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Two stage reconstruction of septic non-union of the humerus with the use of circular external fixation

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ABSTRACT

Achieving quiescence in chronic osteomyelitis remains challenging. Wide resection of all infected and necrotic tissues improves the chances of achieving remission of the disease. Extensive debridement however decreases the already compromised bone stock that increases the complexity of reconstruction. We report on the outcome of eight patients with Cierny and Mader stage IV chronic osteomyelitis of the humerus who underwent debridement followed by bone graft and circular fixator application as a second stage procedure. Resolution of infection and humeral shaft union was achieved in all patients. Our study finds that two-stage reconstruction of stage IV chronic osteomyelitis with the use of circular external fixation is effective in achieving infection control and union in these complex cases.

Introduction

Achieving cure in the setting of chronic osteomyelitis remains challenging despite advances in terms of antibiotic therapy and operative techniques. Wide resection of infected bone improves the chances of relapse-free survival [1]. This approach may however result in decreased bone stock or large bone defects that increase the complexity of reconstruction procedures required.

Where infection is associated with ununited fractures as seen in Cierny and Mader stage IV post-traumatic chronic osteomyelitis the reconstructive process may be complicated by adjacent joint contractures and disuse osteopaenia. These challenges are frequently encountered in longstanding cases and where multiple previous surgical procedures have further compromised the condition of the soft tissues and underlying bone. In addition to the local risk factors, patients who develop chronic osteomyelitis frequently have multiple systemic risk factors and co-morbidities. Furthermore there may be social and psychological sequelae associated with an extended period of loss of function. Treatment therefore necessitates a holistic, multidisciplinary approach and typically starts with host optimisation and risk factor modification.

Following debridement and dead-space management, skeletal stabilisation and reconstruction is required. The Ilizarov method is an attractive option in this setting because of its modularity and ability to effect bone transport. Furthermore, it has been shown to be effective in achieving remission of chronic osteomyelitis and promoting healing of bone defects in the lower extremities [2].

The purpose of this study is to present our experience on the staged approach involving the use of circular external fixation for the reconstruction of stage IV chronic osteomyelitis of the humerus.

Patients and methods

We performed a retrospective chart review of all patients that were treated for Cierny and Mader stage IV chronic osteomyelitis of the humerus between October 2011 and March 2015 [3]. Inclusion criteria were patients of skeletal maturity that underwent reconstruction for septic non-union of the humerus. Patients were excluded if the reconstructive process was still ongoing. Institutional ethics committee approval was obtained for this study.

All patients underwent staged reconstruction. The first intervention was aimed at achieving remission of infection; the second aimed to achieve bony union and the final to restore function through tendon transfers where needed. Prior to commencement of surgical treatment, patients were classified according to the Cierny and Mader chronic osteomyelitis classification and systemic co-morbidities or risk factors were addressed.

Initial surgery involved wide resection of all infected, necrotic and ischaemic tissue. All accessible foreign material, including previous internal fixation metal ware, allograft and polymethyl methacrylate

