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EPIPHYSEODESIS AND EPIPHYSEAL STAPLING ON THE LOWER LIMBS

By

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The object of the present paper is to submit an analysis of the results of growth-inhibiting operations done on the lower limbs at the Orthopaedic Hospital, Aarhus, during the period 1950-1959 inclusive. Two methods were used, the one described by *Phemister* in 1933 and *Blount's* from 1949. Epiphyseal stapling was not used as a temporary growth inhibiting procedure (*Nordentoft* 1964). It seems reasonable to compare the two methods. The calculated correction (*Green & Anderson* 1957) was related to the obtained correction. Primary and secondary complications as well as the number of corrective procedures are reviewed and compared with the results of others (*Nordentoft* 1964, *Pilcher* 1962, and *Trias et al.* 1961).

The cause of growth inhibition in a paralysed limb has not been elucidated. A relationship is assumed to exist between the degree of shortening and the age at onset of paralysis; moreover, the extent of the paralysis seems to influence the consequent difference in limb length (*Stinchfield et al.* 1949).

MATERIAL

During the period 1950-1959 a total of 98 patients were treated, 41 girls and 57 boys. The preoperative diagnoses were: Sequelae of poliomyelitis in 81 cases, unilateral shortness of a lower limb in 6, while 11 patients exhibited the sequelae of various conditions, *viz.* congenital deformities, osteomyelitis, spastic hemiparesis, and burns. Analysis of the group of 81 polio patients with a view to the influence of the age at onset of polio upon the shortening gave the following results (when excluding 6 patients for whom the age at onset was unknown):

No. of pts.	Age at polio	Average shortening	Average age at measurement
25	0-1 yr.	5.2 cm (2.6-8.3 cm)	11.7 yrs. (8-16 yrs.)
24	1-2 yrs.	5.3 cm (1.7-8.6 cm)	11.7 yrs. (10-14 yrs.)
20	2-6 yrs.	4.9 cm (3.1-8.6 cm)	11.6 yrs. (10-13 yrs.)
6	over 6 yrs.	3.1 cm (2.0-4.5 cm)	13.2 yrs. (12-15 yrs.)

We did not find a consistent relationship between the degree of paralysis and its localization in the legs on the one hand and the shortening on the other. There might be considerable shortening of the thigh although the paralysis affected the leg below the knee.

Number of patients who primarily had a Blount operation:	53
Number of patients who primarily had the Phemister operation:	38
Number of patients who primarily had Blount as well as Phemister operation:	7

RESULTS OF BLOUNT OPERATION

In addition to the 53 patients, this group includes the 7 patients who also had the Phemister operation at the same time upon another epiphysis. These patients are included and so are their complications, if any, if they were due to the Blount procedure. In these 60 patients operations were done on 69 epiphyses, 46 times on the proximal tibial epiphysis and 23 times upon the distal femoral epiphysis.

Primary operative complications occurred in 6 patients (10 per cent), viz. in 3 cases wound infection, in 1 restricted movements of the knee, and in 2 transient paresis of the peroneus. In 16 cases displaced, gaping, or broken staples constituted a secondary complication.

CORRECTIVE PROCEDURES

In 12 cases (20 per cent) re-operation had to be done because of asymmetrical growth in the stapled epiphysis. These procedures were performed 1-5 years after the primary operation—because of varus or valgus deformity of the tibia. The corrective procedures consisted in 5 cases in Phemister epiphyseodesis, done twice on one patient, in 3 cases in repeated epiphyseal stapling by the Blount method, and in 4 cases in osteotomy on the tibia.

SUPPLEMENTARY OPERATIONS

In 10 cases (16.6 per cent) re-operation had to be done because of insufficient growth inhibition. In 3 cases a Phemister procedure was done

on the same epiphyseal plate, supplemented by operation on another epiphyseal plate. In 7 cases operation was done on another epiphyseal plate, twice by the Blount method and 5 times by the Phemister method. In 3 cases the staples were removed after the primary operation, as they were causing complaints.

FOLLOW-UP

Fifty patients were seen after cessation of growth. The follow-up examination included in 43 instances radiological spot measurement of the lower limbs. This measurement had also been done preoperatively. In 38 cases the skeletal development had been determined prior to the operation by means of the *Greulich-Pyle atlas* (1950). This showed the skeletal age to range from 9.5 to 13.5 years, average 10.9.

At clinical follow-up 16 patients (32 per cent) had recurvation of the operated knee. In 14 instances there was a recurvation of 5–10°, while in 2 the recurvation was 20°. A varus or valgus deformity was found in 8 cases (16 per cent). The deformity was in one case only so pronounced that the patient wished corrective surgery, but this was not felt to be indicated.

On an average, the obtained correction was 2.0 cm, maximum 7.3 and minimum —5.2. The cause of the failing effect in this last-mentioned patient is not known. The operation was performed on the distal femoral epiphysis, but the inequality in leg length increased quite uninfluenced by the operation. 65.2 per cent of the cases showed a residual difference in leg length of —2 cm to +1.2 cm, as over-correction was found to have occurred in two. The remaining 18 had a difference exceeding 3 cm, maximum 11.4 cm.

RESULTS OF PHEMISTER OPERATION

38 patients had primary operation by this method. To this group should be added the 7 patients who had both types of operation. The operation was done on a total of 58 epiphyses, in 43 cases on the proximal tibial epiphysis and in 15 on the distal femoral epiphysis. Primary operative complications occurred in 2 cases (4.4 per cent), viz. 1 case of transient peroneal paresis, and one case of transient restriction of knee movement.

