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VALGUS DEFORMITY AFTER FRACTURE OF THE PROXIMAL TIBIAL METAPHYSIS IN CHILDHOOD

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When a childhood fracture of the proximal tibial metaphysis with valgus dislocation is not anatomically reduced, a valgus deformity comparable with the angulation seen on the accident X-ray develops within a few weeks.
The angulation of the proximal tibia shows neither exacerbation nor regression, but in a number of cases correction of the mechanical axis occurs in the distal epiphyseal plate.

Key words: genu valgum; tibial fracture

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Fractures of the proximal tibial metaphysis, due to an injury which involves valgus dislocation, often lead to valgus deformity. Several explanations for this fact have been suggested: asymmetric stimulation of the epiphyseal plate (Cozen 1953, Blount 1954); endosteal callus formation in the fracture space (Lehner & Dubas 1954, Jackson & Cozen 1971); asymmetric damage of the epiphyseal plate with growth inhibition on the lateral side (Goff 1960); incongruity of tibial and fibular growth (Taylor 1963); early weight-bearing in a plaster cast leading to secondary valgus deformity (Pollen 1973); interposition of periosteum and pes anserinus in the fracture space (Weber 1977) and periosteal damage beneath the pes anserinus (Houghton & Rooker 1979).

The purpose of this retrospective study was to establish how often valgus deformity occurred after conservative treatment of fractures of the proximal tibial metaphysis, when it developed, and whether spontaneous correction occurred during growth.

PATIENTS AND METHOD

Between 1971 and 1978, 390 children with lesions of the proximal tibial metaphysis and tibial diaphysis were treated in the Groningen University Hospital. There were 13 children with fractures of the proximal tibial metaphysis, associated with valgus dislocation in 10 and without axis deviation in 3. When an axis deviation was present, an attempt was made to correct it atraumatically. The fractures were immobilized in a long circular cast for 6 to 8 weeks. Anteroposterior and lateral X-rays of the lower leg were obtained in the course of treatment. On the anteroposterior X-rays, the angle between the epiphyseal plate and the tibial shaft (the plate-shaft angle = PS) below the original fracture site was measured (Figure 1A). The fracture site was identifiable, after consolidation, by local sclerosis at the level of the medial cortical layer. The complementary angle to the angle between the epiphyseal plate and the tibial shaft (complementary plate-shaft angle = cPS) is a measure of the axis deviation in the proximal tibia (Figure 1A). In the follow-up, teleroentgenography was performed while rotation of the legs was carefully avoided. On these X-rays the cPS was measured both on the left and right legs, and the difference between the two angles (cPS at follow-up = cPS_{FU}) was calculated. In addition, the angle between the mechanical femoral and tibial axes was measured on the left and right legs (Figure 1B) and again the difference between the two angles (valgus at follow-up = $valgus_{FU}$) was calculated. The data for these patients are presented in Table 1.

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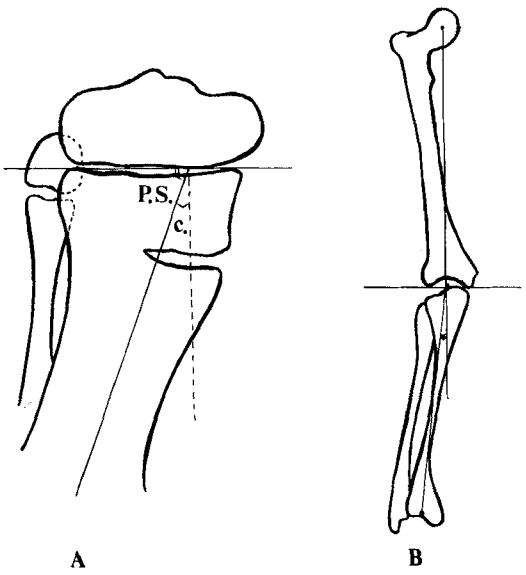

Figure 1A. Drawing of a fracture of the proximal tibial metaphysis with valgus deformity. PS: angle between growth plate and tibial shaft below the fracture site. cPS: complementary angle, which is a measure of the axis deviation in the proximal tibia.

