Reconstruction with Composite Cement-Autoclaved Autograft after a Near-Total Excision of the Humerus for Osteosarcoma: A Case Report

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ABSTRACT

Osteosarcoma occurring in the humerus is often confined to the proximal part, in which case, reconstruction after excision is less daunting. When the tumour spreads down the medullary cavity distally, a total humeral replacement is often required. This is costly and beyond the means of the average patient in a developing country. An amputation is often the procedure of first resort. We report a 13-year-old boy with osteosarcoma originating from the left proximal humerus, with involvement of the marrow reaching down to the distal diaphyseal-metaphyseal junction, leaving only 6 cm of the distal humerus intact after wide resection. Reconstruction of the defect was done with a composite cement-autoclaved autograft fixed to the remaining humerus with a plate. At 40 months of follow-up, the patient is well with normal function of the elbow, wrist and hand. Salvaging the limb despite near total involvement of the humerus by high grade osteosarcoma is possible using material available in the average orthopaedic operating room.

INTRODUCTION

Osteosarcomas commonly occur at the proximal humerus. When it spreads down the medullary cavity distally, a total or near-total excision of the humerus is required, leaving only a short distal end. This necessitates a total humeral replacement or a tumour prosthesis with a short stem secured by cross pins to prevent aseptic loosening. Both are costly and technically difficult to do. We report a case where reconstruction was preformed with a composite cement-autoclaved autograft. To the best of our knowledge, this method of reconstruction has not been previously reported.

CASE REPORT

A 13-year-old boy was first seen at the Orthopaedic clinic with pain and swelling over the left shoulder of one month's duration. Examination revealed a 12 by 15 cm swelling over the shoulder and proximal part of the arm. Classical features of an osteosarcoma of the proximal humerus were seen on plain x-rays. An MRI showed that the tumour had extended down the marrow cavity to the level of the distal quarter of the humerus (Fig 1).

A biopsy confirmed the growth as a classical osteosarcoma. The chest radiograph, CT thorax and bone scan did not show any evidence of metastatis. Neoadjuvant chemotherapy with doxorubicin and cisplatin was started. Two weeks after the third cycle, the patient underwent a wide excision of the tumour. During surgery, the tumour mass was removed with a cuff of normal muscle together with the biopsy scar. This included the deltoid, and parts of the pectoralis major, biceps and rotator cuff muscles. The axillary nerve was sacrificed. The musculocutaneous nerve and the rest of the major neuromuscular bundle were identified and preserved. The humerus was osteotomised 3 cm distal to the intramedullary extent of the tumour as shown on the MRI. This left a 6 cm remnant of the distal end of the humerus (4 cm from the lateral epicondyle). The excised specimen was stripped of the covering soft tissue and gross tumour. The humeral head and adjacent metaphysis which had been destroyed by the tumour were also discarded. The remaining diaphysis was sent for autoclaving at 121 degrees centigrade for 10 minutes, killing all tumour and bone cells but leaving the gross structure intact. Utilising a rush rod cut to length, bone cement moulded in the shape of a humeral head and neck was mounted onto the "proximal end". The distal end was then passed through the autoclaved "tumour" bone and the whole composite fixed onto the remaining distal humerus with a limited contact dynamic compression plate (Fig 2). The construct was covered with intact muscles and the skin closed. The postoperative recovery period was uneventful. The subsequent histopathological examination of the excised tumour showed more than 90% necrosis; the patient proceeded to complete six cycles of the same chemotherapeutic agents.

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Fig. 1: MRI of the humerus showing the extent of the tumour through the medullary cavity.

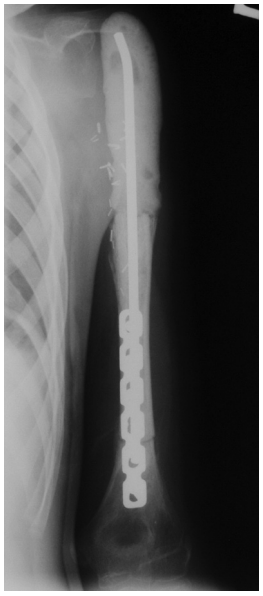

Fig. 2: Postoperative anteroposterior radiograph of the composite fixed to the distal humerus with a plate.

Fig. 3: Photograph of the patient at follow-up showing the function of the elbow, wrist and hand.

At the last follow-up, 40 months after the operation, the patient was well and with good elbow, wrist and hand functions. His Musculoskeletal Tumour Society functional evaluation was rated as 24/30 (80%).

DISCUSSION

The majority of humeral sarcomas occur proximally and are now treated with wide excision and reconstruction of the resulting defect. Various methods have been reported and regardless of the type of reconstruction, Damron *et al.*[1] stated that the function of the distal part (elbow, forearm and hand) was generally excellent. Postoperative shoulder function seems to be more variable. Courpied *et al*[2] reported a series of 46 patients and found that better results were obtained when the abductor mechanism was intact.

Asavamongkolkul *et al*[3], in his report of 59 patients with endoprosthetic reconstruction, concluded that elbow, forearm, and hand function remained essentially normal for all types of reconstruction. The level of active shoulder motion was a function of stability of the construct and the amount of rotator cuff and deltoid (along with the axillary nerve) retained and depended on the local extent of the tumour. In general, endoprosthetic replacement of the proximal humerus provides good long term results. It is a predictable procedure providing reasonable function of the arm with a low rate of complication[4].

When tumours of the proximal humerus approach the distal diaphyseal-metaphyseal junction, a short distal segment is left after resection with an oncologic margin. In such cases, a large proximal endoprosthesis with a short stem cemented to the distal fragment would be at risk of early failure from aseptic loosening. A total humerus reconstruction would be required. However, the need to rehabilitate two joints in series (shoulder and elbow) is a drawback. Cannon *et al*[5] made use of cross-pin fixation through the distal stem for these patients and reported a reduction in aseptic loosening.

For the patient described herein, the deltoid and axillary nerve were resected with the tumour. Without the abductor mechanism, shoulder movement is minimal with any reconstruction is chosen. Elbow, wrist and hand function were essentially normal. The intramedullary involvement was distal, with only 6 cm of the humerus left. This would have necessitated a total humeral replacement or a proximal long stem endoprosthesis with cross-pins. The cost of a megaprosthesis was beyond the patient's means. The cement autoclaved autograft composite replacement allowed a procedure within his financial constraints and with minimal delay, while preserving a limb with a functional elbow, wrist and hand. The whole of the excised segment could have been replaced by cement moulded on a rod. However, it would have been difficult to fix this cement block onto the distal humerus (6cm, with a widening medullary cavity). The autoclaved diaphysis allowed us to fix the composite construct securely using a plate.

Although there may be possible future problems with shoulder instability and limb shortening, the cost for Reconstruction with composite cement-autoclaved autograft is minimal and it is technically not difficult to do. It adds to the armamentarium of available options for the musculoskeletal tumour surgeon, especially in developing countries.

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