

## Salvage of humeral non-union by extendible total humeral endoprosthesis

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### **Abstract**

We present an elderly patient with an aseptic, diaphyseal non-union of the Humerus, where other methods of management had failed. An extendible total humeral endoprosthetic replacement was used with adequate functional results.

### **Résumé**

Nous présentons un malade âgé avec une pseudarthrose diaphysaire, aseptique de l'humérus après échec des méthodes habituelles de traitement. Un remplacement endoprothétique huméral totale télescopique a été utilisé avec un bon résultat fonctionnel.

## Introduction

Non-unions of the humerus are difficult to treat. Several methods have been described with limited success. One option for salvage of failed non-union of the humerus is an endoprosthesis replacement in selected patients. Use of an extendible endoprosthesis would ensure recovery of length in a shortened arm.

## Case-Report

A right dominant 66-year-old lady was referred to our unit with a non-union of a fracture of the shaft of the right humerus, sustained eight years previously. Initially this was treated conservatively with a brace but the fracture failed to unite. Over the subsequent years she underwent a series of operative procedures all of which failed to result in an osseous union. The surgeries included open reduction and plating with bone grafting of the humerus, intramedullary nailing and further bone grafting, a revision nailing and finally circular frame fixator application. The lady was unable to cope with the ring fixators and hence requested that they be removed after a period of eight months. By that stage it was five and a half years since the injury and she had a frank pseudoarthrosis. She then underwent further surgery in the form of a vascular fibular graft with external fixator stabilization. This resulted in some evidence of union distally but the patient sustained a trivial injury, with resultant disintegration of the graft and a gap non-union of the humerus. She was then referred to our unit for a possible salvage of the situation. The arm was painful and short (Figure 1). There was no evidence of infection or neurological deficit despite the multiple surgical procedures. On assessment it was evident that the function of the upper limb was poor with no useful control of upper arm or elbow. The arm was considerably shortened compared to the other side and there was uncertainty as to how much of this length could be restored. After considerable discussion it was agreed that an extendible custom-made endoprosthesis was most likely to relieve pain and restore some function, in addition to providing the option of lengthening the prosthesis either at the time of surgery or later. At surgery the humerus was completely flail and literally a bag of bones with just the ends being intact (Figure 2). No evidence of infection was found. An extendible total humerus endoprosthesis replacement was inserted via an anterior Henry's approach. A mesh was used to secure the humeral head to the glenoid labrum to prevent subluxation of the head and the distal hinged joint was secured by fixation to the ulna. Only modest lengthening was achieved at the first operation to avoid injury to the neurovascular structures. The upper limb was mobilized post-operatively with rapid recovery of elbow function. The movements of the shoulder were slow to recover and by six weeks she had about 30 degrees of abduction. Functionally however she was able to use her hands to eat, comb her hair and have a stable support. The relief of pain and the return of stability to the arm was a major benefit to the patient. Six months following surgery she had regained an inch of length following two minor procedures to lengthen her prosthesis (Figure 3).

## Discussion

Non-unions of the humerus may arise in about five percent of fractures of the shaft of humerus, being more common in those surgically treated [13]. A lack of stable fixation has been pointed out to be the main causative factor in these cases [9]. Non-union of the humerus have been treated by a variety of methods including autograft and plating [2, 7, 17], plating with cement augmentation [17], interlocking

nailing [12], Ilizarov ring fixators [3,4,11,14] and fibular grafts either in the form of strut grafts [18] or as a vascular fibular grafts [16,19]. There is clearly no ideal solution. Ununited humerus can be extremely disabling especially in the aged [10]. The loss of stability and inability to use the arm may severely affect their mobility particularly in the presence of lower limb problems [15]. On the other hand salvage of humeral non-union can be difficult, complicated, and surgically demanding. The evidence of healing can be slow to show and the results are unpredictable despite the best efforts. Custom-made endoprosthetic replacements would be one option to salvage the failed attempts at union of the humerus. Ununited distal humeral fractures have been treated by an elbow arthroplasty both primarily [5] as well as a salvage procedure [6] and have shown good results. Similarly non-union of the proximal humerus have also been treated by proximal humeral endoprosthesis as a salvage. A case of total humerus prosthesis for chronic osteomyelitis has also been reported in the past [20]. We have used endoprosthesis to treat pathological fractures and frequently following excision of tumours. Our long-term results with endoprosthetic replacement following excision of tumours have been good [8]. The decision to consider an endoprosthetic replacement was taken against a background of repeated failure to achieve union by virtually every method. This decision is to be balanced by the known risks of total humeral endoprosthetic replacement; the main contraindication to use an endoprosthesis is infection and the dreaded complication post-operatively is also infection. Although the shoulder is less functional, the overall function is adequate and the elbow usually has a full range of movements. Insertion of an extendible prosthesis is an attractive option since gradual increase in length could be achieved [1] and it is particularly relevant in cases of gap non-union, where the arm has collapsed into a shortened extremity as seen in our case. These operations can however be technically demanding and need a surgeon familiar with endoprosthetic replacements. Proper patient selection is also necessary since realistic expectations of results and ability to indulge in intensive post-operative physiotherapy are essential.

