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TREATMENT OF CHRONIC OSTEOMYELITIS BY FREE GRAFTS OF CANCELLOUS AUTOLOGOUS BONE TISSUE

A Preliminary Report

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Chronic osteomyelitis was treated by free grafts of autologous bone tissue in 13 consecutive patients aged 18 to 81 years. In all patients the osteomyelitis was located in the leg, and *Staphylococcus aureus* was the causative organism. Seven had an infected non-union. The duration of the osteomyelitis varied from less than 1 year to 75 years. Surgical debridement and grafting of cancellous and cortical cancellous bone were performed at the one operation. The osteomyelitis healed after a single operation in all patients but one, who needed three operations before the infection was eradicated. In one patient a second bone grafting operation was necessary before weight-bearing could be allowed. Although the number of patients is small, the results agree well with larger series published recently. Grafting of autologous bone tissue seems to be a very valuable method of treatment for chronic osteomyelitis.

Key words: autologous transplantation; bone and bones; methods; osteomyelitis

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Surgical debridement combined with long-term medication with antibiotics has changed the previously gloomy outlook of chronic osteomyelitis. Nevertheless in a recent Norwegian study of postoperative osteomyelitis an amputation rate of 14 per cent was reported (Hagen 1974).

Surgical debridement invariably entails bone loss and to avoid reinfection it seems to be essential to refill the defect (Burri 1975). Several methods have been used, from very crude ones such as refilling it with sand (Uebelhör 1971) to elaborate techniques such as free autografts of omentum secured with microvascular anastomoses (Azuma et al. 1976).

Bone defects are best refilled with grafts of bone tissue, but free bone grafts in an infected environment may create new sequestra and so propagate the infection. However, favourable results using the apparently paradoxical technique of grafting free autologous grafts of cancellous bone have recently been reported (Papineau 1973, Burri 1975). The purpose of this study is to present the preliminary findings after using this method to treat 13 consecutive patients with chronic osteomyelitis.

PATIENTS AND METHODS

Patients. The investigation comprised 13 patients admitted to the Orthopaedic Department in the period April 1975 to May 1977, 12 men and 1 woman, aged 18 to 81 years (median 52 years). Twelve had chronic post-traumatic osteomyelitis

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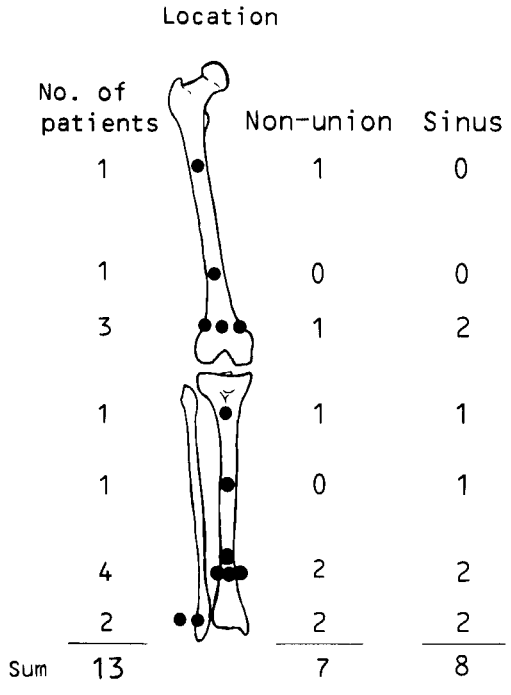

Figure 1. Scatter diagram. Location of infection, non-union and sinuses on right and left legs in 13 consecutive patients.

and one had osteomyelitis of haematogenous origin. Each patient had only one diagnosed infected focus situated in one of the long bones of the leg (Figure 1).

Post-traumatic osteomyelitis. Five out of 12 fractures were open. One fracture had been treated conservatively by traction, the others by one or more other methods: external skeletal fixation (2), cerclage (2), plate and screws (6) and pins (2). The subsequent infection had been treated by systemic antibiotics and various forms of surgery: debridement including removal of sequestra and osteosynthesis material, local irrigation of the wound, skin grafting and plaster of Paris. Following this treatment 5 out of 12 fractures had healed despite persisting infection (Figure 1).

