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Research Paper

Septic Arthritis of the Shoulder with Proximal Humerus Osteomyelitis, Treated by Ilizarov Shoulder Arthrodesis

John Kendall and Martin McNally ✉

Department of Limb Reconstruction, Bone Infection Unit, Nuffield Orthopaedic Centre, Oxford University, Hospitals NHS Foundation Trust, Windmill Road, Oxford, OX3 7HE

✉ Corresponding author: martin.mcnally@ouh.nhs.uk, Tel: 01865 741155

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Abstract

Septic arthritis of the shoulder can destroy the glenohumeral joint resulting in significant pain, instability and poor function. Surgical treatment is notoriously difficult with significant risk of complications. Shoulder arthrodesis has been performed using both internal and external fixation but has high complication rates in the presence of infection.

We present our experience of managing a patient with significant pain and loss of function as a result of septic arthritis of the shoulder following infected proximal humeral fracture fixation with associated proximal humeral osteomyelitis. We discuss patient presentation, appropriate investigations, decision-making, pre-operative planning and the principles of managing of bone and joint infection.

Wide excision with Ilizarov stabilisation and implantation of an absorbable antibiotic carrier, allowed successful fusion with eradication of the infection. The benefits of using this arthrodesis technique include reduced risk of infection recurrence and excellent stability of construct, therefore reducing time to fusion and minimising soft tissue trauma with the opportunity for early rehabilitation and return to optimal level of function.

Key words: Ilizarov, Shoulder Fusion, Arthrodesis, Septic Arthritis, Osteomyelitis, Local Antibiotics

Introduction

Septic arthritis of the shoulder can cause destruction of the glenohumeral joint resulting in significant pain, instability and a reduced level of function. It is notoriously difficult to treat and surgical intervention has significant risks of complications [1].

Shoulder arthrodesis is reported in the literature as a surgical technique for managing a variety of conditions including trauma [2], osteoarthritis [3], brachial plexus injury, deltoid and rotator cuff paralysis, failed revision arthroplasty, severe refractory instability, bone deficiency following tumour resection in the proximal humerus [4, 5], as well as for infection [1, 5, 6, 11]. Shoulder fusion is normally performed using internal fixation [5, 7, 8, 9] and has been performed with arthroscopic assistance [10]. However, in the context of infection this increases the risks of complications. Wick et al [1] reported complication rates of 33% in patients undergoing shoulder arthrodesis for infection – including non-union with implant loosening (in 60% of these cases) and a persistent sinus after arthrodesis.

Fusion with internal fixation often requires supplementary support with external splints which are cumbersome for the patient. External fixation has been reported much less widely. An article written in Czech by Král et al [11] reported a series of five patients treated with shoulder arthrodesis using external fixation for chronic inflammatory complications related to infection following proximal humeral fractures. They achieved stable, painless, infection-free shoulders in all five patients, but noted worsened upper limb function after arthrodesis.

We present our experience of using Ilizarov external fixation to manage a patient who had significant pain and loss of function as a result of septic arthritis of the shoulder with associated proximal humerus osteomyelitis.

Case Presentation

A fifty seven-year-old lady who was previously very active and a keen golfer sustained a closed, comminuted proximal humerus fracture/dislocation of the shoulder of her non-dominant upper limb whilst skiing. This was treated with plate and screw internal fixation the day after her injury. Unfortunately, this was complicated by early infection and within six weeks, she presented with a draining sinus from the wound. She was started on oral Clarithromycin and a subsequent drainage and washout failed to isolate causative organisms.

Ongoing pain and stiffness was attributed to a screw protruding through the humeral articular surface (confirmed on shoulder arthroscopy). However, four months after the injury, at surgery to remove this screw the metalwork was found to be bathed in pus, loosening and with a large cavity in the proximal humerus. The metalwork was removed and the affected area curetted and washed out. She was started on intravenous Vancomycin for two weeks followed by a further four weeks of oral Cephradine. Again no organisms were cultured from operative samples. Blood tests revealed a normal white cell count (WCC), an Erythrocyte Sedimentation Rate (ESR) of 21 mm/h and a C-reactive protein (CRP) level of 5 mg/L. She was referred to our unit at this point.

