Reverse geometry shoulder replacement for proximal humeral metastases

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ABSTRACT

The management of skeletal metastases can be challenging for the orthopaedic surgeon. They represent a significant source of pain and disability for cancer patients, adding to the morbidity of their condition. Treatment is directed at the alleviation of symptoms and the restoration of function. Metastatic involvement of the proximal humerus can be especially debilitating, having the potential to cause severe pain and loss of function. We present a report of three such cases where reverse geometry proximal shoulder replacement was used to provide a pain free functional range of movement in patients with concomitant rotator cuff disease. In all cases, significant symptomatic relief was achieved postoperatively with preservation of upper limb function. No surgical complications were noted. It is our belief that this novel surgical strategy provides a valuable and effective option for the management of proximal humeral metastatic disease in the rotator cuff deficient patient.

KEYWORDS

Reverse – Geometry – Prosthesis – Metastatic – Shoulder

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Metastatic disease is the most common cause of bone malignancies, with the humerus being the second most common long bone to be affected.¹ Humeral lesions may cause severe pain and can be extremely debilitating through loss of function of the upper limb. Furthermore, lesions of the proximal humerus are at risk of spontaneous fracture as the metaphysis is a largely cancellous structure with low cortical rigidity, and it is subject to significant rotational and bending forces.² While chemotherapy and radiotherapy can be effective for sensitive tumours,³ surgery is indicated for intractable pain and for impending or established pathological fractures.⁴ The aim of surgical management is to alleviate pain and restore function, enabling a better quality of life for patients, who often have a limited prognosis.

Conventional surgical strategies for the management of humeral metastases include intramedullary nailing, plate fixation and cement augmentation of large bone defects.¹ When the lesion involves the proximal humerus, however, surgical management can be more challenging and definitive treatment with arthroplasty may be indicated.⁵ In elderly patients, concomitant poor rotator cuff function is not uncommon and can lead to unsatisfactory functional outcomes with standard shoulder prostheses.⁶ We present a report of three cases where the use of reversed geometry proximal humeral prostheses provided excellent symptomatic relief and a pain free functional range of movement in metastatic proximal humerus disease.

Case 1

A 72-year-old man was admitted to our institution following an acute deterioration of progressive left shoulder pain. His past medical history included partial bowel resection for T3 N0 bowel cancer three years previously, basal cell carcinoma of his right leg, paroxysmal atrial fibrillation, type 2 diabetes mellitus and chronic obstructive pulmonary disease. A diagnosis of a pathological fracture of his left proximal humerus was made, and computed tomography (CT) revealed disseminated malignancy with metastatic disease to both bone and lung. No primary lesion was identified. Widespread bony metastases were confirmed on bone imaging and oncology review estimated his prognosis to be in the region of 'months'.

The predominant reason for the patient's admission to hospital was severe shoulder pain secondary to his pathological fracture (Fig 1). This proved very difficult to control despite palliative care input and regular high dose opiate analgesia, leading to referral for operative fixation. *En bloc* excision of his proximal humerus was undertaken without complication and a reverse geometry shoulder prosthesis inserted (Fig 2). Excellent symptomatic relief was obtained immediately following surgery with a good functional range of movement. Despite some persistent hand oedema, both the patient and his carers were very satisfied with the intervention.

Figure 1 Pathological fracture of the left proximal humerus

Figure 3 Pathological fracture of the left proximal humerus (case 2)

Figure 2 Reversed polarity left shoulder prosthesis

Case 2

An 86-year-old man presented to the physicians with a non-specific history of malaise, weight loss and left shoulder pain. He was found to have a pleural effusion, widespread lytic bone lesions and a pathological fracture of his left humerus (Fig 3). Despite multiple investigations (including CT, multiple myeloma screening tests, diagnostic pleural aspiration, tumour markers and colonoscopy), no primary tumour was identified. His only past medical history of note was bilateral herniorrhaphies.

Examination demonstrated significant pain from the patient's left shoulder, greatly limiting his upper limb function. Referral was made for fixation and he subsequently underwent a long stemmed cemented reverse geometry shoulder replacement (Fig 4). This was again without complication and he was pain free by two weeks following surgery. Review two years later revealed a full, pain free range of movement and good radiographic appearance, and the patient described himself as 'almost back to normal'.

Case 3

A 79-year-old woman was admitted with a 1-week history of increasing right leg and right shoulder pain. Her past

Figure 4 Reversed polarity left shoulder prosthesis (case 2)

Figure 6 Long stemmed, cemented, reversed polarity right shoulder prosthesis

Figure 5 Lytic lesion of the right proximal humerus

medical history included right breast cancer diagnosed five years previously with multiple bony metastases. She had also suffered a subdural haematoma following a fall and had previously undergone bilateral total hip replacements with two revisions on the right side. In addition to rib and skull lesions, she was diagnosed with right humeral and distal femoral metastases (Fig 5). This led to prophylactic cable plating of her right femur and reversed geometry long stem right shoulder replacement, bypassing her humeral diaphyseal metastasis (Fig 6). Both were without complication and she was pain free at one week following surgery. All analgesia was discontinued prior to her discharge at two weeks and she demonstrated easy, pain free use of her hand with only slight restriction in shoulder mobility.

Discussion

Where conventional shoulder prostheses are used in cases of proximal humerus metastases, results are invariably poor and range of movement is greatly restricted. If the rotator cuff musculature is too weak to act as a joint centraliser, proximal migration of the prostheses can cause a painful subacromial impingement while functional results show little advantage over a simple diaphyseal spacer.⁷

The benefits of reversed geometry shoulder prostheses in rotator cuff arthropathy are well documented.^{6,8,9} By lowering and medialising the centre of rotation of the glenohumeral joint, the lever arm of the deltoid muscle is lengthened and its function enhanced. Short to medium-term results with such implants are encouraging⁸ and patients demonstrate good, early, active mobility of the upper limb without the risk of proximal migration of the prosthesis.¹⁰ Despite this, its use in proximal humeral tumour metastases is less well reported.

In all three cases we describe, excellent pain relief was achieved in the immediate postoperative period and despite some restricted range of movement, good upper limb function was achieved. Patients were not routinely followed up long term in an attempt to reduce their hospital episodes. However, all were very satisfied with the immediate and short-term results of their surgery. To date, now over four years following implantation of the first reverse prosthesis, none have returned to our service.

Conclusions

It is our belief that this novel surgical strategy for the management of proximal humeral metastatic disease can result in reliable and effective pain relief as well as good restoration of upper limb function when the resection margin is above the level of the deltoid insertion. This is the case without reliance on rotator cuff musculature and should therefore be considered in elderly patients where concomitant rotator cuff arthropathy is likely. A further benefit due to the constrained design of the reverse polarity prosthesis is that

postoperative mobility does not need to be as strictly protected as with fixation (which is highly unlikely to heal) or a standard total shoulder replacement where a lengthy and heavily involved postoperative physiotherapy programme is required. This is clearly desirable in cases where surgical treatment is essentially palliative, with the goal of expedient symptomatic relief and return to independent function.

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