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Original article

Total elbow arthroplasty for primary and metastatic tumor

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ABSTRACT

Background: Prostheses can be used in elbow reconstruction in both primary and metastatic lesions. Several authors have reported their experience with different types of implant, but not with modular prostheses.
Hypothesis: Limb salvage using an elbow prosthesis is effective in obtaining good functional results and reliable local tumor control.
Material and methods: Forty-seven patients treated at the Rizzoli Institute for elbow neoplasm from 1990 to 2012 were evaluated. There were 30 primary tumors (64%), 24 bone tumors and 6 soft tissue sarcomas, and 17 bone metastases. Elbow reconstruction used a modular prosthesis in 25 patients and a standard prosthesis in 22. Reconstruction was primary in 30 patients and secondary in 17.
Results: At last control, 15 (32%) were dead of disease (DOD) at a mean follow-up of 35 months, 12 (25%) were alive with disease (AWD) at a mean follow-up of 29 months, 19 (40%) showed no evidence of disease (NED) at a mean follow-up of 80 months. Early complications were related to unexpected neurological damage, observed in 12 patients (25%): in 5 cases the deficit resolved in a mean 6 months; in the others, no or only partial recovery was observed. Two implants (4%) developed infection: 1 was treated with antibiotic therapy, and the other required implant revision. One implant showing cement extrusion was revised. In 3 patients (6%) radiography showed a radiolucent halo around the stem (2 humeral, 1 ulnar); no measures were taken, as the patients were completely asymptomatic at every follow-up. In 3 patients (6%) partial resorption of the allograft was observed on X-ray, but remained unchanged at last follow-up, without pain or functional impairment. Seven local recurrences (15%) were observed, at a mean of 16 months after surgery; 5 were treated by resection and/or radiotherapy, and 2 by amputation. Mean functional scores on MEPS and MSTS were respectively 84% and 22/30 (73%).
Conclusions: Elbow prostheses provided better function in primary than in metastatic tumor. Elbow prosthesis reconstruction after tumor resection is a viable option both for primary and secondary bone neoplasms.
Type of study: Therapeutic.
Level of evidence: IV, retrospective study.

1. Introduction

The elbow is a rare site for bone and soft tissue tumor (<1%). Before the 1970s, amputation was the most frequent curative treatment for primary malignant tumor of the upper limb. Limb-salvage surgery has since become the most common attitude in carefully selected patients, due to better functional results and emotional acceptance compared with amputation. However, achieving good oncological margins around the elbow often requires nerve and muscle sacrifice, resulting in functional disability [1,2]. Reconstructive options include arthrodesis, osteoarticular allograft, allograft-prosthesis composite (APC), and prosthetic reconstruction. Arthrodesis is poorly tolerated by patients and technically difficult to perform [3]. Reconstruction with osteoarticular allograft frequently shows instability, pain, high rates of major complications and poor functional outcome [4]. APC and elbow prostheses, on the other hand, restore bone defects, with satisfactory function and pain relief and relatively few complications [5–8]. Prosthetic elbow reconstruction for degenerative joint disease, rheumatoid arthritis and trauma has been extensively studied, but series of reconstruction after tumor resection are rare [9,10].

The purpose of this study was to assess whether limb salvage by elbow prosthesis provides benefit without compromising local or systemic disease control.

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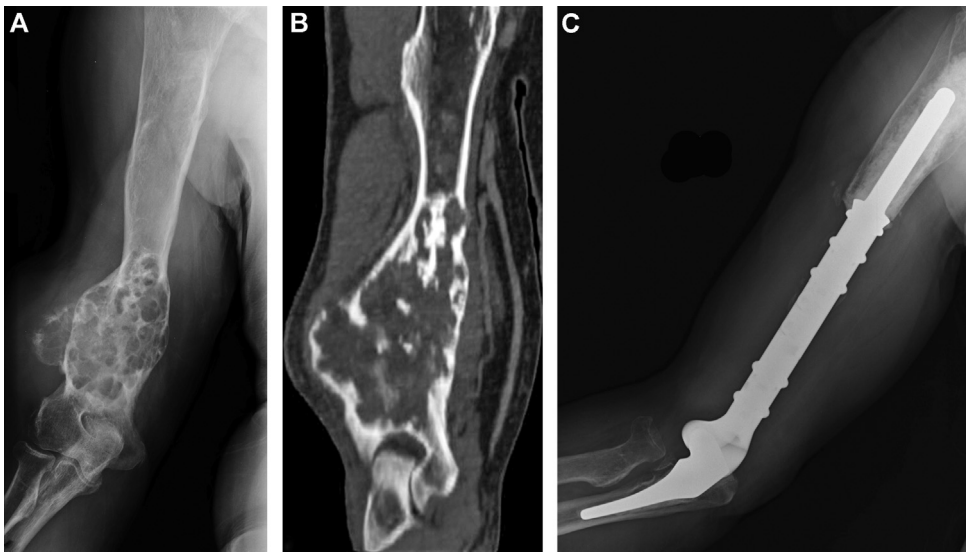

Fig. 1. A 63 year-old man with Ollier disease. X-ray (A) and CT (B) show cartilaginous neoplasms involving the distal humerus. Resection and reconstruction with a Mutars modular prosthesis was performed; X-ray (C) shows control at 2 years' follow-up.

