DEROTATION OSTEOTOMY TO CORRECT ROTATIONAL DEFORMITIES OF THE LOWER EXTREMITIES IN CHILDREN A COMPARISON OF THREE METHODS

J. MYLLE, J. LAMMENS, G. FABRY

Twenty-one supracondylar femoral and 11 tibial derotation osteotomies were performed in 17 patients to correct rotational deformities. Three different methods were used to fix the fragments after derotation : pins incorporated in plaster, plate and screws, and the Ilizarov external fixator. A retrospective review showed no difference in accuracy of derotation between the three methods. However, we recommend the use of the external fixator because it gives less malunion and permits early mobilization and (partial) weight bearing.

Keywords : derotation osteotomy ; rotational deformity ; child ; lower extremity.
Mots-clés : ostéotomie de dérotation ; vices de torsion ; enfant ; membre inférieur.

INTRODUCTION

Torsional deformities in the lower extremities are a frequent cause of referal for orthopedic evaluation. They may be caused by increased femoral and/or tibial torsion. Increased femoral anteversion may be idiopathic or secondary (congenital dysplasia of the hip, cerebral palsy, Legg-Calve-Perthes disease). Increased internal torsion of the tibia is usually associated with talipes equinovarus (3, 9).

Measurement of torsion is possible clinically, by standard radiology and by computed tomography. In most patients, either spontaneous correction or compensatory tibial torsion develops within the first 8 years of life. Nonoperative measures have been shown to be no more effective than observation alone in correcting in-toeing resulting from increased femoral anteversion (5, 6).

Surgical correction is rarely indicated, only in severe functional and/or cosmetic disability without spontaneous correction of the deformity.

The aim of the present work was to compare the results of three fixation methods at the proximal supracondylar area of the femur and at the proximal and distal metaphyseal area of the tibia : pins-in-plaster, plate and screws, and external fixator.

MATERIALS AND METHODS

From 1980 to 1991, 21 patients underwent surgical correction for rotational deformities of the lower extremities. We reviewed 17 patients : 11 girls and 6 boys. Nine patients had cerebral palsy, 2 had talipes equinovarus and 6 had idiopathic toeing-in. Mean age at operation was 10 years (range 5 to 15). Pins in plaster were used in 11 derotations (8 femurs, 3 tibias), plate and screws in 8 derotations (5 femurs, 3 tibias), external fixations in 13 derotations (8 femurs, 5 tibias). Follow-up ranged from 1 to 10.5 years (mean 4 years). Data collected from clinical charts form the basis for the preoperative clinical measurement of femoral anteversion and tibial rotation. Radiographic anteversion was measured pre- and postoperatively using the Dunlap-Shands method (4). Preoperative CT-rotation studies were only available in 6 patients (fixator-group), so that they could not be used in this study.

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Surgical procedures

1. *Pins-in-plaster*

The technique was described by Hoffer *et al.* (7). Two Steinman pins are placed in the metaphyseal region of the distal femur (laterally) or distal tibia (anteromedially), well above the growth plate. The distance between the pins is about 3 cm ; the angle is the anticipated correction. Then the osteotomy is performed and correction achieved by bringing the two pins parallel. The pins are incorporated in a long leg plaster for at least 6 weeks.

2. *Plate and screws*

A lateral approach to the distal femoral metaphysis, an anteromedial approach to the distal tibial metaphysis and a lateral approach to the distal fibula is performed. The osteotomy is done 3 cm above the growth place. A 4- to 6-hole plate is applied after the appropriate derotation, which can be checked by temporary K-wires proximal and distal to the osteotomy. The wound is closed over a drain, and a cast applied for at least 6 weeks.

3. *External fixator (Ilizarov)*

Either a standard Ilizarov 4-ring frame is used, or the author's modification of 2 pairs of crossed Schanz screws are placed in the distal femoral metaphysis and/or proximal tibial metaphysis. The distance between the Schanz screws is about 5 cm. Two rings (or half rings) are applied. A small incision (± 1.5 cm) between the pins gives access to a chisel for the osteotomy in the flare of the bone at the supracondylar region of the femur, distally to the tibial tubercle in the tibia. The amount of derotation can be determined exactly on the rings by counting the holes. There is no need for a cast. Partial weight bearing is started after 4 weeks ; full weight bearing usually after 6 weeks.

RESULTS

All patients were reviewed by one of the authors and the following parameters were checked : patient (parent) satisfaction, gait, clinical anteversion and tibial torsion, radiological anteversion, healing of the osteotomy site. Finally, immobilization time and complications of the three groups were also compared.

