal as compared with the normal curve according to

Heikel (3). Thus a difference in length, varying between 6.5 and 10 mm., arose in the proximal ends of the tibiae. (Figs. 3 and 4).

3. The longitudinal growth in the distal end of the tibia was apparently neither temporarily nor permanently in any appreciable degree affected by the epiphyseodesis. The growth curves were more or less parallel. The growth in length in the distal end of the right tibia was the same as that in the left in one animal, 0.5 mm. greater in two animals and 1 mm. greater than the left tibia in two animals. The differences are so small that they can be considered to lie within the limits of normal variation and of errors in measurement.

4. The relation between the growth inhibition in the proximal end and the "growth increase" in the distal end of the right tibia varied 0 and 1: 7.5 (0.133), being 0.072 on average, i.e. less than 1: 10.

5. The distal epiphyseal lines of both tibias closed at the same time.

CONCLUSION

Epiphyseodesis carried out on the proximal end of the tibia of 80 to 120 day old rabbits has no effect upon the longitudinal growth at the distal end of the tibia, or at most stimulates it quite insignificantly. The question of the applicability of this result to clinical cases falls outside the scope of the present investigation.

RESUME

Une épiphyseodèse pratiquée sur l'extrémité proximale du tibia chez des lapins âgés de 80 à 120 jours n'a aucun effet sur la croissance longitudinale de l'extrémité distale du tibia ou la stimule au plus d'une manière insignifiante. La question de l'application de ce résultat en clinique sort du cadre de la présente enquête.

ZUSAMMENFASSUNG

Eine am proximalen Tibiaende von 80 bis 120 Tagen alten Kaninchen ausgeführte Epiphysecodese hat keine Wirkung auf das Längenwachstum des distalen Endes der Tibia, oder doch nur ganz unbedeutende Wirkung. Die Frage der Anwendbarkeit dieses Ergebnisses auf klinische Fälle liegt ausserhalb der Aufgabe der vorliegenden Untersuchung.

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