Figure 1B. Angle between mechanical femoral and tibial axes.

RESULTS

One patient (case 9) died from a head injury a few days after the accident. In three cases (cases 11, 12 and 13), the accident X-rays revealed no angulation. The fracture ends showed good contact of compact bone on the medial side and no valgus deformity developed in these cases (mean duration of follow-up: 5 years and 7 months). In the remaining 10 cases the accident X-rays showed valgus dislocation (Figure 3), while in 5 cases a fibular greenstick fracture was seen as well. (This, however, exerted no influence on the development of the deformity.) The valgus deformity on the accident X-rays (cPS at injury = cPS_{inj}) ranged from 4° to 16°.

In most cases, some axis correction was achieved by application of the plaster cast (cPS at reposition = cPS_{rep}), but anatomical reduction was not achieved in any of the 10 cases; the fracture ends were still apart on the medial side. After a period of immobilization in a plaster cast the valgus deformity (cPS after immobilization = cPS_{imm}) was again as pronounced as on the accident X-ray. The maximum return to the original

Table 1. Data for 13 patients with fractures of the proximal tibial metaphysis

Case no.	Sex	Age at injury (years)	cPS_{inj}	cPS_{rep}	cPS_{imm}	cPS_{FU}	$valgus_{FU}$	$time_{FU}$ (years)
1	m	9	7°	5°	5°	5°	3° (2)	10
2	m	13	4°	2°	4°	4°	0° (4)	9
3	f	6	4°	4°	4°	4°	4°	8
4	m	5	12°	8°	12°	12°	12°	8
5	m	5	6°	5°	6°	6°	0° (6)	7
6	f	6	16°	4°	16°	16°	12° (4)	4
7	m	3	10°	5°	10°	10°	0° (10)	3
8	m	6	7°	6°	6°	6°	6°	2
9	m	8	10°	6°				
10	f	6	5°	5°	5°	Refracture after 5 months		
11	m	2	0°	0°	0°	0°	0°	4
12	m	1	0°	0°	0°	0°	0°	7
13	f	2	0°	0°	0°	0°	0°	6

cPS = complementary plate-shaft angle
inj = at time of injury
rep = after reposition
imm = after immobilization
FU = at time of follow-up
valgus = angle between mechanical femoral and tibial axes
(·) = correction of the mechanical axis

Figure 2. Case 6: persistent valgus deformity (12°) in the proximal tibia, with 4° correction in the distal epiphyseal plate, causing an S-shaped tibia.

valgus deformity was measured within 3 weeks. The PS remained unchanged during a follow-up period of an average of 6½ years (range: 2–10 years). In five cases, however, correction of the mechanical axis occurred in the distal epiphyseal plate, which in three cases was complete. As a result, the tibia assumed an S-shape on the X-ray (Figure 2). Tibial overgrowth ranging from 0.5 cm to 1 cm was measured in all cases. Refracture (Figure 4) occurred in one case (case 10, Figure 3). In this case, a gap on the medial side persisted throughout treatment (Figure 4). Open reduction after refracture revealed interposition of periosteum and pes anserinus in the fracture space. The valgus deformity present before refracture persisted. The patient complained about the lateral aspect of the knee and the parents, moreover, had cosmetic objections. Temporary epiphysiodesis according to Blount was therefore performed on the medial side. The same procedure was carried out for the same reasons in three other cases (cases 4, 6 and 8).

DISCUSSION

The fact that complete reposition could not be achieved is probably explained by interposition of soft tissues (Weber 1977), as observed in the patient with the refracture. The return to the original valgus deformity within a few weeks can be explained by the resilience of the soft tissues compressed during fracture reduction. That this takes so little time is an argument against asymmetric stimulation or inhibition of the epiphyseal plate as a possible cause of the valgus deformity. The proximal tibial epiphyseal plate lacks the potential to correct the axis deviation in the proximal tibia. In a number of cases there was correction of the mechanical axis in the distal epiphyseal plate.

