Limb salvage in advanced chronic osteomyelitis in children

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Summary. *Chronic osteomyelitis of the entire tibial shaft was treated in 9 children by medical and surgical management in 3 stages. In stage 1, the involved shaft was excised with debridement of the periosteum. Stage 2 consisted of continuous suction-irrigation of the periosteal space with local and systemic antibiotics. In stage 3, the ipsilateral fibular shaft was transferred into the tibial periosteal envelope with the muscles of the middle third and its blood supply. After 18 months, the transferred fibula grew into a new tibia in every case so that the children were able to carry out all their activities of daily living. This method remains the best way of salvaging the limb when the entire tibia is involved.*

Résumé. *L'ostéomyélite chronique de la diaphyse tibiale (panostéomyélite du tibia) a été traitée sur neuf enfants par un protocole medico-chirurgical en trois stades. Le stade numero 1 consiste en une résection de la diaphyse tibiale et un débridement de l'enveloppe du périoste tibial. Le second stade consiste en une succion-irrigation continue de la gaine de périoste à l'aide d'un antibiotique approprié (local et par voie intraveineuse). Le troisième stade consiste en une transposition du même côté de la diaphyse du péroné dans l'enveloppe périostée du tibia tout en maintenant l'insertion musculaire dans son tiers moyen pour la vascularisation. Sur la totalité des patients le péroné ainsi transféré devient un nouveau tibia. Les auteurs*

pensent que cette méthode reste jusqu'à présent le procédé de sauvegarde du membre la plus pratique pour les enfants souffrant de pan-ostéomyélite chronique du tibia. Cette opinion est confirmée par de bons résultats prévisibles dans une période de dix huit mois.

Introduction

In chronic osteomyelitis affecting the entire tibial shaft, amputation may be the most decisive and cost-effective treatment. In children, there have been few reports of resection of the shaft sequester followed by reconstruction and a successful functional result [2, 5, 9].

Huntington introduced synostosis of the adjacent fibula to the proximal and distal remnants of the tibia in 1905 [1, 3, 7]. Since then this procedure has been used to compensate for tibial defects in adults [3, 4, 6, 9].

We present in this paper a 3-stage method of treatment of chronic osteomyelitis of the entire shaft of the tibia in children which salvages the limb within a predictable time frame.

Patients and methods

Between 1971 and 1974, 9 children with chronic osteomyelitis of the entire shaft of the tibia were treated by the same regimen; 5 were girls and 4 were boys with an average age of 7 years (range 5 to 9 years). The disease had been present for an average of 13 months (range 7 to 23 months) before our treatment began they all had from 1 to 8 discharging sinuses. Every patient had lost weight and had haemoglobin levels

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Table 1. Patient data

Case	Age at first operation	Age at follow-up	Sex	Side involved	Duration of symptoms/mos.	Number of sinuses	Hemoglobin Gm/dl AT	Years of follow-up
1	8	18	M	L	16	4	8.6	10
2	7	16	F	R	12	6	8.9	9
3	8	17	F	L	7	3	9.8	9
4	5	13	M	L	14	1	8.8	8
5	6	14	M	L	12	8	9.7	8
6	7	15	M	R	9	5	8.2	8
7	6	13	F	R	23	5	8.3	7
8	9	16	F	L	16	6	9.2	7
9	7	14	F	R	10	2	8.8	7
Average	7	15.11			13.22		8.9	8.11

varying from 8.2 to 9.8 mg/dl Table 1). They had some degree of limitation of joint motion in their knees, ankles and feet when they were first examined (Table 2).

The osteomyelitis was always blood born. *Staphylococcus aureus* was isolated from the sinuses in 7 cases, resistant to penicillin but sensitive to cephalothin which was given intravenously for 24 hours before operation and continued post-operatively. Kanamycin was used in the irrigation solution in every case. Repeated cultures in 2 patients failed to grow organisms, probably because of previous antibiotic therapy.

Management regimen

Stage 1. A longitudinal anterior incision was made and the sequestered tibial shaft excised. Necrotic bone and reactive tissue were removed and the proximal and distal metaphyses curetted down to bleeding bone. Suction-irrigation tubes were

placed within the periosteum which was closed with absorbable sutures. The skin and subcutaneous tissues were then closed with nonabsorbable sutures. A well padded long leg cast was applied with the knee and the ankle each flexed to 90°.

Stage 2. Systemic antibiotics were continued and local antibiotics were used until 3 negative cultures had been obtained from the drainage tubes.

