Idiopathic genu valgum treated by epiphyseodesis in adolescence

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Summary. *Twenty-three patients (13 boys and 10 girls) with the adolescent type of genu valgum were treated by temporary medial epiphyseodesis of both distal femurs with Blount staples (46 knees); 5 also underwent stapling of the proximal tibia. Evaluation before the operation and during the follow up was based on growth charts, photographs and measurement of the intermalleolar distance. The indication for operation was increasing genu valgum with 10 cm or more of intermalleolar separation; the median distance before operation was 13 cm for boys and 12 cm for girls. The staples were removed after a median time of 11 months. At skeletal maturity the median intermalleolar separation was 3 cm for boys and 2 cm for girls. The median frontal angle before operation was 14° for boys and 6° at follow up, the corresponding figures for girls being 14° and 4°. In 2 cases the deformity recurred because the staples were removed too early. In another case a bony bridge formed after the staple was removed and a varus deformity developed; the bridge was resected and the knees became valgus again, but 1 cm of shortening remained on one side. There were no other complications.*

Résumé. *La correction du »genu valgum« de l'adolescent par agrafage temporaire. Vingt trois malades porteurs du »genu valgum« de l'adolescent ont été traités par épiphysiodèse partielle temporaire du fémur distal ou du tibia proximal, à*

l'aide d'agrafes de Blount. Le contrôle clinique pré et postopératoire a été fait au moyen de photos, de graphiques de la croissance et de mesures de l'écart intermalléolaire (DIM). Cet écart a été, en moyenne, de 13,0 cm pour les garçons et de 12,0 cm pour les filles, avant l'opération. Après l'opération l'écart a été de 3,0 cm pour les garçons et de 2,0 cm pour les filles. Dans 2 cas la correction n'a pas été totale et dans un autre, une barre osseuse qui est apparue, a été extirpée chirurgicalement, avec évolution favorable.

Introduction

Many healthy children present variations of the frontal angle of the knee, but most improve spontaneously with growth and do not need treatment [6, 8, 13, 15]. The expected correction may however not occur in a minority, or a child with a previously normal knee may develop an exaggerated valgus in adolescence [7] which, if not corrected, will persist throughout life [9, 12]. Temporary partial medial epiphyseodesis is an option for correction which can be achieved using metal staples [1, 7, 9, 11, 12, 16]. Growth is arrested on the medial side allowing the opposite side to grow normally, thus straightening the knee; the staples can then be removed.

Many reports discuss the treatment of valgus and varus deformities, but do not distinguish idiopathic cases from those due to miscellaneous conditions [4, 5, 9, 17].

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Fig. 1A–C. Anteroposterior radiographs showing typical progress of adolescent genu valgum. (A) The frontal angles were 17° before treatment. (B) The angles had decreased to 8° at 5 months after partial medial epiphyseodesis, and (C) were 6° at skeletal maturity

We have carried out a prospective study which included only those patients with idiopathic genu valgum who were treated by stapling.

Patients and methods

Twenty-three patients with adolescent genu valgum were treated by partial medial epiphyseodesis at the distal femur or tibia (46 knees) with metal staples. There were 13 boys with a median age of 14 years and 3 months (range 12 years to 15 years and 8 months), and 10 girls with a median age of 12 years (range 11 years to 12 years and 9 months); 17 were white and 6 were black.

The diagnosis was made in adolescence when there was bilateral, symmetrical and rapidly increasing genu valgum without any underlying abnormality. Four patients had the deformity since infancy and it had become worse during adolescence. All were photographed and had standing anteroposterior and lateral radiographs. The longitudinal axes of the femur and tibia were traced and the angle between them was taken as the frontal knee angle. The distance between the medial malleoli was measured clinically with the patient lying down; the limbs positioned symmetrically with the medial femoral condyles touching.

Stapling was carried out with 3 metal staples during the growth spurt when the intermalleolar distance was 10 cm or more.

Technique of operation [1]. Under general anaesthesia, the medial periphery of the growth plate was identified with a needle using an image intensifier. The needle was kept in place as a guide throughout the operation. The incision was transverse in 10 knees and oblique along the medial border of vastus medialis in 36. The periphery of the growth plate was approached and 3 Blount staples driven into the bone 1 cm apart. Care was taken to ensure that the staples were well centred in the periphery of the physis. Their position was checked with the image intensifier and a radiograph taken. The

wounds were closed in layers using an intracuticular stitch for the skin.

Five patients who were nearing the end of growth and who had 16 cm or more of intermalleolar separation had in addition stapling of the medial side of the proximal tibial epiphysis.

Knee motion and early walking were encouraged after the operation. The follow up was at intervals of from 2 to 6 months and the intermalleolar distance was recorded. In 15 cases stature was also measured at each visit and a graph was drawn plotting intermalleolar distance against stature. Radiographs were not taken routinely.