In this respect the distal epiphyseal plate obeys the law of Pauwels (1940), which states that a weight-bearing growth plate arranges itself perpendicular to the direction of the load, thus causing realignment. Our data provide no explanation for the fact that no correction occurred in the other cases.

Valgus deformity develops when conservative treatment of childhood fractures of the proximal tibial metaphysis fails to lead to reposition with adequate compact bone contact of the fracture ends. Within a few weeks the valgus deformity is as marked as that measured on the accident X-ray, and subsequently it remains unchanged. It cannot be predicted in which cases correction of the mechanical axis will occur in the distal epiphyseal plate, and whether this will be complete. In four of the nine patients with valgus deformity, correction by temporary epiphysiodesis was required. In one case, open fracture reduc-

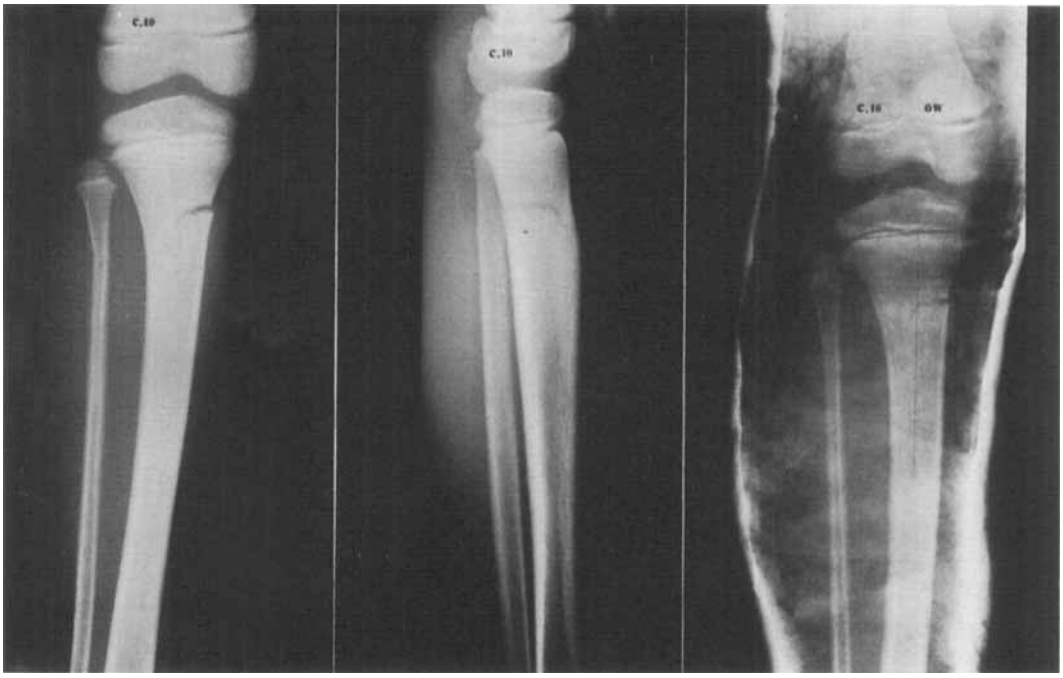

Figure 3. Case 10: fracture of the proximal tibial metaphysis with fibular greenstick fracture and valgus deformity. On the left: anteroposterior projection. Centre: lateral projection. On the right: after reduction and plaster cast immobilization. No adequate compact bone contact between fracture ends on the medial side after reduction.

Figure 4. Case 10. On the left: after consolidation a gap is still discernible on the medial side. Centre and right: refracture occurred after 5 months. Operation revealed interposition of periosteum and pes anserinus in the fracture space.

tion was performed after refracture. Whenever closed reduction fails to achieve anatomical reposition, surgical reduction should be considered.

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