At initial assessment, she had no systemic symptoms of infection and the skin defect had healed. She had a poor residual range of shoulder movement with both flexion and extension limited to thirty degrees, abduction to twenty degrees, with no internal or external rotation. All movements were painful. She had no neurovascular deficit. Radiographs confirmed destruction of the joint surface, an un-united fracture with some collapse and mal-rotation (Figure 1). MRI scans revealed a cavity in the proximal humerus with marked surrounding oedema in the bone and soft tissues (Figure 2).

Clinical assessment revealed that she had almost no glenohumeral movement but had reasonable scapulothoracic movement. She continued on oral Cephradine, completing a three month course. She was referred to physiotherapy to optimise the scapulothoracic muscles, position and posture, rather than concentrating on glenohumeral movement. Her level of function improved to the extent that she was able to return to playing limited golf, although she continued to suffer with significant shoulder and peri-scapula pain. She therefore requested further treatment to alleviate her pain.

Figure 1. AP radiograph at presentation to our Bone Infection Unit, showing joint destruction, bone loss, non-union and fracture displacement.

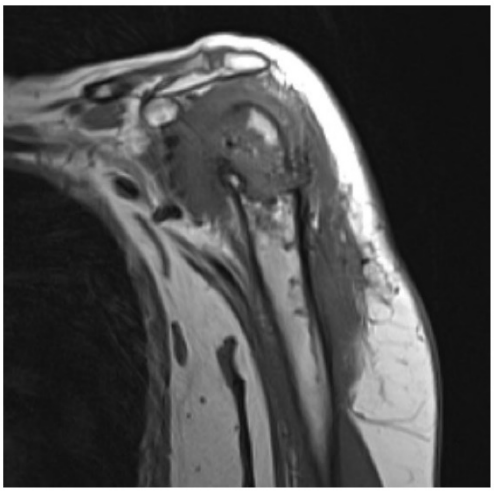

Figure 2. MRI showing the non-union, the inflammatory mass in the joint with bone involvement in the humerus and glenoid.

Given the extent of destruction of the humeral head, glenoid and the rotator cuff attachment it was felt that arthroplasty would be very technically challenging. It would have significant risks (especially of infection recurrence) and whilst it might provide glenohumeral pain relief, it was felt it would be unlikely to improve her function or range of movement. Her active lifestyle would also risk early loosening, periprosthetic fracture and dislocation. Serial clinical examinations, blood tests and MRI scans revealed no further evidence of active or progressive infection.

At this stage, 26 months after her initial injury,

she had significant muscle atrophy with very limited true shoulder movement. An image-guided local anaesthetic/steroid injection provided very effective pain relief for a short period of time allowing her to do many more activities. This confirmed true glenohumeral arthralgia and provided evidence to support the potential benefit of a shoulder arthrodesis for pain relief. A CT scan was arranged to assess the geometry of the shoulder to ensure that a fusion was technically possible. CT scanning confirmed the degree of humeral head collapse but with sparing of the acromion process and the inferior part of the glenoid (Figure 3).

In the operating theatre, the patient was positioned in a beach-chair position. The old lateral incision was re-opened with a deltoid-splitting approach. The shoulder joint was opened and deep samples were taken for microbiology and histology. Intravenous Vancomycin and Meropenem were given after sampling. There was a small amount of fluid and some granulation tissue, but no gross signs of active infection. The shoulder capsule was excised and the bone exposed. The whole proximal humerus was missing. There was one small dead piece of articular surface lying ununited at the front of the shoulder joint which was removed. The glenoid cartilage had been eroded and there was a residual sclerotic bony surface. The appearances were of quiescent infection of the proximal humerus (Cierny-Mader type IV B osteomyelitis) and of post-infective articular damage to the shoulder joint.