CORRECTIVE PROCEDURES

Owing to asymmetrical growth 3 patients were treated (6.7 per cent). These operations were done 1–2 years after the primary operation. In

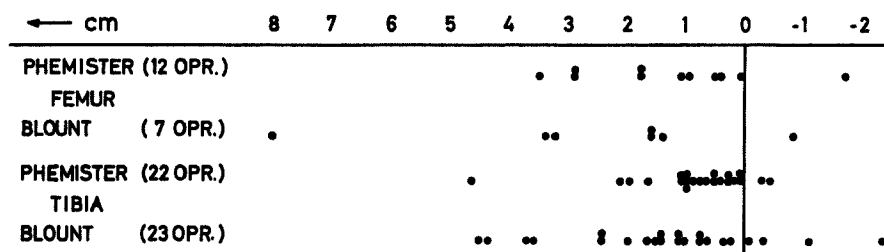


Figure 1. Difference between calculated and obtained correction.

2 cases the procedure consisted in tibial osteotomy and in one case in a Phemister re-operation.

SUPPLEMENTARY OPERATIONS

Due to deficient growth inhibition re-operation had to be done on 2 cases (4.4 per cent). In both instances the Phemister operation was done on another epiphyseal plate. Both operations were carried out one year after the primary operation.

FOLLOW-UP

Thirty-one patients were seen after cessation of growth. In 30 spot measurement was done prior to the operation and at follow-up. In these cases the operation had been done at a skeletal age which according to *Greulich & Pyle's* atlas (1950) ranged from 10–14 years, average 12.1 years.

Four patients exhibited recurvation of the operated knee. In 3 of these patients there was also mild varus deformity. The recurvation was negligible in 3 (5, 5, and 10°), while one patient had a varus deformity so severe that osteotomy was done. In another 2 cases there was mild varus deformity.

The average correction was 2.7 cm. In 74.2 per cent there was a residual inequality in leg length of —3 to +2 cm, as over-correction had resulted in 3 cases.

COMPARISON OF CALCULATED WITH OBTAINED CORRECTION

On the basis of their material, *Green & Anderson* (1957) worked out curves which form the basis of a calculation of the approximate equalization obtainable. These curves were used in the treatment of the

present material. The relationship between the obtained and the calculated corrections is shown in Figure 1. If more than one operation had been done, the figures are calculated on the basis of the most recent one. This calculation includes only cases in which radiological measurement was done preoperatively as well as after cessation of growth.

DISCUSSION

The presupposition of satisfactory correction is approximate accuracy in predicting the extent of the growth inhibition obtainable by the operation. To this end the authors used *Green & Anderson's* (1957) curves and determination of skeletal age on the basis of *Greulich & Pyle's* atlas (1950). Operations were done on a total of 127 epiphyses. Over-correction resulted in 5 cases, in 2 after the Blount and in 3 after the Phemister operation.

Primary operative complications were few and negligible, and less common after the Phemister than after the Blount operation. On the other hand, the frequency of asymmetrical growth after these operations cannot be disregarded. This occurred especially after the Blount operation, 20 per cent requiring re-operation because of asymmetrical growth in the stapled epiphysis. According to the present study of patients whose growth had been completed the Phemister operation seems to be preferable.

Högberg & Lidström (1957) arrived at the same conclusion in their follow-up on a material which had also been treated by both methods. Nevertheless, they advise the Blount operation, as they had a larger number of deformities requiring operative correction after the Phemister operation.

In a discussion on a paper by *Brockway et al.* (1954), *Blount* (1954) pointed out that the complications of the Blount procedure are due to erroneous technique and can therefore be avoided. In our material recurvation was fairly common and may be attributed to incorrect placement of the posterior staples. Dilatation and rupture of the staples must be due to faults in the material of which they are made.

SUMMARY AND CONCLUSION

During the period 1950–1959 a total of 98 patients were treated for shortening of one lower limb so marked that it required operation by the method of Blount or Phemister on the unaffected limb. Of these

patients 81 were seen after cessation of growth. Primary complications were few and negligible. The late complications of the two types of operation are described. Corrective and supplementary operations were commonly done after the Blount operation. The calculated correction is compared with the correction obtained at cessation of growth. The results of the Phemister operation were somewhat better than those of the Blount operation.

RESUME

Entre 1950 et 1959, 98 malades ont été traités pour un raccourcissement d'un membre inférieur si marqué qu'il fallut une opération d'après la méthode de Blount ou de Phemister pour le membre non atteint. Sur ces malades, 81 ont été réexaminés après la cessation de la croissance. Les complications primaires furent peu nombreuses et négligeables. Les complications tardives après ces deux types d'opération sont décrites. Des opérations correctives et complémentaires ont habituellement été pratiquées après l'opération par la méthode de Blount. La correction calculée est comparée avec la correction obtenue à la cessation de la croissance. Les résultats obtenus par l'opération de Phemister ont été quelque peu meilleurs que ceux par l'opération de Blount.

ZUSAMMENFASSUNG

Während des Zeitraumes 1950–1959 wurde eine Gesamtzahl von 98 Patienten wegen Verkürzung der unteren Gliedmasse behandelt, die so ausgesprochen war, dass sie eine Operation nach der Methode von Blount oder Phemister an der nichtbetroffenen Gliedmasse erforderte. Von diesen Patienten wurden 81 nach dem Wachstumsabschluss gesehen. Primäre Komplikationen waren wenige und gering. Die späten Komplikationen beider Operationstypen werden beschrieben. Korrigierende und ergänzende Operationen wurden gewöhnlich nach der Blount-Operation ausgeführt. Die berechnete Korrektur wird mit der Korrektur, die man beim Wachstumsabschluss erhielt, verglichen. Die Ergebnisse der Operation nach Phemister waren etwas besser als die nach der Blount'schen Operation.

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