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Federico Sacchetti
Università di Pisa

Stefano Giannotti
Università degli Studi di Siena

Nicola Bianchi
Università di Pisa

Fabio Cosseddu
Università di Pisa

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Case report

PROXIMAL HUMERUS RECONSTRUCTION AFTER TUMOR RESECTION: ENDOPROSTHESIS IMPLANT FOR ELDERLY PATIENTS.

Federico Sacchetti[1], Stefano Giannotti[2], Nicola Bianchi[1], Fabio Cosseddu[1], Roberta Ghezzi[2], Rodolfo Capanna[1]

1. Department of Orthopaedic and Trauma Surgery, University of Pisa, Italy
2. Department of Orthopaedic and Trauma Surgery, University of Siena, Italy

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ABSTRACT

Humeral reconstruction post tumor resection is a challenging quest. Reconstruction strategies depend first of all on age and general conditions of the patient, tumor dimensions, local invasion and bone quality. Many kinds of surgery are described in literature, mostly megaprosthesis, hemiartoplasty or alloprosthetic composite (APC) implants or allograft, allograft arthrodesis, clavicola pro-humeri or vascolarized fibula reconstructions. One of the most important goals of this surgery is to achieve implant stability. Surgical planning varies according to deltoid muscle, rotator cuff and axillary nerve conditions. When all these structures are conserved, an allograft or composite (anatomic or reverse arthroprosthesis) reconstruction could be a more suitable option for younger patients. When deltoid muscle function is impaired due to tumoral resection or axillary nerve disfunction, especially in elderly patients, surgeons prefer to implant endoprosthesis. The purpose of this paper is to describe the surgical technique to implant humeral megaprosthesis associated with tendon transfers and tips on how to achieve implant stability.

1. Introduction

Proximal humerus is a common location of both metastatic and primary bone tumors (1). After the resection, achievement of a stable and functional construct is mandatory. Reducing risks of complications and failures is equally important. Several reconstruction techniques exist nowadays such as prosthesis, APC implantation, autograft or allograft transplant (2). Allograft transplant was often used in the past, especially in young patients, because it is a bone stock-preserving technique and theoretically it should have optimal functional outcomes. APC can be used for young patients as well in order to achieve high functional results. On the other hand, these surgical solutions are complicated by high rates of failures and re-operations mainly due to fractures or nonunions (2,3,4). Megaprosthesis is a commonly used solution extensively evaluated in literature. Complication and failure rates are very low and it is relatively easy to implant (5,6). Hemiartroplasty has similar indications as megaprosthesis but it can be used only when bone resection is not too extensive.

Vascular fibula allograft is a technique that leads to brilliant functional outcomes and has a low complication rate but it is very difficult from a technical point of view. Clavicula pro-humeri can be used in pediatric patients (2,3).

2. Case presentation

A 74 year old female sought our attention for a left humerus massive osteolysis. She was in treatment for a metastatic lung carcinoma. She felt a disabling pain that was not responding to any medical pain therapy. She was already treated for a left proximal humeral fracture, the massive osteolysis was located distally in the diaphysis. We proposed a humeral resection and a megaprosthesis implant. Her rotator cuff was disrupted and the axillary nerve and deltoid were not functioning due to tumor invasion (figure 1). Our goal was to achieve a stable construct that would allow rotation of the shoulder and functional movements of her wrist and elbow.

* Corresponding author: Federico Sacchetti, federico.sacchetti1989@gmail.com
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Figure 1 - Preoperative Radiograph showing massive osteolysis.

3. Surgical technique

Surgical access and resection

The skin incision extended between the coracoid process and the humeral shaft to expose deltopectoral grove. An ellipse was formed around the biopsy track along with the skin incision. The deltoid was split in line with the biopsy track so as to leave all contaminated deltoid with the resected tumor. The biopsy track was dissected down where it entered the humerus, and care was taken to avoid avulsion to the biopsy track from the proximal humerus. The subscapularis and pectoralis muscles were tenotomized from the proximal humerus, leaving a safe margin. The anterior capsulotomy was performed with the subscapularis takedown. The remaining rotator cuff muscles as well as the superior and posterior capsules were identified and transected leaving a safe margin. The long head of the biceps was tenotomized at the rotator interval. The latissimus dorsi and teres major were identified and transected with a safe margin. The dissection was then carried distally as far as the tumor required. Radial nerve was identified and protected. A saw was then used to osteotomize the humeral shaft with Bennett retractors placed circumferentially to protect surrounding structures.

Proximal humerus and soft tissue reconstruction

Trial stem and proximal humerus prosthesis were implanted to test soft tissue tension. Irrigation of the wound and the distal humerus was then performed. The operator cemented the final stem into the distal humerus using standard cement pressurization techniques while the cement was still soft. The surgical team removed all excess cement and compressed the prosthesis with the appropriate proximal humeral retroversion. After implantation, the surgical team tested stability and internal and external rotations. Modular proximal humeral components could still be changed at this point if necessary to increase tension as needed. We routinely use cement filled with antibiotics. To increase stability, our team fixed the prosthetic head to the scapular glena using prolene net with transosseus stitches (Figure 2). Finally, the operator fixed the latissimus dorsi and pectoralis major tendons to the net. Attached to the anterolateral aspect of the net was pectoralis major to allow internal rotation of the shoulder while attached to the posterolateral aspect was latissimus dorsi so as to achieve external rotation of the shoulder (Figure 3 and 4).

