



## Prophylactic external fixation and extensive bone debridement for chronic osteomyelitis

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There is universal agreement that treatment of osteomyelitis should consist of debridement, obliteration of dead space, tissue coverage and antibiotic therapy, with debridement as the most important factor for therapeutic success. Four patients, 27 to 72 years old, with chronic osteomyelitis after a fracture of the femur (two), or of the tibia (two), were included in this study. The patients had already undergone 5 to 15 (mean : 9) surgical procedures. The same surgical technique was used in all of them : sinuses were carefully excised down to the bone, and necrotic bone was aggressively resected until normal bleeding was seen. A prophylactic circular external fixation frame, built on one proximal and one distal ring connected to the bone by thin wires and half pins, was used to protect and support the limbs, significantly weakened by radical debridement. Bone grafting or distraction osteogenesis was not necessary. All wounds healed without complications, and the infection did not recur. The average follow-up period was 43 months (range : 38 to 54).

**Keywords** : chronic osteomyelitis ; debridement ; prophylactic external fixation.

### INTRODUCTION

Bone infection is one of the most serious complications in the field of orthopaedic surgery and traumatology. Chronic osteomyelitis presents a complex diagnostic and therapeutic problem and, like many other chronic conditions, has a high eco-

nomie cost for healthcare providers. These patients often require a multidisciplinary approach that involves an orthopaedic surgeon, a plastic surgeon and an infectiologist. Long-lasting infection is often associated with avascular necrosis of the bone (13), but the degree of necrosis varies widely. Necrotic bone, once detached from the living bone, becomes a sequestrum. The presence of nonviable tissues in an infected area is responsible for the chronicity of the disease. Treatment requires isolation of the pathogens, suitable antibiotic treatment, meticulous debridement of all infected and necrotic tissue and, finally, reconstruction of bone and soft tissues.

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Antibiotic treatment is a milestone in the treatment sequence and should be administered according to the antibiogram. There are two routes for administering antibiotics. The systemic route, which is used by most physicians, has been recommended for periods varying from 6 to 24 weeks (2, 5). The direct route is based on delivery vehicles which enable the slow release of the antibiotic. The most widely used delivery vehicle is polymethylmethacrylate cement (28, 29). Bioabsorbable vehicles, such as calcium sulphate, synthetic polymers, and fibrin clots, have also been described (10, 14, 17, 18). Bead implantation and the choice of nonabsorbable versus bioabsorbable delivery systems are still controversial.

The goal of surgery in the treatment sequence of chronic osteomyelitis is to remove all nonviable tissue, leaving only viable bone. Obliteration of the dead space can be obtained with antibiotic impregnated beads or with flaps. Flaps yield living tissue, which has the ability to fight the infection process (1, 7-9, 12, 16, 19, 20, 22, 23). Many treatment procedures have been described, and the success rate of treating chronic osteomyelitis varies from 70 to 90% (3).

This study describes four patients with chronic osteomyelitis resistant to conventional treatment. Prophylactic external fixation allowed a very aggressive bone debridement without endangering the stability of the lower limb.

## MATERIAL AND METHODS

The records of four patients (three men and one woman) with chronic osteomyelitis of the femur (two) and of the tibia (two) were retrospectively studied. The average age of the patients was 55.7 years (range : 27 to 72). The osteomyelitis had been present for a mean of 31 years (range : 14 to 60). A fracture was at the origin in all cases. All patients had already undergone 5 to 15 surgical procedures (average : 9) in other hospitals. All had persistent draining sinuses. Osteomyelitic bone damage was diagnosed using plain radiographs and radionuclide scans. The patients had Cierny-Mader types III or IV adult osteomyelitis.