2. Material and methods

Forty-seven patients with musculoskeletal tumor located in the elbow were retrospectively evaluated. All were treated in the same institute, by the same surgical team, between 1990 and 2012. Inclusion criteria were:

- primary or metastatic cancer involving the elbow;
- reconstruction by prosthesis, with or without graft;
- complete follow-up information.

All medical records, histology slides, radiographs and outcome were reviewed. A lateral approach to the upper arm and an anterior approach to the forearm were the most common exposures, modified according to tumor extension. The biopsy tract was always excised, including it in the surgical incision or using another incision. When possible, nerves were detached from the tumor, leaving the sheath attached to the mass so as to secure a wide margin. The triceps tendon was usually spared. Bone resection was planned on MRI. In young patients, primary benign tumors, primary malignant tumors with short resection or small soft-tissue mass, and metastatic lesions without muscle sacrifice, APC was preferred. Cement was applied when only a few centimeters of the distal humerus were resected; when longer resection was necessary, an allograft was used. Total humerus reconstruction was performed after failure of previous treatment of the diaphyseal to proximal humerus or after a very large humerus resection in primary malignant tumor.

Twenty-five modular prostheses were implanted: 18 (38%) HMRS (Stryker-Howmedica Inc., Rutherford, NJ) and 7 (15%) Mutars (Implantcast GmbH, Buxtehude, Germany). Twenty-two standard elbow prostheses were used: 3 (6%) Latitude (Tornier, Stafford, TX) and 19 (40%) Coonrad-Morrey (Zimmer, Warsaw, IN). In 16 cases (72%) a standard prosthesis was combined with allograft (APC); the remaining 6 used cement or small bone grafts. In 15% of patients (7/47), total humerus reconstruction was performed (Figs. 1–3).

All patients had their arm immobilized in a sling for 2 weeks until the wound healed. Active and passive finger movement was initiated in first postoperative day. Active elbow movement was initiated at 1 week in cemented prostheses, 4 weeks in uncemented prostheses, and 6–8 weeks in APC. Functional analysis used the Mayo Elbow Performance (MEP) and Musculo-Skeletal Tumor Society (MSTS) scores. The Toronto Extremity Salvage Score (TESS) was used to evaluate daily life activities. Tests were administered at last check-up. Implant survival was evaluated on Kaplan-Meier survival curves, with date of surgery as starting point and amputation, revision or implant ablation as end-points. Comparison was performed between patients with primary tumor versus metastasis, and between primary implantation versus secondary resection and reconstruction.

3. Results

Patient data are reported in Table 1. Fifteen patients (32%) died of disease at a mean 35 months (range, 7–168 months), 12 (25%) were alive with disease at a mean 29 months (10–54 months), 19 (40%) were continuously disease-free at a mean 80 months (27–226) and 1 was disease-free after resection of lung metastasis and local recurrence at 12 months post-surgery. Thirty-five patients had between 5 and 20 cm distal humerus resection, for a mean of 12 cm. The ulna was resected for 7.5 cm in 1 patient with osteosarcoma, for 12 cm in 1 with metastasis from lung carcinoma, and for 3 cm plus 8 cm of the distal humerus in 1 patient with synovial sarcoma. The radius was resected for 10 cm in 1 patient with soft-tissue sarcoma, and for 5 cm plus 12 cm of the distal humerus in 1 patient with osteosarcoma bone metastasis. In 7 patients (15%), the whole of the humerus with the elbow joint was removed. Surgical margins were wide in 37 patients (79%), wide and contaminated in 3, marginal in 3 and intralesional in 4. Further surgery was not performed for inadequate margins, but chemotherapy and/or radiotherapy when possible. Six cases of local recurrence were observed: 3 primary tumors, and 3 metastases.

In 6 patients (13%), nerves were sacrificed to obtain wide margins: 5 radial and 1 ulnar. Early complications due to unexpected neurological damage were observed in 12 patients (25%): 7 involving the radial nerve (58%), 4 the ulnar nerve (33%) and 1 all elbow nerves (8%). Only 2 partial radial nerve palsies persisted at last follow-up; the other 5 patients showed complete recovery at a mean 6 months. Paresthesia persisted in all patients with ulnar nerve deficit. In the patient in whom all three nerves were involved, only radial nerve deficit persisted at 1 year post-surgery.

Two patients (4%) had postoperative infection. In 1 case, antibiotic therapy maintained chronic infection without implant removal until death from the oncological disease. In the other infected