Stage 3. At the end of stage 2, systemic antibiotics were continued and transfer of the fibula was carried out. Under general anaesthesia and using a tourniquet, the tibial periosteum was opened through the previous skin incision and the proximal and distal stumps exposed. The fibular periosteum was incised at its proximal and distal thirds through the same incision, leaving the middle third with the attached muscles intact and with their blood supply preserved. Osteotomy was performed at both metaphyses leaving the metaphyseal plates untouched. The two ends of the fibula were brought into the centers of the metaphyseal stumps. Proximal fixation was achieved by locking the end of the fibula into the center of the metaphysis and distally by an unthreaded Steinmann's pin that was drilled from the heel through the calcaneum, talus and tibial epiphysis into the medullary canal of the transferred fibula. The tibial periosteum and skin were closed. The pin was shortened and incorporated into a 90°/90° long leg cast.

The cast was changed at intervals and discarded when there was adequate bony consolidation. The leg was protected in a functional brace for up to 18 months when a strong tibia had developed. Physical therapy was needed for 4 to 6 months to restore joint motion and muscle strength.

Table 2. Range of motion at the start of treatment and at the last follow up

Case		Knee extension	Knee flexion	Ankle dorsi flexion	Ankle plantar flexion	Ever-sion	Inver-sion
1	Before	0	115	5	20	5	5
	After	0	130	15	30	10	20
2	Before	0	120	5	25	10	15
	After	0	125	15	30	10	25
3	Before	0	115	0	20	5	10
	After	0	130	10	30	10	25
4	Before	0	100	10	20	0	10
	After	0	115	15	25	10	20
5	Before	0	105	0	15	5	10
	After	0	135	15	30	10	25
6	Before	0	125	10	20	10	15
	After	0	130	15	30	10	25
7	Before	0	110	5	20	5	10
	After	0	115	10	30	10	20
8	Before	0	125	10	30	10	10
	After	0	130	15	30	10	25
9	Before	0	120	10	25	5	15
	After	0	135	15	30	10	25

Table 3. Late complications at last follow up tibial deformity and shortening (mild <15 degrees/moderate 15–25 degrees/severe >25 degrees)

Case	Recurring infection	Lateral bowing	Anterior bowing	Shortening
1	None	Mild	None	2.54 cm
2	None	Mild	Mild	1.90 cm
3	None	Mild	None	1.58 cm
4	None	Mild	Moderate	3.17 cm
5	None	Mild	Mild	1.27 cm
6	None	Mild	None	1.90 cm
7	None	Mild	Moderate	1.27 cm
8	None	Mild	None	2.54 cm
9	None	Mild	None	1.90 cm

Fig. 1. Anteroposterior and lateral radiographs of the tibia with sequestration of the shaft and reactive periosteal bone formation. The epiphyseal plates are present

Fig. 2. Radiograph of the same patient after sequestrectomy of the shaft from metaphysis to metaphysis and excision of necrotic tissue

Fig. 3. Radiographs of another patient showing regeneration with union of the fibula

Fig. 4. Radiograph showing regeneration of the tibial shaft after fibular transfer; the new fibula is united with the reformed tibia 6 years later in patient in Figs. 1 and 2

Fig. 5 Full flexion in the knee, ankle and foot following the 3 stage procedure

Case report

A boy, 6 years of age, who had 8 pretibial sinuses following a year old osteomyelitis of the entire tibial shaft, underwent the 3 stage treatment. The initial radiographs showed advanced osteomyelitis with sequestration of the whole tibial shaft (Fig. 1). The shaft and necrotic tissue were excised (stage 1) (Fig. 2) after which medical treatment was given for 2 weeks

(stage 2). After 2 weeks, the fibular transfer (stage 3) was carried out, leaving the middle third and its muscles untouched. Radiographs at 6 years showed longitudinal and circumferential growth of the new tibia within its periosteum together with regrowth of the proximal and distal fibula (Fig. 4).

Proximal fibular regeneration within its periosteum was better demonstrated on the radiographs of another patient

(Fig. 3); full motion of the left knee, ankle and foot was present (Fig. 5) with 1.27 cm of shortening and mild anterior and lateral bowing (Table 3).

Results

The average final follow up was 8.1 years, 4 patients being followed to skeletal maturity. All the patients were able to stand, squat and walk with a slight limp. There were no early complications, but late complications such as limitation of motion, shortening from 1.27 cm to 3.17 cm and deformity of the lower leg did occur (Tables 2 and 3). Movements had improved at the final follow-up (Table 2). The degree of deformity is shown in Table 3.

Discussion

The senior author (HZ) first used the 3 stage method of treatment in 1971 in an attempt to avoid amputation. The result was satisfactory and encouraged the further use of the regimen. In spite of some restriction of motion, shortening, angular deformity and the cosmetic changes in the soft tissues, the patients and their parents were all satisfied.

Incorporation of diaphyseal sequestra by the involucrum has been reported, but sequestrectomy had to be carried out in those patients who did not improve after a period of observation which might be as long as 12 years [8].

The present method has the advantage of being decisive with a predictable outcome within

18 months. Amputation may not necessarily be the treatment of choice or the most effective method. The present regimen is reproducible in any hospital and we believe it to be the best way of salvaging the limb in most children with advanced chronic osteomyelitis of the entire shaft of the tibia.

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