THE CORRECTION OF GENU VALGUM BY EPIPHYSIAL STAPLING

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Forty-nine patients treated by epiphysial stapling for idiopathic genu valgum are reviewed. The children were aged from eleven to fourteen and a half years. The severity of the condition and subsequent correction were assessed by measuring the inter-malleolar distance.

Results show that femoral stapling is the treatment of choice for most patients with inter-malleolar separation of up to 12.5 centimetres. The optimum age for stapling for both boys and girls is eleven and a half years. Stapling of both epiphyses is advised for those patients presenting late, for example, between thirteen and fourteen and a half years, or where the deformity is greater than 12.5 centimetres of separation. Correction rarely takes more than one year, and was cosmetically satisfactory in all cases.

The operation is virtually free from complication except for a tendency for the scars to be broad and conspicuous. Stapling has proved to be a safe, effective and predictable operation for idiopathic genu valgum.

The common, idiopathic type of genu valgum seen in early childhood almost always corrects itself spontaneously, and is usually improving or corrected by the age of six years. In a few children the deformity persists or develops late, and it may then increase into early adolescence.

In 1933 Phemister described a method of arresting the growth of an epiphysis by producing bony fusion across the epiphysial line. This method has since been widely used for controlling limb length and correcting angular deformity. However, accurate prediction of the potential growth at the epiphysis is necessary in order to time the procedure correctly. In 1945 Haas produced temporary growth arrest by using wire loops round the epiphysial plate. He noted that the retardation occurred only while the wire loop was in place, and that growth was resumed when the loop was removed or broke. He showed that if the wire loop was applied to one side of the epiphysis only, then delay in growth was confined to that side, while growth continued, at least partially, on the opposite side. Blount and Clarke (1949) used wire staples to equalise leg length and correct angular deformity. They claimed that their procedure gave greater control over the correction, because when the required position had been reached the staples could be removed and growth allowed to continue normally.

This paper reviews a series of patients treated for idiopathic valgus deformity by Blount's technique.

PATIENTS AND METHODS

Forty-nine patients with idiopathic genu valgum were treated by epiphysial stapling. Patients with clinical or radiological evidence of pathology which might account for the deformity were excluded from the series. In twenty-one patients the medial side of the lower femoral epiphysis was stapled, in thirteen the medial side of the upper tibial epiphysis was stapled, and in fifteen both the upper tibial and lower femoral epiphyses were stapled. In all cases the operation was carried out on both sides.

The children were aged from eleven to fourteen and a half years, and there were twenty-seven boys and twenty-two girls. The decision to correct the knock-knee was made on cosmetic grounds, the distance between the medial malleoli being a...
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convenient measure of the severity of the deformity. A typical patient is shown in Figure 1.

Children starting treatment moderately late, with severe deformity, and those with less severe deformity but nearing the end of growth, were treated by stapling of both femoral and tibial epiphyses. For the other children, the decision as to which epiphysis should be stapled was based on the radiographic appearance, an attempt being made to judge the site of greater overgrowth.

Fig. 2
Osteoarthritis in a patient of 54, known to have genu valgum in childhood.

Measurements of inter-malleolar distance were made by the same observer before operation and at follow-up. The technique of measurement was standardised as far as possible by inserting a wooden wedge between the medial malleoli with the patient lying supine on an examination couch and with the medial femoral condyles in gentle contact and the patellae facing directly forwards (Howorth 1951).

The operative technique was as described by Blount and Clarke (1949), three staples being inserted at each epiphyseal line. The only deviation from their technique was to place the incision over the femur more vertically than they described. All staples were inserted under radiological control, with their tines parallel to the epiphyseal line. The patients remained in hospital until the sutures were removed ten days after operation, and out-patient follow-up was then continued at three-monthly intervals. At each visit a measurement was made of the inter-malleolar distance, and of the range of flexion and extension of the knees. Radiographs were taken if there was a suspicion that the staples were extruding, or that correction was not continuing satisfactorily. The staples were usually removed when the legs had reached a position of slight over-correction; in other words when a slight bow-leg deformity had developed.

Group I: Medial femoral stapling—This group comprised twenty-one patients, eleven boys and ten girls. Their average age at the time of operation was eleven and a half years and the inter-malleolar separation was 10-13·75 centimetres.

