OBSERVATIONS ON THE ETIOLOGY OF TIBIA VARA

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Varus deformity at the upper end of the tibia was reported by Erlacher (1922) and Lülsdorf (1931), who considered it to be a type of osteochondritis. Blount (1937) presented a personal series of thirteen cases and reviewed fifteen cases from the literature. He called the condition tibia vara and suggested that the term osteochondrosis was more appropriate than osteochondritis. Further reports of single or small numbers of cases were followed by a review of twenty-three cases by Langenskiöld (1952). Altogether nearly 100 cases have been published (Gailey 1956). This paper reviews a personal series of thirty-one cases, twenty-eight in infants and three in adolescents. Tibia vara seems to be particularly common and severe in the West Indies. In this series, unlike those of Blount and of Langenskiöld, the condition affected boys (seventeen) more commonly than girls (eleven).

Tibia vara is characterised by a failure of growth localised to the postero-medial part of the upper tibial metaphysis and epiphysis. The growth of the epiphysial cartilage as well as that of the metaphysis and the epiphysis is disturbed, with consequent angulation of the tibia at the upper epiphysis which may, in untreated cases, produce bizarre deformities.

It is always the postero-medial part of the epiphysial line which is affected, so that three deformities are produced: 1) Severe varus; 2) severe medial torsion of the tibia; and 3) a variable degree of flexion of the diaphysis on the upper tibial epiphysis.

The condition was grouped by Blount (1937) into an infantile type which occurred in the first year or so of life, and an adolescent unilateral type which appeared between six and thirteen years and never reached great severity. In this series there were twenty-eight cases of the infantile type and three cases of the adolescent type, which is relatively fewer than those presented by Blount (1937) who had twenty cases of the infantile type and nine of the adolescent. Langenskiöld (1952) presented seventeen of the infantile type and six of the adolescent. Our three cases of the adolescent type show no remarkable features and will not be discussed further.

CLINICAL FEATURES OF THE INFANTILE TYPE

In this series there were seventeen boys and eleven girls. In both Blount’s and Langenskiöld’s series there was a preponderance of girls, Blount reporting seventeen girls to two boys and Langenskiöld eleven girls to six boys.

The children are usually brought by their parents on beginning to walk at about ten to twelve months. Except for the marked varus and medial torsion of the tibiae no associated abnormality, such as rickets, yaws or syphilis, has been seen. In twenty-three of our patients the deformity was bilateral and in the remaining five the left leg only was affected. All the patients had been bow-legged from the time they first began to stand.

At this stage it is difficult to decide whether the condition is simply a severe “physiological” bowing of the legs which may straighten spontaneously, or tibia vara which will steadily progress. There have been reports of the condition in several members of one family (Tobin 1957) and we have observed this on one occasion.

The radiographs may be helpful in the early state, for there is usually an irregularity of the entire ossific zone of the metaphysis. A little later islands of calcified tissue may appear which are separated from the metaphysis by clear zones. The medial part of the epiphysis is poorly developed and a beak appears on the postero-medial aspect of the metaphysis.

These changes are progressive. By four years of age a depression is present in the metaphysis which has been shown to be occupied by cartilaginous tissue. The metaphysis
begins to slope distally away from the joint to end in an enlarging "beak" which is palpable clinically and visible radiologically. The lateral view may show a dense line convex downwards representing the depression in the metaphysis proximal to the beak.

The differential diagnosis is not difficult. Systemic disease such as vitamin D resistant rickets should be excluded. The history will exclude injury, infection or previous radiotherapy (Langenskiöld and Edgren 1950). The radiological appearance will exclude the similar but bilaterally symmetrical deformity of gonadal dysgenesis (Kosowicz 1960).

The main difficulty in early diagnosis of tibia vara is from the "physiological" bow leg of the newborn which tends to persist (Blount 1941, Forrest 1949, Leonard and Cohen 1946). In fact, it is impossible to differentiate between tibia vara and an unusually marked "physiological" bow leg when the infant is first seen. Nevertheless, a palpable beaking of the medial tibial condyle, particularly if seen radiologically with an accompanying irregularity of the epiphysial line, makes the diagnosis of progressive tibia vara probable, and further examinations at intervals of six months will make it obvious.

By the age of six it appears radiologically that the medial half of the upper tibial epiphysis is fitting into the step in the metaphysis, which causes an apparent widening of the medial joint space of the knee. Cases have been recorded in which, even as late as this, some spontaneous improvement occurred. In these rare cases the final state resembles that of the adolescent type. In this series spontaneous regression has not been observed, and there has been a steady increase of the deformity, most marked at the medial tibial condyle which slopes from the intercondylar notch distally towards the beak. By the age of eight the patient has a varus deformity of over 15 degrees and this may increase to as much as 60 degrees by the time that growth finishes (Fig. 1). Radiological and histological examinations show that the epiphysial line is usually double on the medial side.

About the time of puberty the whole epiphysial plate begins to fuse on the medial side while the lateral half continues to grow, thus continuing to increase the deformity (Fig. 2).
Our older patients showed considerable ligamentous laxity and the development of osteoarthritis in the early twenties. Our oldest patient was thirty-eight and suffered crippling osteoarthritis.

**TREATMENT**

It is now generally agreed that the treatment of tibia vara is by early osteotomy. This results in a remarkable regrowth of the medial epiphysial plate which radiologically returns to normal, after which growth proceeds normally.

When the deformity is less than 15 degrees the operation is not difficult. If the deformity is more than 15 degrees it is probable that a second osteotomy will be needed about a year later in order to get adequate correction, and if the deformity is more than 25 degrees it is unlikely that full correction will ever be obtained.

