

# MANAGEMENT OF CHRONIC OSTEOMYELITIS IN A DEVELOPING COUNTRY USING CEFTRIAXONE-PMMA BEADS: AN INITIAL STUDY

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**SUMMARY** .Chronic osteomyelitis is a debilitating disease that is fairly common in developing countries. Various operative techniques have been adopted in the management of this disease but there have been few reports of their use in Africa. In this report, we present our experience of the use of a modified two-staged Belfast operation in patients with chronic osteomyelitis in Ibadan, Nigeria. An important modification of the procedure was the substitution of gentamicin beads (Septopal) with ceftriaxone-polymethylmethacrylate (PMMA) beads at the saucerised segment of bone at the first stage. Thirty-four patients with chronic osteomyelitis had the two-stage Belfast operation in 35 long bones; of these, 32 patients had ceftriaxone-PMMA antibiotic beads inserted at the saucerised segment of bone at the first stage, while the other two patients had gentamicin beads inserted. One of the two patients who had gentamicin beads had a residual collection of pus at second stage surgery but, following a repeat debridement, the cavity was rid of infection. There was recurrence of infection in three patients (8.6%) who had a suction drain inserted at the first stage and in six patients (17.1%) who had no suction drain at the first stage. The locally produced ceftriaxone-PMMA beads were found to be as efficient as the commercially available gentamicin beads in eluting antibiotics locally, thereby eliminating the residual infection in the bone cavities after the first stage. Another important outcome was a fourfold saving in cost in choosing to use ceftriaxone-PMMA beads rather than gentamicin beads. (*Int J Clin Pract* 2002; **56**(3): 181-183)

Chronic osteomyelitis is more a problem of chronic ischaemia than of chronic sepsis.<sup>1</sup> Primary chronic osteomyelitis arising *de novo* or following acute osteomyelitis is common among patients with sickle cell anaemia.<sup>2</sup> Secondary chronic osteomyelitis arising as a complication of open fractures, arthroplasties or following bone surgery are encountered in all orthopaedic and trauma units worldwide.<sup>3,4</sup> Several operative procedures have been carried out in the management of this distressing condition ranging from simple saucerisation and curettage, to the Papineau technique,<sup>5</sup> continuous wound irrigation with antibiotic,<sup>6</sup> the two-stage Belfast technique,<sup>7</sup> bone resection and callotasis and the versatile but cumbersome Illizarov frame.<sup>8</sup> Irrespective of the operative option embarked upon, chronic osteomyelitis requires treatment that is primarily surgical because the complete debridement of all the devitalised bone and soft tissue is essential, regardless of the size of the wound.<sup>9</sup>

In this study, we employed the Belfast technique in the management of 35 long bones in 34 patients with primary and secondary chronic osteomyelitis. Ceftriaxone polymethylmethacrylate (PMMA) beads were made intra-operatively and used in all but two patients. The outcome of

the two-stage Belfast procedure using these custom made or patient-specific antibiotic beads is presented.

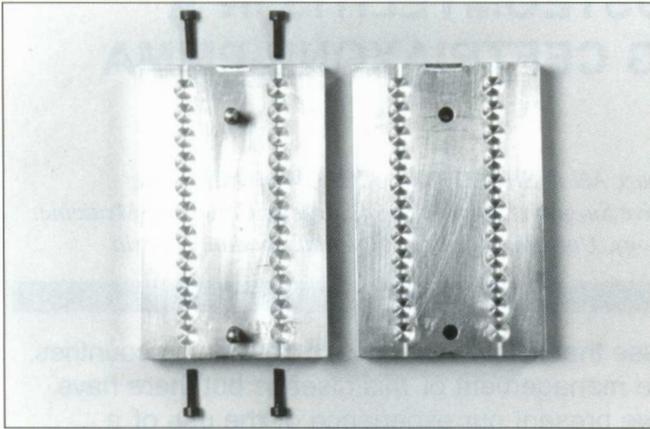
## PATIENTS AND METHODS

The subjects of the study were 34 patients with chronic osteomyelitis who were seen at the orthopaedic unit of the University College Hospital, Ibadan, Nigeria between September 1995 and August 2000. Seven other patients with chronic osteomyelitis were seen during the same period but were unable to afford the cost of operative treatment and were therefore excluded from the study.

## Evaluation of patients

Initial assessment comprised a thorough general examination with emphasis on anaemia, jaundice and other hallmarks of haemoglobinopathy. Wound swabs were taken for microscopy, culture and sensitivity, routine haematological investigation (full blood count, erythrocyte sedimentation rates and haemoglobin genotype), and baseline bone biochemistry and electrolytes and urea were carried out as appropriate. Joint review and preoperative planning were carried out with the plastic surgeon.

The perioperative antibiotic regimen consisted of



**Figure 1. Alonge-Wale intraoperative antibiotic bead maker (dismantled)**

intravenous ceftriaxone and metronidazole. All patients had general anaesthesia. A tourniquet was not used.

Ceftriaxone-PMMA beads were prepared under sterile conditions before the start of surgery using the Alonge-Wale intraoperative antibiotic bead maker (Figure 1).<sup>10</sup> Only two patients were able to afford the gentamicin beads and these were inserted at the first stage.

#### First stage

Surgical incisions included discharging sinuses and previous scars where possible. A rectangular piece of bone was removed and sent for microscopy, culture and sensitivity. The osteomyelitic cavity was curetted and thoroughly lavaged with copious amounts of normal saline. The antibiotic beads were then laid in the 'gutter' created, with parts of the beads threaded proximally and distally in the marrow cavities. The excess beads were discarded and the wound closed in layers over a suction drain. Three patients with chronic osteomyelitis of the distal third of the tibia had flap covers at the first stage (two fasciocutaneous transposition flaps and one cross-leg flap). Postoperatively, all the patients were prescribed oral flucloxacillin for six weeks.