The shoulder joint and underside of the acromion were cleared of granulation tissue back to healthy bleeding bone. Three large spikes of proximal humerus were removed to create a good surface for fusion. The medullary canal was opened and seen to bleed freely. The area was thoroughly washed with aqueous chlorhexidine. The humerus was placed in the fusion position (twenty degrees of abduction, thirty degrees of flexion and forty degrees of internal rotation) and good bone contact was achieved with shortening (4cm), allowing contact with the acromion. An external fixator was constructed with three half pins in the humerus avoiding the radial and axillary nerves. The scapula was transfixed with a single wire, entering the coracoid process anteriorly and exiting through the scapular spine at the back. Two, 4mm diameter half pins were passed into the acromion and scapular spine through the glenoid neck. Very good fixation was achieved. A three-ring Ilizarov frame was assembled with hinged rods to allow positioning of the humerus and compression of the fusion site (Figure 4). Very good bone contact and compression was achieved. With the shoulder in position there was an antero-lateral bone defect in the proximal humerus which was filled with 10mls of Cerament™ G antibiotic eluting bone void filler with Gentamycin. The wound was closed directly.

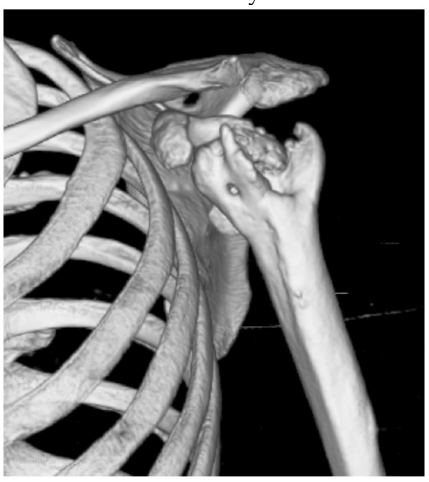

Figure 3. CT reconstruction confirmed the humeral head collapse with sparing of the acromion.

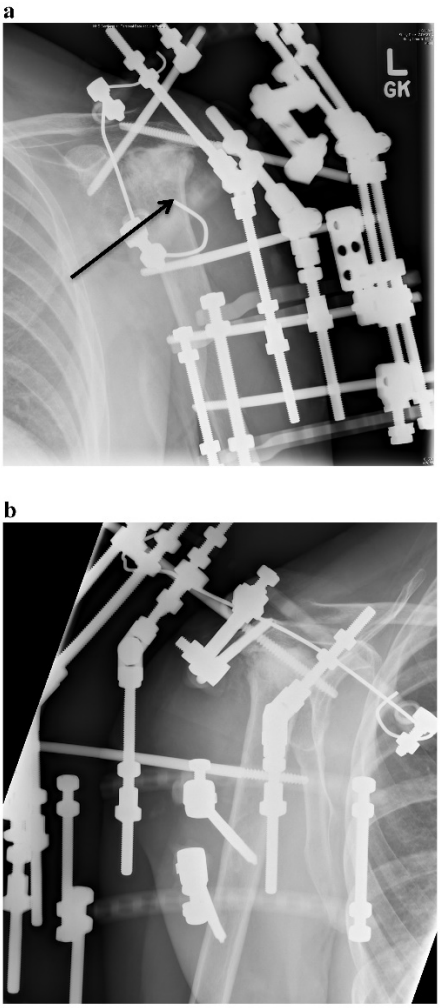

Figure 4. (a and b). Immediate AP and Lateral postoperative radiograph showing the construct of the Ilizarov fixator. The anterior bone defect was filled with absorbable antibiotic carrier (black arrow)