Group II: Medial tibial stapling—This group comprised seven boys and six girls. The average age of the boys was eleven years, and the separation 8·75 centimetres. The average age of the girls was ten and a half years, and the inter-malleolar separation 9·4 centimetres.

Group III: Combined tibial and femoral stapling—This group consisted of six boys and six girls. The average age of the boys was thirteen years, and the inter-malleolar separation 12·5-15 centimetres. The average age of the girls was twelve years, and the separation 12·5-14·4 centimetres.

Group IV: Combined tibial and femoral stapling in older children—Two boys and one girl with a separation of 10 centimetres were treated at the age of fourteen and a half years by stapling the medial side of both epiphyses.

RESULTS

For the majority of patients sufficient measurements were made to enable a chart to be made of the progress of correction of the deformity. It was found that for any given group these charts superimposed sufficiently accurately to make it possible to choose a representative chart from each group to illustrate the events.

Group I: Femoral stapling—Figure 3 shows the curve for the boys and Figure 4 shows that for the girls. The two curves are almost identical, and correction was achieved within twelve to fifteen months.

The staples were removed when the deformity was slightly over-corrected, and the diagram shows that for a short period after removal of the staples the epiphyseal plate was still arrested. This period lasted for approximately two months, and following this there was a temporary acceleration of growth for between eight and ten months, after which growth progressed symmetrically, leaving the knees fully corrected. There was no recurrence of deformity over the follow-up period until growth ceased.

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Group II: Tibial stapling. Boys—Figure 5 illustrates events in this group. The time to reach correction was twenty-four months. Again there was slight growth acceleration after removal of the staples, leaving the children with an acceptable correction by the age of fourteen years.

Girls—Figure 6 shows that in this group the time for correction was slightly quicker, correction being achieved in eighteen months.

Group III: Tibial and femoral stapling—Figure 7 shows the curve for the boys starting at the age of thirteen, and also the curve for the girls which follows the same pattern, but starting at the age of twelve years. In this group correction of the deformity was achieved in nine to twelve months.

Group IV: Tibial and femoral stapling in older children—In this small group correction was achieved in nine months (Fig. 8). This diagram shows one such patient in whom the staples were removed rather early, and here there was a final residual separation of 1·9 centimetres which was acceptable.

ILLUSTRATIVE CASE REPORTS

Case 1—A boy aged eleven and a half years with a separation of 8·75 centimetres, was treated initially by femoral stapling (Fig. 9). He corrected in the usual manner until the separation had diminished to 3·75 centimetres, when the staples became loose; growth recommenced and the deformity recurred. At the age of thirteen years and two months a further operation was carried out to staple both femoral and tibial epiphyses. Correction progressed quickly, the legs straightening over a
period of ten months. At fourteen years and nine months the staples were removed and, after the usual temporary acceleration, the final correction was satisfactory.

Case 2—A girl aged ten years and nine months, with a separation of 11-25 centimetres. Tibial stapling was carried out (Fig. 10). Correction followed until the staples loosened one year and one month later, resulting in slight recurrence of the deformity. At the age of twelve and a half years, the tibial staples were replaced and the femoral epiphysis was also stapled. Again correction continued for another year, when, with an inter-malleolar separation of 2-5 centimetres, the staples again became loose and were removed. In this case the correction was incomplete but acceptable.

COMPLICATIONS

Complications were few and all were of a minor nature. In no patient seen at three months was there significant effusion or limitation of movement in the knee joint. There were no infections. Extrusion of staples, and their subsequent reinsertion was necessary in three patients. Spreading or breakage of staples did not occur. The staples were deliberately inserted extra-periosteally, and in no case was there difficulty in removing them because of bony overgrowth. Hyperextension or fixed flexion deformity has been reported as a complication of epiphysial stapling. None was seen in this series, and we believe that these are unlikely to occur when only one side of an epiphysis is stapled. Premature closure of the epiphysis did not occur in any patient. Eight of the patients complained of some pain over the scars at the time of the review. In the majority of the patients the scars were conspicuous, some of them having widened considerably (Fig. 11). In six of the patients there was a residual deformity of up to 3-75 centimetres because of failure to allow sufficient over-correction, but even here the patients were satisfied with the appearance of their legs.