#### Second stage

The patients were readmitted 6-8 weeks later for the second stage, which comprised the removal of the antibiotic beads and bone grafting if necessary. In this study, one patient required bone grafting of the proximal femur at the second stage. Nine patients were allowed partial weight bearing on crutches without plaster immobilisation for six weeks after second stage surgery. However, five patients were offered protective above-knee plaster immobilisation for six weeks after the second stage because of the risk of fracture.

#### RESULTS

The average age of the patients was 21.9 years (range 5-46 years); there were 12 females and 22 males. All the patients had had symptoms for at least six months before review in our unit. The femur alone was affected in 16 patients, the humerus alone in five patients, the ulna in two patients and

**Table 1. Aetiopathogenesis of secondary chronic osteomyelitis**

Causes	Number	Percentage
Previous closed fracture	1	7.7
Previous open fracture	4	30.7
Previous open reduction and internal fixation	7	53.8
Contiguous spread from septic arthritis	1	7.7

the tibia alone in 12 patients. Chronic osteomyelitis occurred around the knee in three patients, with infection spreading to the contiguous knee joint, necessitating an arthrodesis at the first stage of the Belfast operation. Twenty-one patients had primary chronic osteomyelitis, of whom seven (33.3%) suffered from sickle cell anaemia (HbSS). Thirteen patients had secondary chronic osteomyelitis, seven (53.8%) of these following open reduction and internal fixation (Table 1). All the patients had been on various antibiotics for a minimum of 12 weeks. Twenty-nine (82.9%) of these patients had chronic discharging sinuses at the time of presentation in the outpatient clinic.

At surgery, and in all instances, the periosteum was hyperaemic and rough, with variation in its attachment to the bone. In all cases, pus exuded from the marrow of the affected bone, even with an intact skin and despite prolonged antibiotics. Bacteriological examination of the discharging sinuses in 24 patients revealed positive cultures in 21 patients and no growth in three patients; 75% of the isolates from the chronic discharging sinuses and necrotic bones removed at surgery grew *Staphylococcus aureus*. All the patients except one had healthy granulation tissue filling the cavity at second stage surgery. This patient, with known sickle cell anaemia and chronic osteomyelitis of the humerus, had gentamicin-PMMA beads inserted, but pus reaccumulated at the second stage, necessitating a repeat debridement.

There was radiological evidence of bone regeneration in most instances, as evidenced by cortical thickening and bony



**Figure 2. Chronic osteomyelitis of the proximal tibia metaphysis in an 8-year-old boy with extensive bone destruction and metaphyseal osteomyelitic cavity**



**Figure 3. The same patient six weeks after the first stage of the Belfast operation showing lateral tibia cortical thickening (symbolising new bone formation) and resorption of the metaphyseal cavitation**

substitution of osteomyelitic cavities (Figures 2 and 3). There was slippage of the antibiotic bead off the wire suture in one patient, but the bead was easily retrieved, because the number and the location of the radio-opaque beads were noted before surgery with the aid of a plain X-ray.

The average follow-up of these patients is three years. One patient with sickle cell anaemia died of an unrelated cause six months after his second stage surgery, and another died of sequestration crisis after the second stage. There was recurrence of infection (as evidenced by repeated purulent discharge in the affected limb after the second stage) in three patients (8.6%) who had a suction drain inserted at the first stage and in six patients (17.1%) who had no suction drain at the first stage.

## DISCUSSION

The use of PMMA bone cement as a drug delivery system ensures the delivery of a high concentration of the appropriate antibiotic locally.<sup>11</sup> This high local concentration of the antibiotic is maintained by primary skin closure at first stage surgery as advocated by the Belfast technique.<sup>7</sup> We showed in an earlier study<sup>12</sup> that ceftriaxone-PMMA beads can be produced locally at low cost and that the beads elute ceftriaxone with moderate to extensive zones of inhibition demonstrated when these beads were placed in pure cultures of the organisms most commonly found in chronic osteomyelitis in our environment. In this study, an average of 15 ceftriaxone-PMMA beads were used per patient, thereby considerably reducing the cost of the beads per patient, as four to five patients can use the beads produced at one sitting. The mass production of ceftriaxone-PMMA beads using the Alonge-Wale intraoperative antibiotic bead maker (Figure 1), coupled with the advantages of the Belfast technique, make this treatment modality affordable to most patients in resource-poor environments.

The antibiotic beads used in the Belfast operation in these

patients serve as fillers but, most importantly, deliver ceftriaxone to the site of implantation in the bone. The operation obviated the need for prolonged wound dressing and antibiotic therapy with its attendant adverse effects.<sup>13</sup> Primary wound closure at both stages shortened hospital stay and allowed the patients to return to work. The use of suction drains appears to affect the outcome of the operation with respect to the rate of recurrence. From this initial report we advocate the use of a suction drain at both stages but certainly at the first stage to aid the evacuation of the residual haematoma, thereby minimising the risk of reinfection.

In developing countries where healthcare funding is the primary responsibility of patients and their relations, the Belfast technique appears to be a safe and cost-effective operation in the management of chronic osteomyelitis. The ceftriaxone-PMMA beads used in this initial study appear to be cheaper and the outcome of this modality of treatment and the shelf life of these beads is the subject of on-going research in our unit. A randomised clinical trial comparing ceftriaxone-PMMA beads with simple saucerisation and curettage is planned.

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