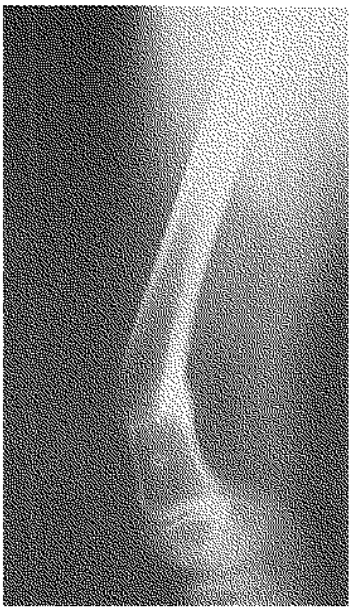

Fig. 1a

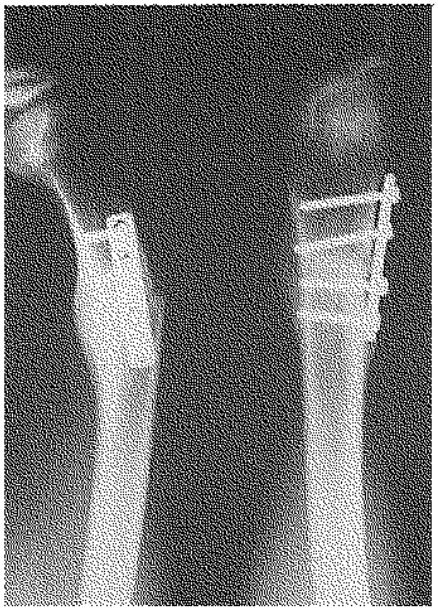

Fig. 1b

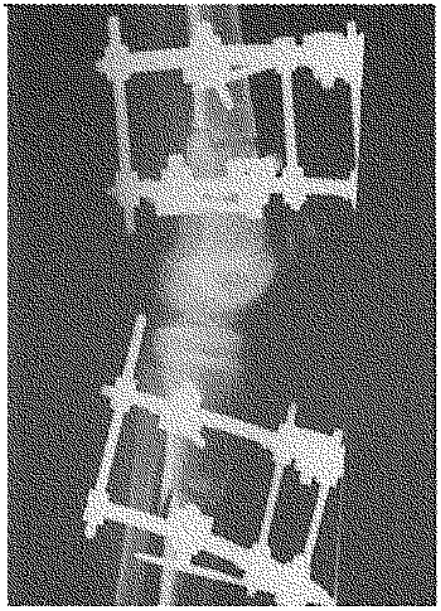

Fig. 1c

Fig. 1. — a) Supracondylar femoral osteotomy, 40° antecurvatum (pins-in-plaster group). b) Supracondylar femoral osteotomy, 30° antecurvatum (plate group), c) Supracondylar femoral osteotomy, good alignment (Ilizarov group).

All osteotomies healed well. All but 2 patients (parents) said the gait was markedly improved. The first exception was a patient with cerebral palsy in whom the femur was derotated with the pin-in-plaster technique. Associated neurological problems made it difficult to find the real cause of discontent. Clinical and radiological examination showed clear improvement ; the in-toeing probably was caused by muscle imbalance and/or abnormal pelvic rotation (1). The second patient was an otherwise healthy 13-year-old boy in whom both femurs and the right tibia were derotated with an external fixator. Clinical, radiological and CT-measurements showed a good objective result. However, he had persistent intermittent in-toeing especially during fast gait and running. No patient was worse after operation.

Clinical anteversion was measured by the amount of internal rotation of the hips (table I). The postoperative clinical anteversion was statistically not significantly different in the three groups.

Radiological anteversion, measured by the method of Dunlap-Shands, both pre- and postoperatively is shown in table II. Mean anteversion after correction is 22°, and again, no statistically significant difference could be found between the 3 groups.

Data about exact tibial torsion preoperatively were not available. We do know that in 9 of the 11 tibial osteotomies, there was a compensatory external torsion of the tibia. All 9 derotations resulted in an acceptable range of torsion (9° to 32°, with a mean of 20°). The other two were external derotation osteotomies for increased tibial endotorsion associated with talipes equinovarus (both pin-in-plaster). Clinical exorotation postoperatively was 50° and 60° respectively.

The postoperative rehabilitation scheme is summarized in table III. The external fixtor allows early ambulation.

Complications occurred in all groups. They are summarized in table IV. All superficial infections cleared with local care and oral antibiotics. The deep infection in the "plate-group" occurred after union of the osteotomy and was successfully treated by removal of the plate and intravenous antibiotics for 3 weeks. Malunion in the first two groups had a typical pattern : antecurvatum in the supracondylar region of the femur, retrocurvatum and valgus at the distal tibia. The deformity was worse in the pin group (maximum of 35°), than in the plate group (maximum of 15°). Although remodelling was always incomplete, there was no functional disability due to these malunions.