We have used a vertical incision two inches long, starting just distal to the head of the fibula. The fibula is divided obliquely well distal to the lateral popliteal nerve and the wound is left open. A second curved incision is made in the skin creases from the beak on the medial side of the tibial condyle to a point lateral to the patellar tendon. The metaphysial region is exposed subperiosteally and the osteotomy performed in a curved manner. This allows the diaphysis to move medially without the danger of slipping too far and producing a pressure sore, and prevents excessive angulation of the fibula which might damage the lateral popliteal nerve. The deformity is corrected as far as possible, particular attention being paid to reducing as much of the medial rotation deformity as possible. The divided fibula is inspected to ensure that the fragments have disengaged. After the wound has been closed a full length plaster spica is applied to hold the osteotomy securely.

In our cases and those of Langenskiöld adequate osteotomy performed before the patient was six and when the deformity was less than 15 degrees has resulted in cure. The epiphysial line returns to normal, the beaking disappears and there seems to be no tendency to recurrence. However, when osteotomy has been inadequate the condition has recurred in three cases and a second osteotomy has been needed. The extraordinary recovery of the epiphysial plate has been observed by all authors and is the most remarkable feature of the condition. Our cases have been followed up for between two and seven years which is too short a time to be quite certain that late recurrence does not occur.

In patients with a deformity of 25 degrees or more the most one can hope to do is to improve the appearance.

Biopsy specimens have been obtained in six cases and have confirmed the findings of other workers that there is no evidence of disease, avascular necrosis or infection. They showed that the cartilage over the medial side of the epiphysial line, particularly in the area of the "beak," is grossly disorganised in pattern with irregular cartilage columns, the cells in some areas being hypertrophic, in others almost non-cellular fibrocartilage.

**ETIOLOGY**

Langenskiöld (1952) concluded that tibia vara was "a disturbance of growth, maturation and ossification" but that "our present knowledge of the mode of reaction of epiphysial cartilage to different injurious factors is not sufficient to allow conclusions on the basis of histological findings."

We have obtained additional information, not on the histological changes which show no difference from those previously reported, but on the behaviour of the epiphysial cartilage in our patients: 1) The condition is particularly common and particularly severe in the West Indies and West Africa. 2) It appears early and progresses rapidly in Negroes and needs early surgical correction. 3) Osteotomy with adequate realignment of the tibia is followed by normal growth at the upper tibial epiphysis. 4) Similar changes in the upper part of the tibia have been seen after severe trauma (Fig. 3) and in rickets (Fig. 4), but only rarely occur.
in the lower femoral epiphysis, the outer side of which may occasionally be affected in genu valgum. 5) The ligaments around the knee, as judged by the degree of hyperextension that occurs normally, is greater in Negro children. 6) The Negro child stands and walks earlier than the European.

These last two observations imply that when a Negro child with “physiological” bow-legs begins to walk, more movement can occur between tibia and femur. A comparison of radiographs of the knees taken standing and lying down shows that when standing, the upper tibial epiphysis shifts a little laterally and at the same time the outer side of the knee joint opens (Figs. 5 and 6). The effect of this is that weight on the inner side of the knee does not meet the upper tibial epiphysis at a right angle but obliquely. The obliquity of this force will tend to displace the tibial epiphysis laterally.

If the trabecular pattern of the metaphysial region is examined it will be seen that in tibia vara the trabeculae curve medially to align themselves to the direction of the stress on them. At the same time the epiphysial line curves down so that it becomes at right angles to the stress upon it. This curving also has the effect of preventing any tendency of the epiphysis to slide laterally (Figs. 7 and 8). The direction of growth has now become directed not along the axis of the tibia but at an angle to it so that the medial side of the shaft becomes shorter than the lateral. A vicious circle is established because the effect of this alteration in growth is to increase the varus deformity. As soon as the direction of force across the epiphysial line is corrected by osteotomy the process is reversed and normal growth proceeds.

The increased incidence in Negroes is explained by the greater mobility of the knee and the fact that they walk earlier than Europeans.

This leaves the problem of why the great majority of children with bow-legs do not develop tibia vara. The usual response to the increased weight borne by the inner side of the knee in a child with bow-legs is a relative increase in the rate of growth of the medial femoral and tibial epiphyses. It is only where the loss due to change in alignment is greater than the effect of stimulation that tibia vara develops.

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**FIG. 3**

Figure 3—Traumatic separation of the upper tibial epiphysis in a child of four which had occurred eighteen months previously.

**FIG. 4**

Figure 4—Active rickets in a child of two and a half.
Figure 5—Radiograph in the recumbent position of the left knee of a child of three with physiological bowing.

Figure 6—The same child standing, showing the lateral shift of the upper tibial epiphysis and opening of the outer side of the knee. The epiphysis has remained horizontal.

Figure 7—Case of tibia vara in a child of five. Radiograph of the knee in the recumbent position.

Figure 8—The same child standing up, showing the movement of the epiphysis so that the articular surfaces of the medial compartment remain parallel.
SUMMARY

1. Twenty-eight cases of the infantile and three cases of the adolescent type of tibia vara occurring in West Indian Negroes are reported.
2. The condition is characterised by failure of growth of the postero-medial part of the upper tibial epiphysis.
3. The deformity produced is acute varus at the upper tibia with medial torsion and eventually flexion of the diaphysis on the epiphysis.
4. These deformities are considered to be due to a vicious circle set up by considerable alteration of the lines of force on the medial portion of the upper tibial epiphysial line.

REFERENCES