In most patients the staples were removed when the intermalleolar distance was zero or when there was slight overcorrection [14].

The median follow-up was 36 months; it was until the end of growth in 16 patients and in 7 to the complete closure of the growth plates. Photographs and radiographs were taken at this stage. The author examined all the patients during treatment and follow up, and made all the measurements.

Results

The median intermalleolar distance before operation was 13 cm (range 10 to 21 cm) in boys and 12 cm (range 10 to 21 cm) in girls. The final result was a mean intermalleolar distance of 3 cm in boys (range 0 to 8 cm) and 2 cm (range 0.5 to 5 cm) in girls. The median frontal angle before operation was 14° for boys and 6° at follow up; the corresponding figures for girls being 14° and 4°. Figure 1 shows a typical result. In most cases correction followed the increase in stature (Fig. 2). The staples remained in place for a median time of 11 months (range 8 to 15 months). In nearly every case there was a rebound effect that was greatest

Fig. 2. Growth chart of a patient showing a reverse relationship between the intermalleolar distance and stature after epiphyseodesis. The staples did not need to be removed

Fig. 3. After medial femoral epiphyseodesis, there was rapid correction of the valgus, indicated by the decrease in the intermalleolar distance. There was slight overcorrection, but after the staples were removed the rebound effect resulted in a separation of 2 cm at the end of growth

after the staples were removed, but slowed down in the following months (Fig. 3).

Growth continued unexpectedly in 2 patients; the intermalleolar distance was zero when the staples were removed, but further growth resulted in a recurrence of valgus with 7 cm of separation in one and 8 cm in the other (Fig. 4). In 6 cases, the staples did not need to be removed because the correct alignment had been achieved at the end of growth.

One patient had a second operation to replace 2 loose staples. The staples were inserted too deeply in one of our early cases, and the peripheral growth plate was injured during their removal. As a con-

Fig. 4. In this case the staples were removed too early, and the deformity recurred

Fig. 5. The intermalleolar distance was zero in this case 11 months after epiphyseodesis. The staples were then removed, but a bony bridge subsequently developed and was associated with a progressive varus deformity. The bridge was resected and the knees became valgus with 2 cm of intermalleolar separation

sequence, medial bony bridges formed on both sides with a progressive varus deformity. The bridges were resected at a further operation and the alignment became valgus, but there was slight asymmetry with 1 cm of shortening on the right side (Fig. 5).

There were no cases of infection or limitation of joint motion. The scar was insensitive in 7 cases. Healing was best when an oblique incision was used.

Discussion

These results showed that partial epiphyseodesis provided effective correction of the symmetrical valgus deformity with few complications, and normal physical activities could be resumed while correction was occurring. The temporary growth arrest on the medial side allowed normal growth on the lateral side to continue and produce the desired correction. The indications for the procedure must be exact and moderate [10], and close observation is needed during the follow up period [14]. Most of the reported complications can be avoided with a careful technique.

The optimum ages for the operation are between 11 and 13 years in girls and 12 to 14 years in boys and leaves sufficient time for correction to occur [2, 10]. If stapling is undertaken earlier, the remaining growth is difficult to predict and there is a higher rate of recurrence [10, 11].

The degree of the deformity can be expressed by either the intermalleolar distance or by the frontal angle drawn on radiographs. The former is easy to measure and we have demonstrated that it is better correlated with the appearance of the knee and has smaller errors [15]. Intermalleolar separation of 10 cm is ugly and is the time to carry out the correction with the minimal age of 11 years for girls and 12 years for boys.

The two recurrences in this series are explained by too early staple removal. Two methods of trigonometric estimation have been described to enable the appropriate time to be calculated to perform epiphyseodesis so that correction is accomplished by the end of growth and the staples do not need to be removed [3, 11]. Both methods are based on determining skeletal age using Greulich and Pyle's atlas which is not valid for Brazilian people [16]. Consequently, we prefer to use growth charts and the intermalleolar distance to decide the best time to carry out the procedure and to remove the staples, but in some individuals the prediction of the remaining growth may be difficult and the estimated final correction may not be fully achieved.

The periphery of the growth plate must not be disturbed. The staples are inserted without stripping the perichondrium and periosteum, and their cross-bar placed so that it just touches the cartilage surface. The same careful technique must be followed when the staples are removed so as to avoid the formation of bony bridges. A small skin incision may be used, but even so the scar may be

conspicuous and unsightly [12]. The appearance was better in our cases when the incision followed the border of the vastus medialis muscle, and gentle retraction is also important.

Correction of excessive genu valgum during adolescence can be achieved by medial epiphyseodesis, but a careful technique and close follow up are important if complications are to be avoided.

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