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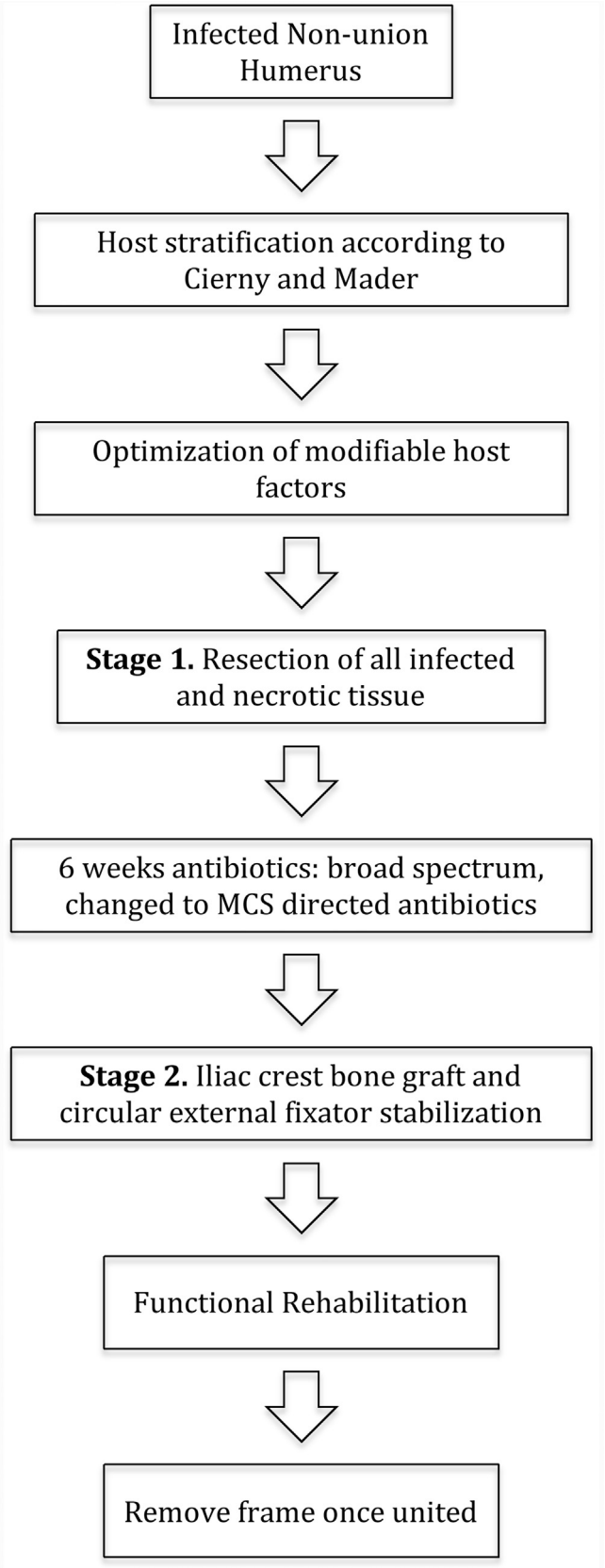
(PMMA) cement was removed. Tissue specimens for microscopy, culture and sensitivity (MCS) were taken in all cases. The incisions were closed over a drain and the limb was immobilised in a brace and sling. Initial intravenous broad-spectrum antibiotics (Cefazolin and Meropenem) were changed to directed oral antibiotics following availability of the MCS results. Rifampicin, aimed at biofilm based organisms, was added as a second oral agent. Patients were discharged home to complete a total of six weeks of antibiotics therapy. Following surgical intervention, all patients were referred for physiotherapy and occupational therapy to maintain and improve shoulder, elbow, and wrist and hand function.

The second stage surgical procedure was performed between eight and 12 weeks after the initial procedure and once resolution of infection was confirmed by clinical examination and laboratory investigations. This included a normal erythrocyte sedimentation rate and C-reactive protein level. Surgical intervention included resection of any remaining sclerotic bone, docking of bone ends, iliac crest Phemister-type bone grafting and application of a circular external fixator [4]. Fixators consisted of one 5/8th ring open anterior to allow elbow flexion, connected to a half ring that was open medially to allow the upper arm to be adducted against the body. Fixation consisted of two tensioned fine wires and a hydroxyapatite (HA) coated half pin on the distal ring and two or three HA coated half pins in the proximal ring. Where the spread between the two rings were more than 150 mm a dummy 5/8th ring was added between the fixation rings. Standard prophylactic antibiotics were prescribed for 24 h post surgery and rehabilitation with the assistance of the physiotherapist and occupational therapist was resumed.

Outpatient follow-up was scheduled at two weekly intervals until a robust rehabilitation routine was established. Thereafter, the interval between follow-up appointments was increased to four weeks. Removal of the external fixator was considered once circumferential consolidation was radiologically evident. At this point, the external fixator was dynamised to allow manual stressing of the union site. If this did not cause any pain or deformity, union was deemed confirmed and the external fixator removed. All patients were followed up clinically and radiologically for a minimum of six months following removal of the frame. Recalcitrant infection, non-union and angular deformity was considered as a failure of treatment.

Patients that presented with radial nerve injuries were considered for tendon transfers once equilibrium of the affected limb was achieved. This included complete resolution of infection, restoration and humeral continuity, removal of the external fixator and healing of all wounds and pin sites.



Results

Eight patients met the inclusion criteria. No patients were excluded. The cohort comprised five men and three women with a mean age of 47.9 years (range 22–73) (Table 1). Mean follow-up was 13.6 months (range 9–24). All infections were classified as Cierny and Mader stage IV chronic osteomyelitis with humeral shaft discontinuity (Table 1).

Medical co-morbidities were identified in three patients (37.5%). One patient was diabetic while the remaining two patients were human immunodeficiency virus (HIV) infected with cluster of differentiation 4 (CD4) cell counts of 400 cells/mm^3 and 684 cells/mm^3 respectively. Both HIV positive patients were on highly active anti-retroviral treatment (HAART). There were no active smokers.

The mean time elapsed from injury to presentation to our unit was 36 months (range 4–56). Six (75%) patients had initially sustained open fractures. Initial fracture stabilisation consisted of monolateral external fixators in two patients, antegrade intramedullary nails in three patients and plates and screws in three patients (Fig. 1).