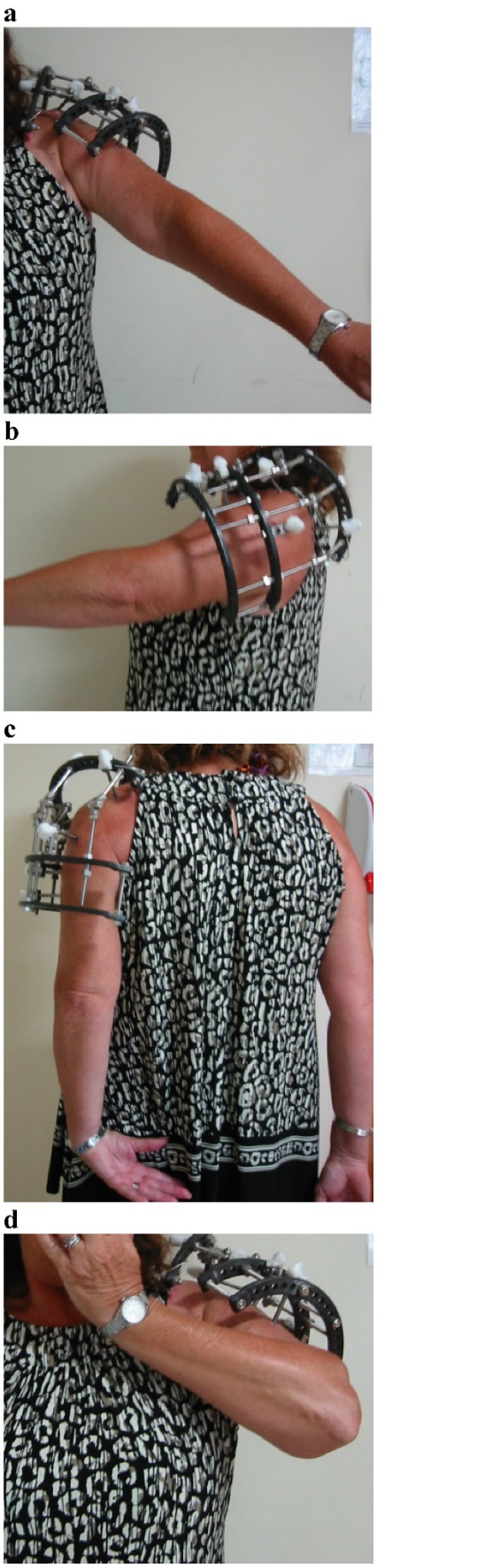

Figure 5. (a to d). Functional range at 8 weeks after frame application.

Post-operative recovery was uneventful. The wounds healed well and she mobilised her scapulothoracic joint from day 2. Intra-operative samples did not grow any organisms and histology samples were not diagnostic of active infection, although intra-operatively there were obvious post-infective changes. The patient was discharged on a six week course of oral Ciprofloxacin and Rifampicin according to our hospital protocol for culture-negative osteomyelitis.

She regained very good scapulothoracic motion (Figure 5) and returned to playing golf (putting) within a month of surgery. She stopped antibiotic therapy after six weeks. Check radiographs of the shoulder showed good evidence of active bone fusion with maintained stable fixation. She had some irritation from her coracoid wire. She developed two minor, isolated, superficial pin site infections – one at two months post-operatively and another one month later – both of which were effectively treated with ten-day courses of oral antibiotics.

Her Ilizarov frame was neutralised and the arthrodesis was tested both clinically and with image-intensifier screening under sedation. The fusion was deemed to be stable and the frame was removed after four months. She was temporarily immobilised in a polysling and advised not to use the shoulder for two weeks, when the arthrodesis was clinically stable and check radiographs showed a maturing fusion site (Figure 6). She gradually built up use of her shoulder with increasingly prolonged periods out of the polysling, but with no heavy lifting for a further four weeks.

At her most recent outpatient appointment (sixteen months after frame removal) she had continued to return to full activities with no shoulder pain. She had obtained a very good pain-free range of functional movement (Figure 7) with no sign of infection recurrence. There was no pain on stressing the fusion site and check radiographs were again satisfactory.