Nontraumatic osteomyelitis. The oldest patient in this material (81 years) had contracted a haematogenous osteomyelitis as a child. For 75 years he had suffered from a chronic exudative femoral osteomyelitis which had resisted repeated surgical interventions combined with systemic antibiotics.

The duration of the osteomyelitis prior to final treatment with bone grafts varied from 1 month to 75 years (median 1 year). The duration of previous hospitalization varied from 1 month to 3 years. Nine patients had been treated at other hospitals before being admitted here.

Microorganism and sinus. Staphylococcus aureus had been cultured from the infected area in all patients. The staphylococci were insensitive to penicillin in 11 of the 13 patients, but were sensitive to lincomycin in all of them. Eight patients had a sinus (Figure 1).

Methods. Surgical debridement and bone grafting were performed on all patients in a one-stage operation by different surgeons.

Operative procedure. Bone autografts were taken prior to surgery of the infected area and kept in a bandage soaked in isotonic Ringer's solution. Cancellous grafts were taken from the superior posterior iliac spine (12 times) and cortical cancelleous grafts from the anterior iliac crest (5 times).

The infected bone focus was widely opened and obviously diseased soft and hard tissue were removed before the bone defect was refilled with bone grafts. The wound edges were then, if possible, loosely sutured in one layer with a few nylon stitches; otherwise the wound was left open and the bone grafts covered by a loose bandage soaked in isotonic Ringer's solution. Non-unions were immobilized either in plaster of Paris (2 patients) or by external skeletal fixation (Hoffmann 1952, Adrey 1971) (5 patients).

Antibiotic treatment and follow-up. All patients received systemic antibiotics postoperatively, usually lincomycin 0.5 g three to four times daily, until the clinical signs of the infection had subsided (3–12 months). One patient received a sulphonamide in addition; another patient was treated with cloxacillin alone for less than a month. The length of follow-up after the osteomyelitis healed was from 9 months to 3 years.

RESULTS

All the patients tolerated the operations well and we observed no complications from the donor sites. The osteomyelitis healed in all but one patient after a single operation. This particular patient needed three operations to eradicate the infection. In one patient a

second bone grafting operation was necessary before allowing weight-bearing (see case report).

In the patients with an open wound the visible, uncovered bone chips were gradually covered by granulation tissue as described by Burri (1975). The wounds gradually closed and skin grafting was not necessary. In the radiographs the bone grafts were seen to initiate new bone formation, which gradually refilled the defect.

Hospital stay and duration of incapacity. In 12 patients the hospital stay after the first bone grafting operation varied from 21 to 58 days (median 30 days). In all these patients the lesions were completely healed and they had resumed full activity 3–18 months after the operation (median 7 months). One patient stayed in hospital for 4 months after the first operation, which failed. After two further operations the infected non-union of the leg healed, about 2 years after his first operation.

CASE REPORT

Male, aged 45. He sustained a closed femoral fracture in a traffic accident and was treated by plating (AO plate). Osteomyelitis caused by pencillin-resistant staphylococci developed. After 2.5 years radical surgical debridement was carried out including removal of plate and screws. The fracture healed, but a large lateral cortical defect did not refill with bone and the femur refractured. When the patient was admitted to this hospital (Figure 2 a,b) the fracture was immobilized with a double frame external fixation device. Radiographs showed no callus after 3 months; therefore without further delay a bone graft was performed. First 40 ml of pus was removed; this gave a pure culture of penicillin-resistant staphylococci, and then the cancellous bone grafts were inserted. Since the bone grafts only filled a small part of the large defect in the lateral cortex (both fragments) and of the small one in the medial cortex (proximal fragment only) a larger quantity of grafts would have been desirable. In less than 6 months the fracture and the osteomyelitis had healed, but at this time the large bone defects – created by previous operations – had not refilled enough to withstand weight-bearing (Figure 2 c,d). Regrafting was therefore performed. At reoperation no infection was observed. Uneventful postoperative healing followed rebuilding of the lateral cortex with cortical cancellous bone chips and the fixation device was removed 6 months later.

DISCUSSION

Biological refilling of a bone defect, whether it is a fracture or a chronic osteomyelitic defect, depends on osteoclastic and above all on osteoblastic activity. As outlined by Frost (1963) and Sudmann & Marton (1975), osteoblastic activity – and likewise bone formation – can be classified in terms of primitive, disordered or differentiated, ordered activity.

