THE MANAGEMENT OF TIBIAL TORSION IN
PATIENTS WITH SPINA BIFIDA

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We reviewed 20 patients with spina bifida who had had surgical management of tibial torsion. Eight had had bilateral procedures and 12 a unilateral procedure, giving a total of 28 limbs for analysis. We performed closed osteoclasis on seven limbs and tibial osteotomy on 21.

In the closed osteoclasis group six limbs (85%) had a good result after an average follow-up of nine years (2 to 22). All limbs developed postoperative anteromedial bowing of the tibia which later remodelled. In the tibial osteotomy group 19 (90%) had a good result. The average follow-up was nine years (2 to 28). Complications occurred in seven limbs (33%).

We recommend closed osteoclasis of the tibia for the young patient with spina bifida in whom walking is impeded by excessive internal tibial torsion, and supramalleolar tibial osteotomy in the older patient with excessive external tibial torsion and a planovalgus foot.

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The natural history of tibial torsion in normal children has been well described by Staheli et al (1985), but the data are not directly applicable to children with spina bifida. Such patients may develop either excessive internal tibial torsion or the classic triad of ankle valgus, external tibial torsion and genu valgum with fibular shortening, which is secondary to muscle paralysis (Makin 1965; Dias 1978).

Excessive internal tibial torsion may be dynamic, when it is secondary to an imbalance between the medial and lateral hamstrings, or fixed (Golski and Menelaus 1976). Excessive external tibial torsion is always fixed. It may be an isolated deformity or associated with ankle valgus, an abduction deformity of the mid-tarsal joint and a planus deformity of the medial longitudinal arch (Nicol and Menelaus 1983). These torsional deformities result in an awkward gait, excessive shoe wear, difficulties with orthotic fitting and secondary trophic ulceration of the foot.

Dynamic internal tibial torsion, with no associated fixed bony deformity, may be treated by transfer of either the semimembranosus and semitendinosus tendons or the semitendinosus tendon alone to the head of the fibula (Golski and Menelaus 1976; Dias, Jasty and Collins 1984). Fixed tibial torsion is usually corrected by a derotation osteotomy, but this procedure in children has been associated with significant complications in up to 35% of cases (Steel, Sandrow and Sullivan 1971; Mycoskie 1981; Van Olm and Gillespie 1984).

We could find no previous reports of the use of closed osteoclasis to correct excessive tibial torsion in patients with spina bifida. We therefore report its use to correct internal tibial torsion in such children.

PATIENTS AND METHODS

During the 31 years from 1960 to 1990, 26 patients with spina bifida had surgical correction of tibial torsion at the Royal Children's Hospital, Melbourne. One subsequently died and five could not be traced, leaving 20 (77%) for review. There were seven females and 13 males. Eight patients had had bilateral procedures giving a total of 28 limbs.

The neurological level of each limb was assessed according to the criteria described by Sharrard (1964), with minor modifications. At review, the rotational profile of each limb was recorded. The foot-progression angle was measured in those patients who were ambulant. Hip rotation, the thigh-foot angle, the transmalleolar axis, and the foot shape were recorded with the patient prone. Measurements that were within the rotational variations described by Staheli et al (1985) were accepted as normal. Union of the osteotomy site was defined as the time at which there was no pain or movement on stressing it and at which bony trabeculae were seen radiographically to cross the osteotomy site. Delayed union was defined as failure to unite by 16 weeks after surgery.

The results were graded according to the criteria of Dias et al (1984). A good result is complete correction of
the rotational malalignment associated with an overall improvement in gait. A fair result is less than 15° of residual in-toeing with an obvious improvement in gait. A poor result is persisting rotational malalignment and no improvement in gait.

Torsion had been corrected by closed osteoclasis in seven limbs and by tibial osteotomy in the other 21. These two groups are described separately.

Closed osteoclasis. All seven limbs had had internal tibial torsion ranging from 30° to 90°, associated with varying degrees of equinovarus deformity of the hindfoot and adduction deformity of the forefoot. Patients who were ambulant had an in-toed gait and tended to trip easily. At review all the patients were classified as community ambulators (Hoffer et al 1973). The average age at surgery was 21 months (16 to 28). Neurological levels were L4 in six and S1 in one.

Technique. The patient was under general anaesthesia and lay supine with the affected leg externally rotated. A padded osteoclasis wedge was placed under the mid-shaft of the fibula. The surgeon, with his arms extended and his hands over the metaphyseal portion of the fibula, to avoid physeal injury, then rocked up and down to fracture the fibula and the tibia. If the tibia could not be fractured, the leg was placed in internal rotation and the procedure repeated. The limb was then immobilised in an above-knee cast, with the normal thigh-foot angle restored, until bony union.

Tibial osteotomy. Before operation, there was external tibial torsion of 25° to 40° in 15 limbs associated with ankle valgus of 10° to 30° in 11 limbs, and with subtalar valgus or plano-abduction deformity of the foot in 12 limbs. Six limbs showed internal tibial torsion of 20° to 35°.

The average age at surgery had been nine years (20 months to 16 years). The neurological level was at L2 in one limb, L3 in four, L4 in 11, L5 in one and S1 in four limbs. At review 19 patients were classified as community ambulators, one as a household ambulator. One patient with an L2 neurological level, had been ambulant until the age of 21 years but had since been confined to a wheelchair.

