

Sophies Minde Orthopaedic Hospital, University of Oslo, Norway.

GENU RECURVATUM

A Late Complication of Tibial Wire Traction in Fractures of the Femur in Children

INGJALD BJERKREIM & PÅL BENUM

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Genu recurvatum developing as a late sequela after tibial traction has scarcely been mentioned in the literature reviewed. The purpose of the present paper is to draw attention to this late complication by referring to several cases treated over the past ten years.

MATERIAL

The material consists of seven cases, five boys and two girls, who had been treated for fracture of the femoral shaft, three on the right side and four on the left side. The relevant data are given in Table 1.

The age of the patients when the fracture occurred varied between 9 and 14 years. Wire traction was used for 10 to 14 weeks, the duration of the traction being unknown in one case. Complications developed in five of the cases. One had a severe infection which delayed union and led to a 5.6 cm shortening of the femur. In two cases angulation occurred and corrective osteotomies were performed 10 and 20 months after the accident, respectively. Furthermore, two patients slipped and re-fractured when allowed up on crutches.

In none of the cases is there any information of early complications due to the wire. During the first few years following the fracture, and wire traction, all but the youngest patient developed symptoms in the knee region; viz. pain, fatigue, weakness, or impaired function.

RESULTS

On clinical examination a characteristic recurvation deformity of the upper end of the tibia was found in all cases (Figure 1). A distinct increased extension mobility was observed in the knee joint, and the flexion mobility was somewhat reduced as compared with the normal side. A slight increase in the valgus of the knee joint was apparent in five of the cases. Leg shortening was found in all cases, both in the femur and in the tibia.

Figure 1. Boy, 16 years old, with the characteristic recurvation deformity of the upper end of the tibia.

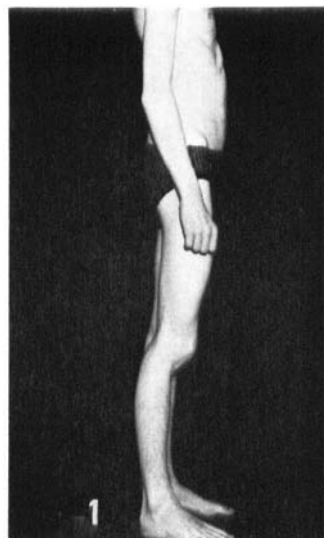


Figure 2. a. The left knee of a 16-year-old girl showing the forward tilting of the upper tibial joint surface and the atrophy of the tibial tuberosity 5 years after tibial wire traction.

Radiograms showed in all cases a forward tilting of the upper tibial joint surface (Figure 2, a and b). The anterior angle between the joint surface and the longitudinal axis of the tibia was reduced from the normal 93–97° (von Lanz & Wachsmuth 1938) to 71–85°. Moreover, in all cases a marked atrophy of the tibial tuberosity region had occurred. A premature fusion of the anterior part of the epiphyseal plate of the affected knee was observed in patients with an epiphyseal plate which was still visible (Figure 3 a). The tilting increased with growth.

Figure 2. b. The normal right knee of the same patient.



Figure 2. c. The left knee after corrective osteotomy.

Table 1. Survey of seven cases of genu recurvatum treated in Sophies Minde Orthopaedic Hospital (SMOH).

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Age (years) when fracture occurred	11	10	12	13	9	14	9
Duration of wire traction (weeks)	12	12	14	10	unknown	12	12
Age when admitted to SMOH (years)	16	20	16	21	16	34	11
Hyperextension mobility (degrees)	25 (5)*	20 (5)	25 (3)	25 (5)	15 (5)	15 (5)	15 (5)
Flexion mobility	145 (170)	125 (150)	reduced 10	reduced 10-15	135 (135)	unknown	unknown
Tibial level angle	75 (98)	73 (94)	71 (93)	77 (94)	75 (92)	85 (94)	85 (93)
Tuberosital atrophy	+	+	+	+	+	+	+

• Figures applicable to the normal side are given in brackets.

