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Partial humeral replacement for peri-prosthetic fractures of the humerus

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ABSTRACT

Introduction: Treating peri-prosthetic fractures of the humerus can be very challenging, especially when there is poor bone stock and in the presence of adjacent joint prostheses. We discuss the option of a partial humeral replacement as a salvage procedure for such cases with some technical comments.
Methods: This paper presents a technique which utilises a custom- made cemented connector to incorporate the existing well functioning elbow or shoulder replacement with a commercially available partial humeral replacement (PHR) or to an existing prosthetic humeral stem.
Results: Our series involves 6 patients with severe rheumatoid arthritis, all female, with a mean age of 62.5 years. Their surgeries were performed over a span of 10 years, with an average follow up of 49 months. All had a well functioning implant at final follow-up, with a mean Mayo Elbow Performance score of 65. There were no cases of infection, nerve injury or dislocation in our patients. There were 2 deaths in our series, from unrelated medical causes at 2 and 4 years following their surgery.
Conclusion: Although a partial humeral replacement connected to a well functioning implant is a rare procedure for salvage of a humeral peri-prosthetic fracture, it can be a viable option in certain patient populations. Every attempt should be made to maintain the secondary shoulder stabilisers at the proximal humerus as a functioning unit.

1. Introduction

Peri-prosthetic fractures of the humerus can be managed in a number of ways if the implants are stable; many eventually unite if treated conservatively. Open reduction and internal fixation with plates and screws can be performed if there is good bone stock available for apposition and screw purchase. Fixation can be augmented with bone allograft, or an allograft prosthetic composite can be used if the bone quality is inadequate.[1–4] If the elbow or shoulder implant is short stemmed it could be removed and the fracture bridged with a longer stem. However in some end- stage cases, the biology of healing fails or there are problems with the joint above. Managing peri-prosthetic fractures in rheumatoid arthritis (RA) patients can be very challenging, because of their poor bone stock and the presence of adjacent joint prostheses. Systemic inflammation, loose implants and poor bone heath, as in RA patients can increase fracture healing time and the rate of complications, including non-unions.[5]

We present a technique which utilises a custom- made cemented connector to incorporate the existing total elbow humeral component with commercially available proximal humeral replacements (PHRs) or the existing shoulder replacements. The use of proximal femoral, distal femoral and even total femoral replacements in complex fracture management has been described in the literature previously[6] and the use of cement tubes to attach to femoral implants has also been reported.[7–9] To our knowledge, this is the first paper reporting the use of PHRs for the management of peri-prosthetic fractures involving total elbow replacements in the literature.

2. Methods

We report this technique in RA patients with total elbow replacements, who subsequently sustained peri-prosthetic humeral fractures. We will also discuss some patients with ipsilateral shoulder hemi arthroplasties and total elbow replacements, who had their fractures treated in a similar fashion with custom made cemented tubes to connect the two adjacent implants.

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Pre-operatively, the length of the custom made extension piece and the level of the bony resection at the distal fracture end is determined so that it fits with the humeral segments/shoulder hemiarthroplasty stems and restores the native humeral length (Fig. 1). The custom designed piece is essentially a hollow tube that is cemented over the humeral stem of the native total elbow replacement. This tube is fashioned to either combine with the proximal PHR segments or be cemented over the existing humeral stems to bypass the fracture and restore upper limb function. The cavity in the extension piece has an irregular cross sectional area to allow for macro fixation of the cement, and there are also small proximal holes into it, to allow for cement escape when the stem is being inserted into the cement mantle. Figs. 2 and 3 show the design schematics for extension pieces created for various total elbow humeral stems previously.

2.1. Surgical technique

General anaesthesia with an inter-scalene block was utilised, with prophylactic antibiotics given on induction. Patients are positioned in a beach chair position, with all their pressure areas padded and calf pumps for deep vein thrombosis prophylaxis.

An extended Henry's approach to the humerus[10] is utilised to address the fracture with meticulous haemostasis along the way. The interval between pectoralis major and the deltoid insertion is identified and this forms the plain for longitudinally splitting the proximal humerus with an oscillating saw. The pre- determined amount of bone and loose proximal cement is removed off the arthroplasty humeral stem. Humeral head resection is then made and then the medullary content of the proximal humerus is removed with a large bone nibbler. An identical routine is carried out at the distal humerus if the prosthesis is to be cemented onto an existing humeral component.