Discussion

Septic arthritis of the shoulder joint and resultant osteomyelitis of the proximal humerus can cause significant morbidity in terms of pain, loss of function and sequelae of infection (e.g. discharging sinuses). It is essential to effectively treat any active infection, but even after this post-infective changes result in continued problems for patients.

It is essential to set out treatment goals prior to any intervention. In an acute septic arthritis, joint salvage may be realistic, however, in delayed presentations and in chronic or post-infective cases this is often no longer possible. The treatment goals

then change to symptom relief and optimisation of residual function. The increased risks of infection recurrence make internal fixation a more risky option and so external fixation may provide a better surgical solution.

Most osteomyelitis seen in the western world is as a result of contiguous spread - commonly from fractures (open or closed) or operative intervention. Early surgical treatment of septic arthritis with appropriate antibiotics gives the best chance of joint salvage. Empirical antibiotic treatment prior to surgical sampling significantly reduces the chance of isolating causative organisms and therefore of targeting antibiotic therapy. If patients are septic and unwell then this is unavoidable, but where possible patients should ideally remain off antibiotics for a period prior to sampling. In this case, no causative organism was found as the patient was always on antibiotics prior to sampling.

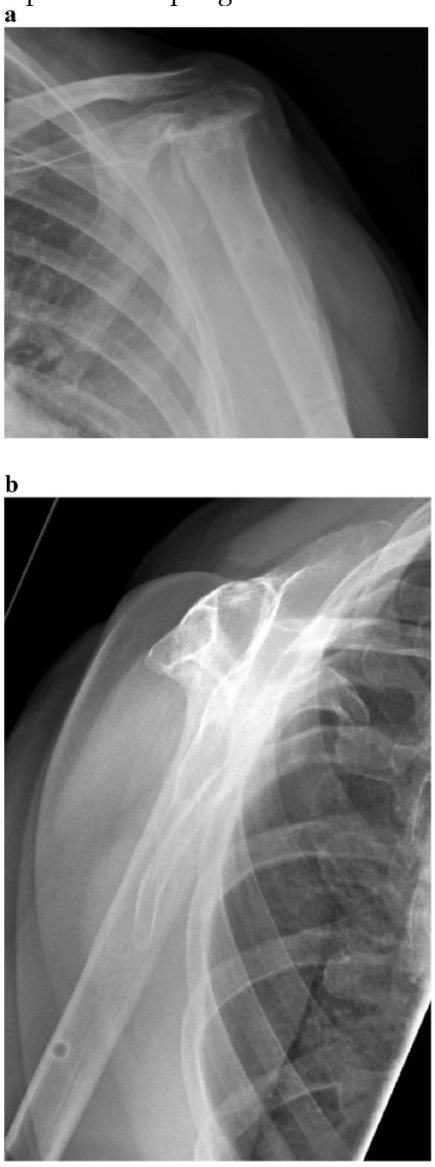

Figure 6. (a and b). AP and Lateral radiographs of healed arthrodesis.