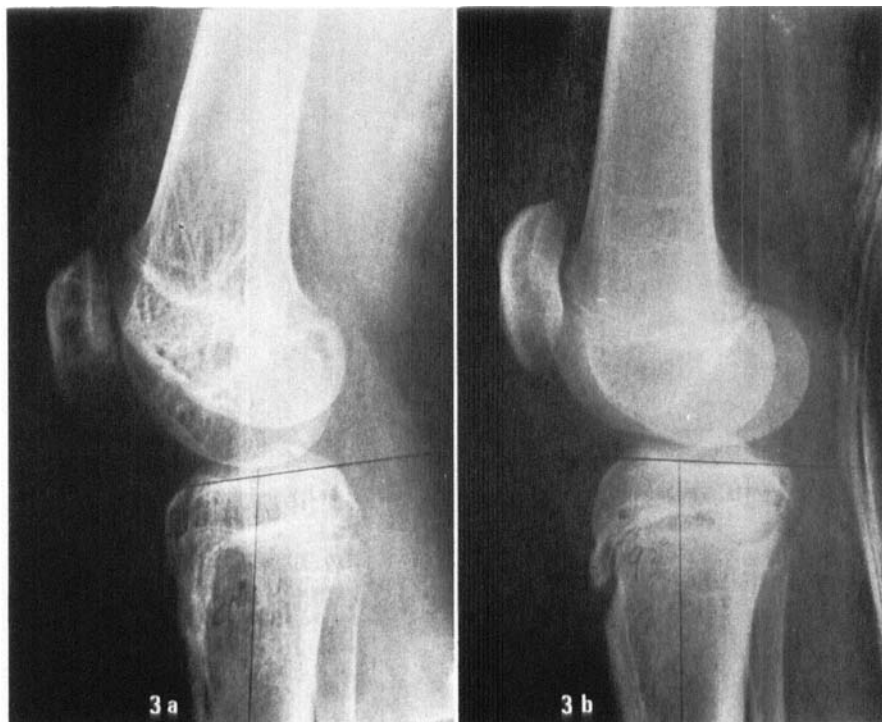


Figure 3. a. The right knee of a boy, 14 years old, treated with tibial wire traction 2 years earlier. The epiphyseal plate is closed beneath the tibial tuberosity, but is still visible in the posterior part.

b. The x-ray of the normal left knee of the same patient shows the anterior part of the epiphyseal growth plate running distally beneath the tibial tuberosity.

A wedge osteotomy (Figure 2 c) was carried out in the upper part of the tibia in six cases in order to re-establish the normal tibial level angle. To minimize limb shortening a wedge of homologous bone was inserted anteriorly in five cases, and in one case a dorsal wedge was removed. The osteotomy was secured with staples or plates. The final clinical and radiographical result has been satisfactory in all cases. The bowed tibia of the latest patient, recently admitted at an age of 11 years, will presumably have to be corrected in the future.

DISCUSSION

The seven cases of genu recurvatum reported here were all observed in patients who had been treated at the age of 9 to 14 years with wire

traction through the proximal end of the tibia, over a period of several weeks. The forward tilting of the joint surface of the tibia indicates that the deformities have been caused by premature closure of, or by retarded growth within, the anterior part of the epiphyseal plate. This view was also confirmed by the observation of a premature ossification of the epiphyseal plate of the affected knee in patients with still visible epiphyseal plates.

When considering the possible mechanism of such a growth disturbance, it should be emphasized that the anterior part of the epiphyseal growth plate runs distally beneath the tibial tuberosity (Figure 3 b). Within the latter a tongue-like projection of the ossified area of the proximal epiphysis is seen during childhood from eight years onwards; occasionally also an additional centre of ossification appears within the tuberosity. The tongue-shaped process of the tibial epiphysis and the separate ossicle fuse to the metaphysis, normally at the age of 15 in girls and at the age of 18 in boys (Flecker 1942). The anterior part of the growth plate can therefore be damaged if a traction wire is placed too close to the tibial tuberosity, it being a well-known fact that such wires easily migrate some distance during traction.

It might be inferred that a traction wire would most likely damage only a small part of the growth plate underneath the tibial tuberosity. Hence also the growth disturbance would very likely be located only in the lower part of the epiphyseal region and not give rise to severe angular deformation of the tibia. It has been reported, however, that angular deformation may occur when the growth plate underlying the tibial tuberosity is fused prematurely and spontaneously as a result of Osgood-Schlatter's disease (Stirling 1952, Jeffreys 1965). A similar deformity may also develop following transplantation of the tibial tuberosity in children with recurrent dislocation of the patella (Heywood 1961).