The surgical procedure started with an intraoperative fistulography using methylene blue. The fistula was completely excised down to the bone. All necrotic bone was

aggressively resected until normal bleeding was seen. The "paprika sign" (uniform punctuate haversian bleeding) was not considered sufficient to stop the debridement. Samples from the bone and from the deeper part of the wound were obtained for tissue culture and antibiogram. Massive irrigation was the rule. The bone was reduced to approximately half or less of its original size. A circular external fixation frame composed of one proximal and one distal ring, fixed to the bone with thin wires and half pins, was used prophylactically to protect and support the limbs which were significantly weakened.

The wounds were primarily closed in the two patients with osteomyelitis of the tibia, without tension ; suction drainage was used for five days. The other two patients had chronic osteomyelitis within the distal third of the femur, necessitating gastrocnemius flaps for coverage of the infected sites and obliteration of the dead space. One of these patients (case 2) had a through-and-through hole in the femur (mediolateral) ; both gastrocnemii muscles were harvested and their distal parts were fixed within the cavity. A skin graft was placed on top of the muscle.

Partial weight-bearing with crutches was allowed after 3 to 6 days. One patient, a 72-year-old blind man, was unable to use crutches and started full weight-bearing on the sixth postoperative day. For the remaining patients, full weight-bearing was gradually permitted according to their condition, usually from the second to the third postoperative week. Antibiotics were administered intravenously for 6 weeks, according to the antibiogram. Time spent in the external fixator varied from 8 to 13 weeks (table I). After removal of the external fixator, full weight-bearing was continued without a protective cast. The healing process was followed radiologically.

### Case 1

A 27-year-old female had undergone 5 operations for chronic osteomyelitis of the tibia, after a fracture at age 13. Surgery consisted of radical debridement, sequestrectomy, primary wound closure and suction drainage. A protective Ilizarov device was applied for 8 weeks. Partial weight-bearing with crutches was initiated on the third postoperative day, and full weight-bearing with crutches two weeks later. The wound healed uneventfully. After removal of the external fixator, full weight-bearing with crutches was continued for another month. No clinical or radiological signs of chronic infection were seen at follow-up after 54 months. The knee and ankle had a full range of motion.

Table I. — Details of the patients with chronic osteomyelitis

No.	Age/ gender	Site	Duration of infection	Flap	Trans-articular fixation	Fixation duration	Result
1.	27/F	Tibia	14 years	No	No	8 weeks	Good
2.	70/M	Femur	60 years	Yes	Yes (30 days)	12 weeks	Good
3.	72/M	Tibia	28 years	No	No	13 weeks	Good
4.	54/M	Femur	22 years	Yes	Yes (30 days)	8 weeks	Good

### Case 2

A 70-year-old man had suffered from chronic osteomyelitis of the distal third of the femur since 60 years. He had undergone 15 operations. A draining sinus was still present. After radical debridement two gastrocnemius flaps were necessary to fill the bone cavity. The femoral part of the external fixator consisted of one proximal half-ring and one distal ring ; this construction was extended below the knee to keep the joint at 15° of flexion to avoid tension on the muscle flaps. Partial weight-bearing with crutches was allowed from the sixth postoperative day on, and full weight-bearing was gradually permitted two weeks later. After another three weeks the tibial extension of the external fixator was removed to enable mobilisation of the knee. The wounds healed uneventfully. Superficial pin tract infection was noted but successfully treated with oral antibiotics and local dressings with chlorhexidine. Thirty-eight months after surgery no recurrence was seen and the preoperative range of motion was preserved.



Fig. 1. — Preoperative clinical picture with purulent discharge from the lower third of the thigh.

### Case 3

A blind 72-year-old male had a 28-year history of chronic osteomyelitis of the tibial diaphysis. He had undergone seven operations. After admission he underwent radical debridement and sequestrectomy. An Ilizarov frame was kept on for 95 days. Full weight-bearing without crutches was initiated immediately. After removal of the external fixation frame, full weight-bearing was continued without a protective cast. Follow-up after 42 months showed absence of recurrence.



Fig. 2. — Intraoperative lateral radiograph showing extension of the debridement.