DISCUSSION

Despite its relative simplicity epiphysial stapling has not been widely accepted as a method of correcting bow-leg and knock-knee deformities. There has been a tendency to consider together the results of stapling for correction of length discrepancies or angular deformities, and the same complications have been assumed to apply to both circumstances. Epiphysial stapling for the correction of leg length carries a significant complication rate (Brockway, Craig and Cockrell 1954; Green and Anderson 1957), the main problems being loosening and extrusion of staples, with occasional breakage, and the development of severe deformities. In the present series none of these complications was seen apart from extrusion of the staples, which occurred rarely, and which was almost certainly due to poor technique of insertion. As we have suggested, it seems unlikely that hyperextension or fixed flexion deformity will occur after stapling only one side of an epiphysis, but the importance of regular and frequent follow-up cannot be over-stressed. Our patients are seen at three-monthly intervals so that the staples can be examined and any developing deformities noted. The parents are warned of the possible dangers of non-attendance, and care is taken to ensure that when the decision is made to adjust or remove the staples the patient's name is not placed on a waiting list but a definite date for admission is arranged.

The operation is performed mainly for cosmetic reasons, and in all the patients reviewed the final shape of the legs was satisfactory. The operation, however, may have the additional benefit of preventing lateral compartmental osteoarthritis in later life. Figure 2 shows a severe bilateral osteoarthritis in the knees of a patient aged fifty-four, who was known to have severe genu valgum in adolescence.

The present review gives an indication of the optimum times for inserting and removing the staples, and of the procedures to adopt in the different age groups.

All the patients in this series had an inter-malleolar distance of more than 8-75 centimetres. It may be argued that the measurement of inter-malleolar separation gives little indication of the angle of valgus of the knee, as this obviously depends upon the length of the tibia. There is a further problem in that the tibia grows in length during the period of correction and, in addition, the measurement of separation between the malleoli is inevitably a very inaccurate one. When used by the same observer, however, it is sufficiently reliable to indicate the severity of the condition and the progress of correction. Possibly it would be more desirable to measure the angle of valgus either clinically or preferably by a standard radiographic technique, but, as the desired end point is reached when the medial malleoli are touching (Fig. 12), greater accuracy is, in practice, not needed.

The choice of epiphysis to be stapled is probably a less important matter than the technique of insertion. A
review of radiographs in the present series suggests that the decision to carry out either tibial or femoral stapling was a somewhat arbitrary one, and the results suggest that tibial stapling alone is probably rarely justified (Pritchard 1957). It is a slightly more difficult procedure than femoral stapling (Green and Anderson 1957). There is always the risk of driving the upper leg of the staple into the knee joint, and correction takes longer than femoral stapling; some cases taking over two years. Femoral stapling appears to be the procedure of choice for most patients, and is satisfactory for the correction of up to 12.5 centimetres of inter-malleolar separation. The optimum starting age for both boys and girls is eleven and a half. In patients who present late, or with an inter-malleolar separation of greater than 12.5 centimetres, stapling of both femoral and tibial epiphyses is advisable, provided both epiphysial plates are open. In our experience the time to correction is rarely more than one year, even with an inter-malleolar gap of 16-25 centimetres.

The indications can be expressed diagrammatically (Fig. 13). Those children whose age and inter-malleolar distance fall within the unshaded area can be expected to achieve correction following femoral stapling alone. Any child whose age and inter-malleolar separation place him within the shaded area should be treated by femoral and tibial stapling. The upper age limit for femoral stapling alone in girls is one year earlier than for boys because of their earlier epiphysial closure.

The temporary acceleration of growth following removal of the staples (Blount and Zeier 1952) occurred in all the patients in the present series. Fortunately, once this period has passed, skeletal growth then proceeds symmetrically, and in none of our patients was there a significant recurrence of deformity.

Although the operation is virtually free from complication, its most obvious disadvantage is its tendency to produce ugly scars. This is a feature of most incisions around the knee in this age group, and the tendency of the scars to spread and to become conspicuous appears to be independent of the placing or direction of the incision. With practice it is possible to carry out the operation through a small accurately placed incision, so that the scarring can be minimised, but this problem remains, and warrants further study. It may be that subcutaneous sutures or post-operative immobilisation will help in this respect.

From the results of this retrospective survey epiphysial stapling has proved to be a safe, effective and predictable operation.

REFERENCES