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## Legends



Figure 1: Radiograph of the right humeral non-union of a 66-year old lady. The short, floppy and unstable arm shows evidence of multiple previous surgeries.

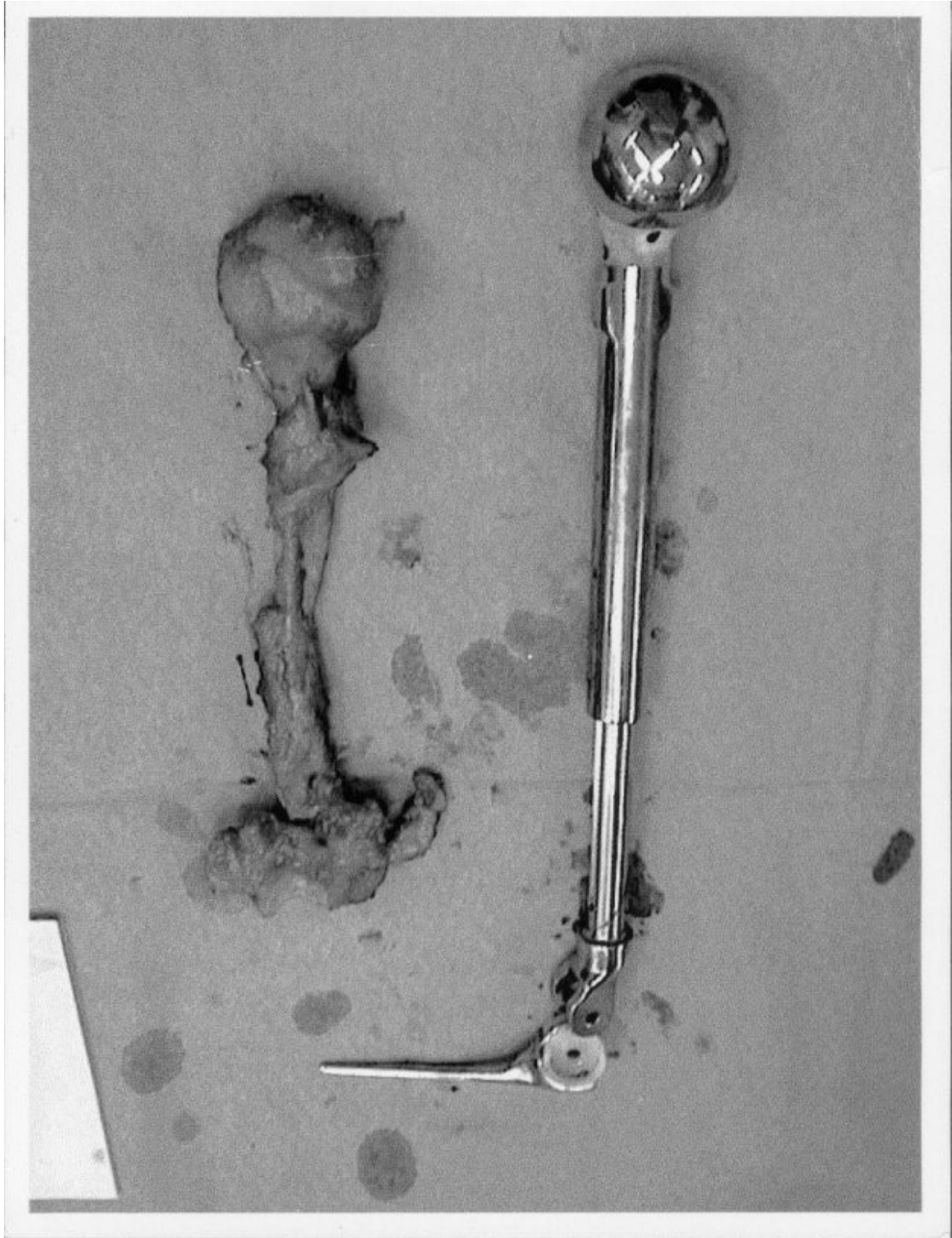


Figure 2: Intra-operative radiograph showing the entire humerus dissected out and placed alongside the total humeral endoprosthesis. The endoprosthesis demonstrates the maximum lengthening possible with the implant.



Figure 3: Post-operative radiograph with the total humeral endoprosthesis in situ after two lengthening procedures.

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