Technique. A transverse tibial osteotomy was performed at the supramalleolar level in 17 limbs, at mid-shaft level in two and in the proximal tibia in two. An associated fibular osteotomy was performed in 12 limbs. The osteotomy was fixed by a staple in 14 limbs and by crossed Kirschner wires in four. In three limbs, Knowles pins were inserted into the proximal and distal fragments and incorporated into the cast to maintain the correction. Eleven limbs had an associated valgus deformity of the ankle of > 10°; in these limbs a laterally-based wedge was excised at the osteotomy site to correct the angulation.

Twelve additional bony procedures were performed for associated subtalar valgus deformity or for plano-abduction deformity of the foot. These were inlay triple arthrodesis (7), calcaneal osteotomy and heel shift for valgus deformity (3) and Grice subtalar arthrodesis (2); nine of the procedures were performed at the time of the tibial osteotomy.

RESULTS

The overall results were good in 25 limbs, fair in two limbs and poor in one. The neurological level of the limb is related to the type of tibial torsion in Table I.

| Table I. Relationship between neurological level and the direction of tibial torsion in 28 limbs |
|-------------------|-------|-------|-------|-------|-------|
| Neurological level | L2    | L3    | L4    | L5    | S1    |
| Internal           | 1     | 1     | 9     | 1     | 1     |
| External           | 4     | 7     | 4     |       |       |

Closed osteoclasis. Six limbs had a good result (85%) and one a poor result. The average follow-up was nine years (2 to 22). All the tibiae united within five to seven weeks. The distal tibial physes of one limb sustained a minimally displaced Salter-Harris 2 fracture, which healed uneventfully with no growth arrest (Salter and Harris 1963).

From the serial radiographs it was noted that all the fibulae had either plastic deformation or a greenstick fracture. By contrast, all the tibiae had complete fractures. After the osteoclasis, all seven tibiae showed anterior bowing of between 9° and 40°, but at review this had remodelled completely in six, and one tibia showed 20° of residual bowing. Five tibiae had a valgus deformity of 10° to 20° on the postoperative radiograph, and there was residual valgus of 10° to 15° in five of them at review. These valgus deformities were all localised to the mid-shaft of the tibiae and were not clinically evident.

Tibial osteotomy. Nineteen limbs had a good result (90%) and two a fair result. The average follow-up was nine years (2 to 28) and the average time to union was 16 weeks (8 to 39).

There were ten complications in seven limbs (33%), but although these led to increased morbidity, they did not compromise the final rotational alignment of the limb. There was delayed union in six limbs, the average time to union in these being 27 weeks (20 to 39). In four patients, an external fixator had been applied percutaneously, under radiographic control, to compress the osteotomy site. This resulted in union in all four cases without the addition of bone graft. There were three wound infections and one limb had unexplained swelling of the lower tibial region for six months after the osteotomy.

DISCUSSION

The natural history of tibial torsion in patients with spina bifida is not clear. Wright et al (1992), in a study of
alignment of the lower limb in these patients, have described a natural history of frontal-plane alignment which differs from that of normal patients. These differences may also apply to tibial torsion. The neurological level of the limb may also influence the direction of torsion, as is suggested by our results, and we are now analysing a larger group of patients with spina bifida in this respect.

Adverse long-term effects of idiopathic tibial torsion on the knee have been described, but the indications for surgical intervention have been limited (Turner and Smillie 1981; Staheli 1989). In an ambulant spina-bifida patient, excessive internal tibial torsion is associated with an in-toed gait; the patient tends to trip easily. Excessive external tibial torsion is often accompanied by progressive valgus of the hindfoot and mid-foot which cannot be controlled by an orthosis and results in a shuffling gait, excessive shoe wear and trophic ulceration over the medial aspect of the foot (Nicol and Menelaus 1983; Dias et al 1984).

For the patient with internal tibial torsion, twister cables may be used when the surgeon wishes to temporise. These may improve the gait while they are in use, but have no influence on fixed torsional deformity. The indications for the surgical treatment of tibial torsion in ambulant patients with spina bifida can therefore be more clearly defined; in our view this is indicated for fixed torsion when the symptoms mentioned above are present.

We found that closed osteoclasis was successful in six of the seven limbs in which it was used. This method is most applicable to patients under the age of two-and-a-half years, and has the advantages of simplicity, rapid union, and the absence of a surgical scar. The anteromedial bowing of the tibia which is produced usually remodels.

In older patients, derotation tibial osteotomy is the method of choice. There is a high complication rate, but the final result was satisfactory in all our patients. Osteotomy at the supramalleolar level has several advantages. It avoids the neurovascular complications seen in up to 29% of proximal tibial osteotomies (Steel et al 1971) and it also allows the simultaneous correction of ankle valgus or varus by the removal of an appropriate bony wedge. The surgical scar is less visible and fibular osteotomy is not always necessary.

For patients with dynamic internal tibial torsion, transfer of the semitendinosus tendon alone or the semitendinosus and semimembranosus tendons to the head of the fibula has been described, in an attempt to correct an imbalance between medial and lateral hamstrings (Golski and Menelaus 1976; Dias et al 1984). In the presence of a dynamic component, residual in-toeing has been reported after derotation tibial osteotomy when a simultaneous tendon transfer has not been performed (Dias et al 1984). In our series, however, of 13 limbs with internal tibial torsion, nine of which were at L4 level, giving hamstring imbalance, none had recurrence of internal tibial torsion after bone surgery without tendon transfer.

We conclude that tibial torsion which is producing symptoms in a patient with spina bifida can be treated effectively. We recommend closed osteoclasis for children under two-and-a-half years of age, and tibial osteotomy for older patients.

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REFERENCES