Table I. — Pre- and postop. clinical internal rotation

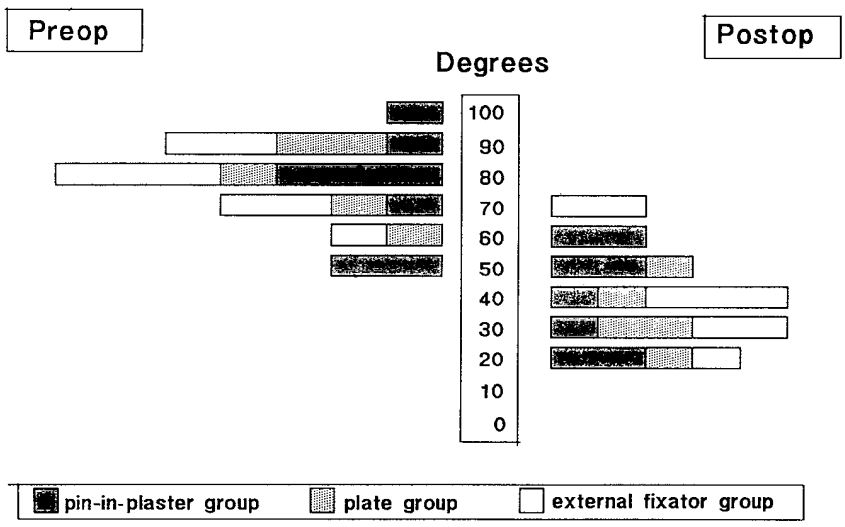

Table II. — Pre- and postop. radiological anteversion

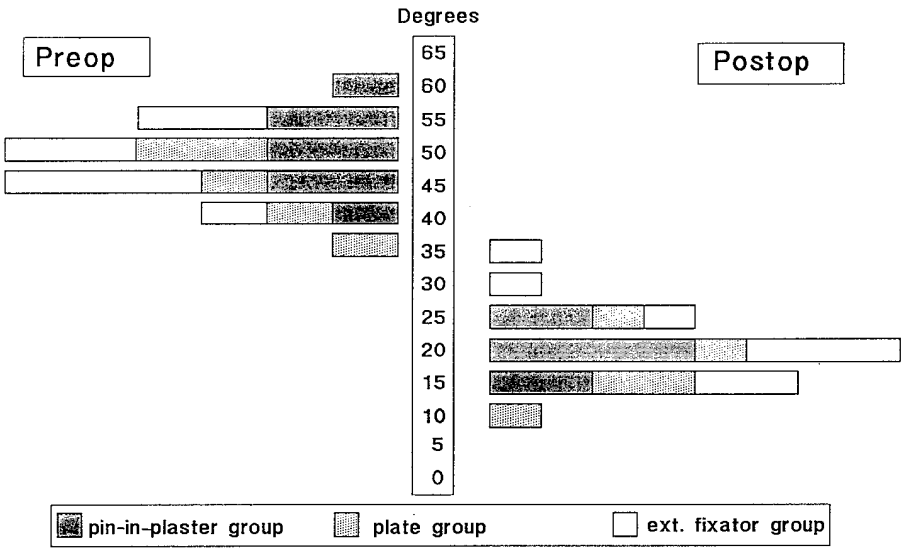

Table III. — Postop. rehabilitation

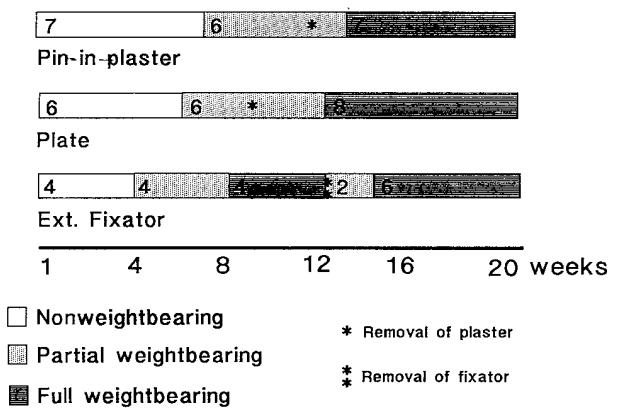

Table IV. — Complications

	Infection		Malunion	Neurol. deficit	Delayed union
	Superf.	Deep			
Pin-in-plaster	3		7		1
Plate		1	5	1	
Ext. fixator	3		1	1	1

Neurological deficit occurred twice. The first was in the plate group (plate to both femurs and tibias) : a common peroneal lesion which recovered partially. An interphalangeal fusion of the hallux was necessary to relieve symptoms. The second was a temporary deep peroneal paralysis in the external fixator group, which recovered spontaneously.