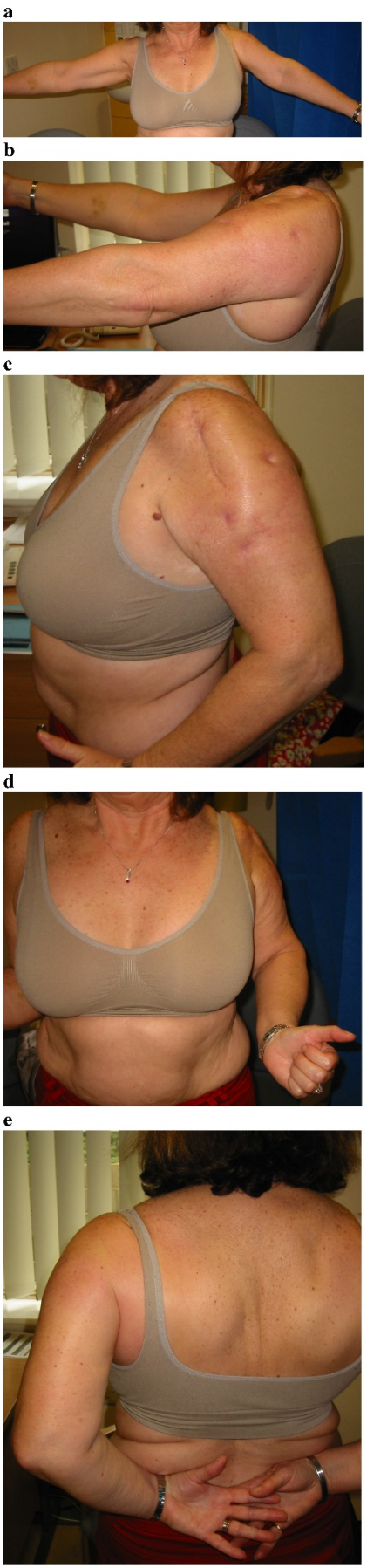

Figure 7. (a to e). Functional range of movement out of the Ilizarov frame.

Plain radiographs are a useful first-line imaging modality for assessing joint destruction, fracture union and infective changes. MRI scans remain the gold standard for assessing active and quiescent infection and for assessing extent of bone and joint involvement. CT scanning provides the best imaging modality for assessing bony architecture (e.g. for pre-operative planning for an arthrodesis).

Pain in the context of a chronic infection in the shoulder can arise from a number of sources including true glenohumeral joint pain, scapulothoracic articulation pain, muscle pain, proximal humerus bone pain and nerve pain. Image-guided injections into the glenohumeral joint allow an accurate assessment as to the proportion of an individual patient's pain coming from the glenohumeral joint and the likely extent of pain relief from a glenohumeral arthrodesis.

Successful treatment of bone infection relies on representative, uncontaminated sampling of infected tissue, complete clearance of infection (including biofilm), dead space filling, vascularised soft tissue coverage, stabilisation of fracture/fusion sites and appropriate adjuvant antibiotic treatment for a sufficient time period. Clearance back to healthy bleeding bone on both surfaces of fractures or fusion sites optimises chances of a successful union. However, this radical clearance may produce bone defects which must be carefully managed. Cerament ™ G was used as a dead space filler within the bone and in addition it releases a very high local concentration of antibiotics to the affected area for a short period of time. It has been shown to be a useful adjunct to the management of chronic bone infections [12].

Stability of fixation – either internal or external – is essential to allow successful fusion and is a very important factor in treatment of infection. Internal fixation may have been possible in this case but would have been technically demanding. After surgery, the patient would have required external support for many weeks until healing, which would have prevented good scapulothoracic rehabilitation. The Ilizarov fixator was well tolerated by the patient.

A significant proportion of shoulder girdle movement arises at the scapulothoracic articulation and so even with complete glenohumeral fusion a useful range of movement and function can be maintained alongside improving pain arising from the glenohumeral joint. Peri-operative physiotherapy allows optimisation of range of movement and muscle strength. Another benefit of Ilizarov external fixation for shoulder fusion is that complete stabilisation of the fusion site is maintained with good compression and minimal soft tissue trauma and therefore early active mobilisation of the scapulothoracic articulation is possible reducing deconditioning and accelerating rehabilitation.

In conclusion, Ilizarov fixator-assisted glenohumeral fusion was an effective technique for treating infection, improving symptoms and optimising function in a patient presenting with chronic or post-infective septic arthritis and associated humeral osteomyelitis. There are benefits from using this fusion technique including reduced risk of infection recurrence, excellent stability of construct and therefore short time to fusion and minimal soft tissue trauma with the ability for early rehabilitation and return to optimal level of function.

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Competing Interests

The authors have declared that no competing interest exists.

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