### Case 4

A 54-year-old male had been operated upon 10 times, over a period of 22 years, for chronic osteomyelitis of the distal third of the femur. There was a suppurative wound in the same area and the knee was ankylosed (fig 1). After radical debridement (fig 2), a gastrocnemius flap was



**Fig. 3.** — Lateral gastrocnemius flap raised and packed into the bone defect.



**Fig. 4.** — Clinical picture on the second postoperative day : trans-knee external fixation frame with bed support for elevation of the operated lower limb.

used to fill up the dead space (fig 3). The external fixator immobilised the knee in slight flexion, so as to protect the muscle flap (fig 4). Partial weight-bearing with crutches was allowed from the sixth postoperative day on, and full weight-bearing was gradually permitted two weeks later. External fixation was maintained for two months. Superficial pin tract infection was treated with oral antibiotics and local dressings with chlorhexidine. Forty months after surgery, function of the knee was quite satisfactory (fig 5), while total eradication of the infection was achieved (fig 6).



**Fig. 5.** — Range of motion after 40 months

## RESULTS

The mean hospitalisation time varied from 8 to 46 days (average : 17 days). The wounds healed without complications and there were no signs of recurrent infection during the follow-up period. None of the patients required a supplementary bone grafting procedure. Restoration of the bone structure, sufficient for functional loading, was obtained in all patients. No pathologic fracture was recorded. The only minor complication was a superficial pin tract infection in two patients ; it resolved with local antiseptics and systemic antibiotics.

## DISCUSSION

The classical treatment of chronic osteomyelitis includes thorough debridement, obliteration of the dead space, good tissue coverage and antibiotics (12). Despite recent advances in antibiotic therapy, radical surgical debridement is still the most important factor for therapeutic success. Patients



**Fig. 6.** — Lateral and A-P radiographs, 40 months after surgery.

are often exposed to multiple surgical interventions and long-term antibiotic treatment. However, in spite of radical debridement, systemic antibiotics and soft tissue coverage, the published failure rate is still up to 30% (25, 27).

The term “radical surgical debridement” is often mentioned in the literature but the meaning deserves some clarification. One of the most popular recommendations is that it should be done until healthy bone and a “paprika sign” (punctiform bleeding) are obtained. However, the macroscopic aspect does not always represent real healthy tissue ; on the other hand, microscopic examination during surgery is too laborious a procedure. In the authors’ opinion, debridement with the bone biting forceps must be more aggressive, even if the stability of the bone is endangered. This is the most important step, exactly like in cancer surgery. Simpson *et al* (24) recommends a resection margin of at least 5 mm within healthy bone, but the

authors extend the resection much beyond this limit. There is no doubt that even a small amount of remaining infected bone reduces the success rate.

Of course, the risk of an iatrogenic fracture is high, when debridement reduces the cortical volume to less than 70% (21, 27). Prevention of a pathologic fracture was the rationale for using a prophylactic external fixator to protect the bone. A plaster cast is an alternative, but it hampers wound care, and it requires long-term immobilisation of the adjacent joints, which results in joint stiffness. Internal fixation is another alternative, but it introduces a foreign body in an infected area. In other words, external fixation appears to be ideal to compensate for the aggressive debridement. The external fixator can be extended, if needed, to the adjacent bone segment for temporary transarticular immobilisation, especially in case of periarticular osteomyelitis. The thin wire circular Ilizarov device provides enough stability for functional weight-bearing.

When needed, especially in patients with massive involvement, the bone resection may be followed by distraction osteogenesis for limb length restoration, as proposed by several authors (4, 15, 24, 26). The bone transport technique according to Ilizarov is another option for dealing with bone defects (11). Similarly, Emara (6) describes removal of the infected anterior half of the tibial cortex, followed in a second time by hemi-circumferential corticotomy of the remaining anterior cortex, and bone fragment transfer in order to fill up the defect.

The authors conclude that extensive bone debridement and prophylactic external fixation, associated with antibiotic therapy and muscle flaps when needed, is an acceptable treatment protocol for the management of chronic osteomyelitis.

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