Delayed union occurred in one case in the pin group (24 weeks for a tibia) and once in the Ilizarov group (24 weeks for a tibia). There were no fractures and no vascular complications.

DISCUSSION

If one considers a derotation osteotomy to treat rotational problems in lower extremities in children, the following four questions have to be answered. An answer to the first three questions has been found in the literature. We have tried to provide an answer to the fourth.

1. Is an operation necessary ?

Because of the risk of complications and the tendency towards spontaneous regression of toeing-in due to femoral anteversion, mainly because of secondary changes in the tibia, most authors

recommend a much more conservative attitude with regard to operative treatment (11, 12). Besides, there is no proven correlation between increased anteversion and later osteoarthritis. Previously reported indications for surgery include anteversion of more than 45° to 50°, internal rotation more than 85°-90°, external rotation less than 20°, external tibial torsion less than 35° and functional and/or cosmetic disability (6, 11).

2. Can toeing-in be solved by derotation ?

Other causes of toeing-in must be ruled out : abnormal pelvic rotation, muscle imbalance (e.g. cerebral palsy), forefoot adductus. CT-scan has become invaluable for measurements of torsion of both femur and tibia, and is superior to both clinical and standard radiological measurements (9).

3. At what level should the osteotomy be performed ?

The femoral osteotomy can be done at three levels : intertrochanteric, subtrochanteric and supracondylar. The first has been abandoned by most surgeons because there is a considerable risk of damaging the apophyseal plate (10, 11). A subtrochanteric osteotomy should be performed if an additional correction of valgus or varus of the femoral neck or other (soft tissue) procedures around the hip joint are necessary. In all other cases, most surgeons prefer the supracondylar osteotomy because it is easier, allows more precise correction, causes less blood loss, and permits earlier ambulation (7).

However, it is contraindicated in a patient whose hip is unstable or when the femoral head is subluxed and/or in a valgus position.

The tibial osteotomy has been described at almost all levels. Although distal tibial osteotomy is advocated by many authors (1, 2, 8), we encountered many problems, especially malunion (4 cases in 6 osteotomies) and delayed union (1 case in 6 osteotomies). In our hands, proximal tibial osteotomy gives better control of the position of the fragments (no malunion) and less complications (1 delayed union/5 osteotomies). In one case, a lengthening procedure was associated using the proximal osteotomy for callostasis i.e. osteogenesis by distraction of callus.

4. What type of fixation should be used ?

We found no comparative studies in the Anglosaxon literature. The results of our retrospective study are in favor of the external fixator. All three methods (pin-in-plaster, plate and screws and external fixator) give a comparable predictable amount of correction. However, the external fixator gives less (serious) complications (table IV) and allows earlier ambulation (table III).

CONCLUSION

A derotation osteotomy to correct rotational problems of the lower extremities in a child is only necessary in exceptional cases where spontaneous correction does not occur. If required at the femur, we advocate a supracondylar derotation, fixed with the external modified Ilizarov fixator. If required at the tibia, we prefer a proximal tibial osteotomy fixed with a standard 4-ring Ilizarov frame.

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SMENVATTING

J. MYLLE, J. LAMMENS, G. FABRY. Derotatie-osteotomie bij de behandeling van rotatie-afwijkingen in de onderste ledematen. Vergelijking van drie methodes.

Eenentwintig supracondylaire femurosteotomies en elf tibia-osteotomies werden uitgevoerd bij zeventien patiënten ter correctie van rotatie-afwijkingen.

Drie verschillende fixatiemethodes werden gebruikt na derotatie : pinnen in gips, plaat met schroeven, Ilizarov uitwendige fixator.

Een retrospectieve studie kon geen verschil aantonen wat accuraatheid van derotatie betreft bij deze drie groepen. Onze voorkeur gaat echter uit naar de externe fixator gezien deze minder malunion geeft en een vroegere mobilisatie en steunname toelaat.

RÉSUMÉ

J. MYLLE, J. LAMMENS, G. FABRY. Traitement des vices de torsion des membres inférieurs par ostéotomie de dérotation. Comparaison de trois méthodes.

Vingt-et-une ostéotomies fémorales supracondyliennes et onze ostéotomies tibiales ont été effectuées chez dix-sept patients.
Trois méthodes de fixation ont été employées : broches incorporées dans le plâtre, plaque et vis, fixateur externe type Ilizarov.
Une étude rétrospective établit que le degré de dérotation obtenu par les trois méthodes est comparable. Notre préférence va au fixateur externe qui donne moins de cals vicieux et permet mobilisation et appui précoces.