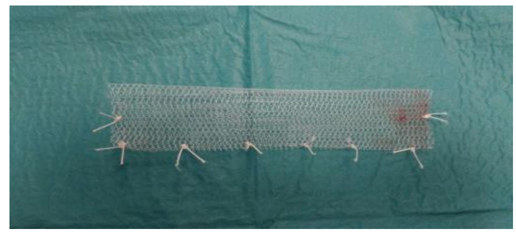

Figure 2 – Prolene net

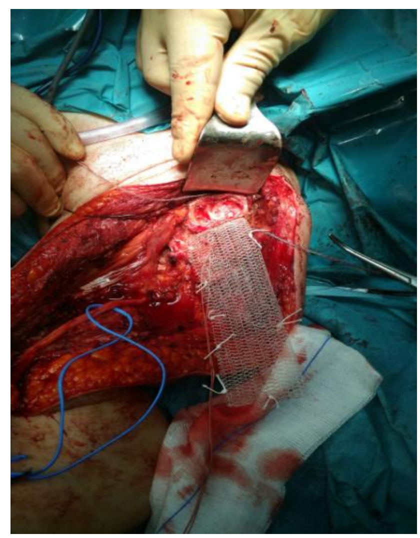

Figure 3 – Prolene net fixed to the glenoid cavity.

Figure 4 - Endoprosthesis implantation.

4. Discussion

Over the years, limb salvage has become the preferred choice after oncological musculoskeletal resections. Given the same survival rates and the same cost-effectiveness, limb salvage can allow patients to have more acceptable outcomes. Several reconstruction techniques can be performed after oncological resection of the proximal humerus. The correct choice should be made according to tumor characteristics, age, general conditions and the resection plan. Axillary nerve, deltoid muscle and rotator cuff conditions should be carefully evaluated before surgery. Most observers have noted a reduction in the ability to lift and function with the upper limb after resection of the proximal humerus with any form of limb-sparing reconstruction, however, they have also noted good positioning of the hand, good manual dexterity and emotional acceptance (2,3,6). Endoprosthetic replacement of proximal humerus has been extensively reported in literature and is considered the safest technique in terms of failure and complication rates (2,3,6). Allograft and APC techniques could allow the best functional outcomes but complications, failures and re-operation rates are very high compared to megaprosthesis implants. Allograft and APC transplants should grant major stability with rotator cuff repair and a better terrain for the host soft tissue attachment. Nevertheless non-union and fracturing at the site of contact with host bone are common and in the long term the rotator cuff repair tends to degenerate. Vascularized fibula and clavicula pro-humeri are techniques usually reserved to pediatric patients and although it has good functional outcomes, these techniques are very demanding and require long-lasting interventions. In our opinion, age and general conditions should be the primary factors to consider when deciding upon a surgical reconstruction technique. In younger patients with long life expectancy, autograft or APC transplant should be proposed considering preservation of bone stock and better functional outcomes. In elderly patients, endoprosthetic replacement should be the preferred option, especially considering the very high survival rates and low re-operation rate (Figure 5).

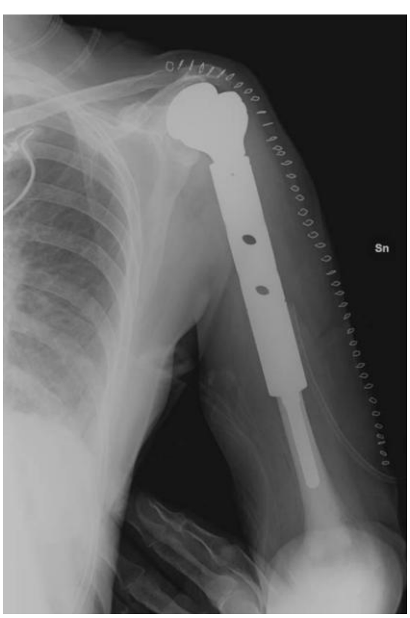

Figure 5 - postoperative Radiograph.

In order to accomplish their daily activities, these patients should be able to move their elbow and wrist and perform shoulder rotations. Implanting endoprosthesis generally leads to good functional outcomes for elderly people. Their reconstructed shoulders should be stable and able to rotate. Our surgical technique was planned to reach these goals. We fixed the prosthetic head with prolene net to the scapular glena in order to gain stability, while tendon attachments were also planned to gain rotational movements. In our opinion, prolene net can contribute to create a terrain where soft tissue attachment can be easier than on metal. In conclusion, endoprosthetic implants should be the first choice to reconstruct proximal humerus after resection in elderly patients.

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