It has been shown experimentally that curetted or drilled defects of an epiphyseal plate are likely to be repaired by bone. The transepiphyseal bone plug thus formed connects the epiphysis to the metaphysis. The cartilage cells of the uninjured part of the growth plate continue to proliferate for some time but finally the proliferation ceases and even the adjacent part of the growth plate is replaced by bone in the same way as during fusion of epiphyseal plates by means of staples. The final cessation of the proliferation of the cartilage cells has in such cases been ascribed to increased pressure within the cartilage which is created by the fixation of the epiphysis to the metaphysis (Siffert

1956). Hence it seems reasonable that a fusion between only some parts of the apophysis of the tibial tuberosity and the metaphysis, caused by damage to the underlying growth plate by a migrating traction wire, would also result in a premature ossification of the adjacent parts of the epiphyseal plate. This could be the mechanism involved in the development of the recurvation deformities reported here.

Other pathogenetic mechanisms might be suggested. Thus local infection, although it is a relatively infrequent complication of wire traction (Dencker 1964), could at least be a contributing factor in the development of the growth disturbances. However, no sign of infection around the wire has been observed in the cases reported here. Furthermore, the epiphyseal plate is resistant to infection, and growth is not usually disturbed by infection on the metaphyseal side of the plate (Siffert 1957).

Premature fusion of the proximal tibial epiphysis has been observed following longlasting immobilization in tuberculosis of the hip (Gill 1944, Parke et al. 1949). However, such fusion, which in most cases is central and does not lead to recurvation of the knee, is unlikely to occur unless the period of treatment exceeds 2 years (Parke et al. 1949). Hence the immobilization alone can hardly be held responsible for the deformities following tibial wire traction, although five of the reported cases had been immobilized for some time in addition to the traction period.

Genu recurvatum frequently gives rise to considerable complaint. Accordingly our patients also suffered from pain, instability and weakness of the affected knee joint, and in six of the seven patients these complaints justified corrective osteotomy of the tibia. Recurvatum of the knee may also cause development of osteochondritis dissecans (Smillie 1962) and osteoarthritis. Although this deformity probably is a relatively uncommon complication of tibial wire traction, the serious complaints to which it may lead indicate that care should be taken to ensure that the wire is placed distal to the tibial tuberosity, when such traction is applied in children.

SUMMARY

Seven cases of genu recurvatum following wire traction through the proximal end of the tibia in children treated for fractures of the femur are reported. A premature closure of the anterior part of the growth plate was most probably caused by too close a proximity of the wire to

the tibial tuberosity. Where tibial wire traction is used in children it is advisable to insert the wire distal to the tuberosity.

Addendum

Since this report was written a similar case with bilateral knee recurvation has been treated in this hospital.

REFERENCES

- Dencker, H. (1964) Wire traction complications associated with treatment of femoral shaft fractures. *Acta orthop. scand.* **35**, 158-163.
- Flecker, H. (1942) Time of appearance and fusion of ossification centers as observed by roentgenographic methods. *Amer. J. Roentgenol.* **47**, 91-159.
- Gill, G. G. (1944) The cause of discrepancy in length of the limbs following tuberculosis of the hip in children. Arrest of growth from premature central closure of the epiphyseal cartilages about the knee. *J. Bone Jt Surg.* **26**, 272-281.
- Heywood, A. W. B. (1961) Recurrent dislocation of the patella. A study of its pathology and treatment in 106 knees. *J. Bone Jt Surg.* **43-B**, 508-517.
- Jeffreys, T. E. (1965) Genu recurvatum after Osgood-Schlatter's Disease. Report of a case. *J. Bone Jt Surg.* **47-B**, 298-299.
- von Lanz, T. & Wachsmuth, W. (1938) *Praktische Anatomie*. Julius Springer, Berlin.
- Parke, W., Colvin, G. S. & Almond, A. H. G. (1949) Premature epiphyseal fusion at the knee joint in tuberculous disease of the hip. *J. Bone Jt Surg.* **31-B**, 63-73.
- Siffert, R. S. (1956) The effect of staples and longitudinal wires on epiphyseal growth. An experimental study. *J. Bone Jt Surg.* **38-A**, 1077-1088.
- Siffert, R. S. (1957) The effect of juxta-epiphyseal pyogenic infection on epiphyseal growth. *Clin. Orthop.* **10**, 131-139.
- Smillie, I. S. (1962) *Injuries of the knee joint*, 3rd ed. Livingstone, Edinburgh and London.
- Stirling, R. I. (1952) Complications of Osgood-Schlatter's disease. *J. Bone Jt Surg.* **34-B**, 149-150.

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Correspondence to:
Ingjald Bjerkreim
Sophies Minde Ortopedisk Hospital
Trondheimsveien 132
Oslo 5, Norway