Primitive, disordered osteoblasts form large amounts of new woven-fibred bone, whereas differentiated, ordered osteoblasts form much smaller amounts of parallel-fibred bone during the same period (Frost 1963, Sudmann 1976). Accordingly, a bone defect is most readily refilled if primitive, disordered osteoblastic activity is initiated in it. In a non-infected environment such activity is best initiated by refilling the defect with free cancellous and cortical cancellous autologous bone grafts. Such grafts provide: (1) a supply of living osteogenetic cells which may survive, differentiate and form (primary) primitive bone tissue, (2) a biological scaffold for the granulation tissue to grow on and (3) by means of bone induction this bony scaffold later causes osteogenetic cells within the granulation tissue to form (secondary) primitive bone tissue. The question is whether the granulation tissue will revascularize the grafts in the presence of infection. As indicated by the results of this study these grafts do not seem to form sequestra of any clinical significance.

Infection is the main adverse biological factor to be eliminated. In addition to surgical debridement and bone grafting of the osteomyelitic focus we treated most of the patients with lincomycin orally both pre- and postoperatively. However, this study gives no definite answer as to whether or not anti-

Figure 2 (a–d). Radiographs of left femur (case report). (a,b). Refractured femur upon admission. (c,d). After the first bone grafting operation, the fracture and the osteomyelitis healed in 3 months, but the defects in the medial and lateral cortex did not refill with bone. White arrowheads indicate defect in medial cortex, black ones proximal part of defect in lateral cortex.

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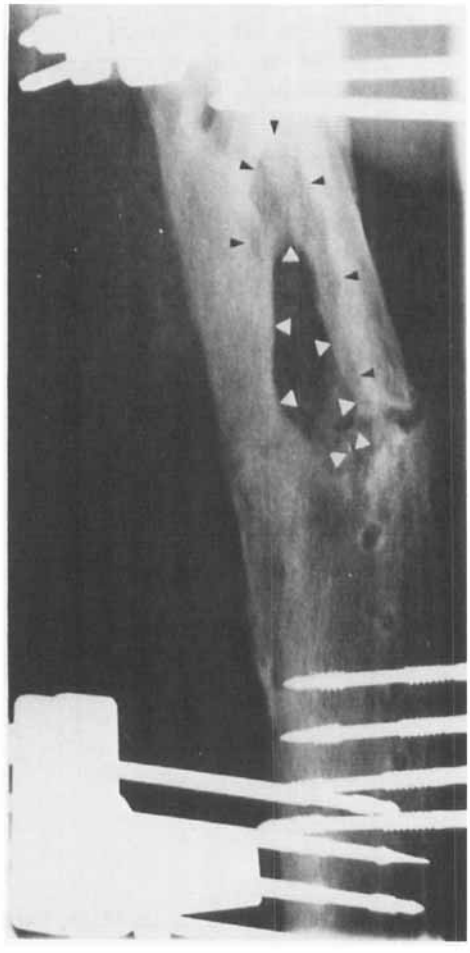

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biotics are absolutely necessary for optimum results. Since surgical debridement in combination with long-term antibiotic medication alone may fail (Hagen 1974), we consider bone grafting an essential addition.

Instability and diastasis are the main mechanical and physical adverse factors to be eliminated. Differentiated, ordered bone formation, i.e., longitudinal Haversian remodelling across the fracture line, is possible even in an infected environment provided the fracture is immobilized by rigid plate osteosynthesis (Rittmann & Perren 1974). However, a bone defect is most rapidly refilled by primitive, disordered bone formation. In contrast to differentiated bone formation, primitive bone formation does not require rigid fixation. Thus, the foreign body effect of a plate may outweigh the advantages of its stabilizing effect. Accordingly we avoid plate fixation whenever possible and find rigid double frame external fixation, as outlined by Adrey (1971), sufficient.

Although the number of patients with chronic osteomyelitis studied here is small, our short-term results agree well with larger series published recently (Papinau 1973, Burri 1975, Roy-Camille et al. 1976). We therefore consider autologous bone grafting a very useful method in the treatment of chronic osteomyelitis.

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