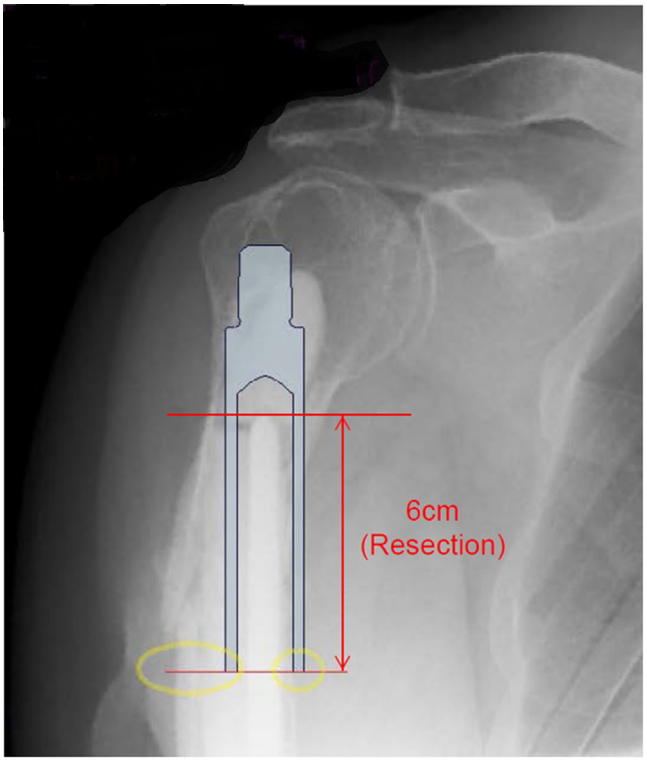

Fig. 1. Pre-operative templating of the custom made extension piece and the level of the distal bony resection for Patient A.

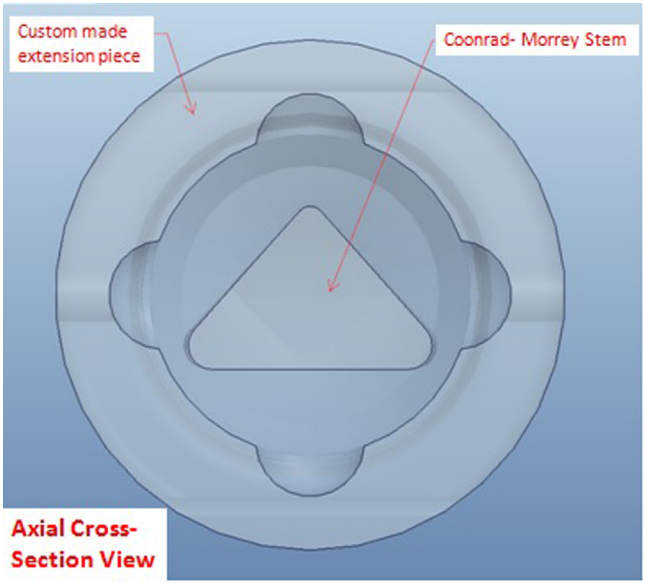

Fig. 2. Axial cross section view of an extension piece created for Patient A, who had a Coonrad- Morrey stem in situ. Note the irregular cross sectional shape of the cavity to ensure macro fixation of the cement.

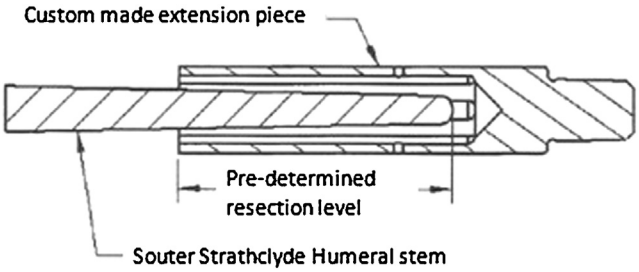

Fig. 3. Sagittal cross section view of an extension piece created for Patient B, who had a Souter- Strathclyde revision humeral stem in situ. Note the necessary minimum 6 cm overlap and the small proximal holes into the cavity to allow cement escape when the stem is inserted into the cement mantle.

Trial reduction with the definitive implants is then attempted. Once successful, they are removed and strong transosseous sutures are placed proximally in the inter-tuberosity region and circumferentially distally as well. This is in preparation for eventual closure of the humeral bone 'shell' over the definitive implants. The custom made sleeve is then filled with cement and docked on to humeral stem of the total elbow arthroplasty. The PHR is then fitted onto this in approximately 30° of retro version.

Once reduced, the greater and lesser tuberosities are reduced and secured through bone and over the implant. The distal circumferential sutures and the lateral aspect of the rotator interval are also secured. This will result in a satisfactory reduction of the humerus, which is stable through range of motion on the table and with good restoration of the soft tissue tension. The wound is copiously washed and closed in layers. Patients are allowed gentle active range of motion physiotherapy and are usually discharged on the second post-operative day.

3. Results

Our series has 6 RA patients whose peri-prosthetic fractures involving total elbow replacements were treated using custom made cemented tube extension pieces. These were performed over a span of 10 years, from 2006 to 2016. The patients were all female

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