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CASE REPORT

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Endoprosthetic replacement of the humerus combined with trapezius and latissimus dorsi transfer: a report of three patients

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Abstract *Introduction* To improve the functional outcome after proximal and/or total humerus replacement, we combined the surgical procedures described by Bateman and Gerber. *Materials and methods* In three patients after wide tumor resection, endoprosthetic replacement with a modular tumor endoprosthesis (MUTARS System) was performed. In addition to a capsular and muscular reconstruction using the Trevira tube, a trapezius transfer onto the Trevira tube in combination with a latissimus dorsi transfer onto the Trevira tube was performed. The patients were immobilized for 6 weeks after surgery with an abductor cast. *Results* After a follow-up of 1 year, there was no significant improvement of the shoulder function in comparison with patients who did not undergo the combined muscle transfer (control group $n=16$: mean abduction 37.5°; mean anteversion 35.0°; mean internal rotation 15.2°; mean external rotation 25.2°). *Conclusion* In our patients, the combination of the Gerber and the Bateman procedures did not improve the shoulder function in patients with proximal and/or total humerus replacements. Therefore, the functional results do not justify two separate approaches and a prolonged operation time.

Keywords Arthroplasty · Humerus · Postoperative complication · Prosthesis failure · Prosthesis-related infection/surgery

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Introduction

A current problem in the endoprosthetic replacement of the proximal humerus and the total humerus in tumor and revision cases is the high rate of reoperation for failure of the reconstruction [5]. The functional outcome after partial and total humerus replacement is poor, so an improvement in endoprosthestetic reconstruction would increase the quality of life [10].

Case report

Between June and September 2001, three patients underwent a proximal and/or total humerus replacement with a modular endoprosthesis, performing the Bateman procedure in combination with the Gerber procedure (Table 1).

The tumor resection was performed according to the surgical oncologic rules established by Enneking et al. [2]. Resection of the axillary nerve was included to achieve a wide margin. Therefore, the abductor ability of the deltoid was disabled. The bony defect was reconstructed with a modular tumor endoprosthesis of the MUTARS System, Implantcast Corp. (Fig. 1), which is made of titanium-aluminum-vanadium to minimize weight and facilitate muscle control of the extremity. To prevent dislocation of the endoprosthesis, we used a Trevira tube for capsular reconstruction (Fig. 2). This tube was fixed to the labrum glenoidale and to the endoprosthesis with non-absorbable Ethibond sutures. In a second approach, the lattisimus dorsi transfer according to Gerber et al. [4] was performed with a tendon reattachment onto the tube (Fig. 3). This procedure should establish an active external rotator and should compensate the absence of the supraspinatus and the infraspinatus muscle function. Furthermore, the trapezius muscle, including the lateral part of the acromion and clavicle [1], was transposed to the attached tube of the endoprosthetic device according to Bateman

Table 1 Patient data and functional results (*NED* no evidence of disease, *K-Q* functional evaluation, MSTS score [13]

Case no.	Age (years)	Diagnosis/ indication	Resection	Operation time (minutes)	Follow-up (months)	Shoulder abduction	Shoulder flexion	Shoulder ext. rotation	Shoulder int. rotation	Pain	Function	Emotional acceptance	Positioning of hand	Manual dexterity	Lifting ability	Total
1	10	Intralesional nailing for a pathological fracture because of osteosarcoma of the humerus	Wide intraarticular	310	18 NED	40°	40°	35°	20°	5	5	4	2	5	4	25
2	12	Osteosarcoma of the proximal humerus	Wide intraarticular	345	12 NED	35°	30°	25°	20°	5	5	4	1	5	4	24
3	14	Osteosarcoma of the humerus	Wide intraarticular	420	12 NED	30°	35°	30°	15°	5	5	4	2	5	4	25

Fig. 1 MUTARS proximal humerus replacement, made of titanium-aluminium-vanadium for cementless implantation

(Fig. 4). This technique should improve the abductor capability.

Furthermore, the subscapular muscle, the deltoid, the triceps and the biceps muscle were reattached onto the Trevira tube according to Gosheger et al. [7]. The patients were immobilized with an abductor cast for 6 weeks after surgery.

Results

All patients showed primary wound healing without any complications. Six weeks after immobilization with an abductor cast, physical therapy was started. The usual range of motion of patients with proximal/total humerus replacement was reached within 3 months. The radiographic follow-up showed a maintained articulation of the humerus replacement with the glenoid and a bony ingrowth of the transposed acromion into the Trevira tube (Fig. 5). The functional results concerning abduction, flexion and external rotation could not be improved (Table 1) in comparison with the control group of 16 patients without the combined procedures. The control group presented a mean active abductor motion against gravity of 37.5° (range 0–75°), a mean anteversion of 35.0° (range 5–79°), a mean internal rotation of 15.2° (range 10–35°), and a mean external rotation of 25.2° (range 15–45°). The cosmetic aspect showed a positive outcome by avoiding a sulcus

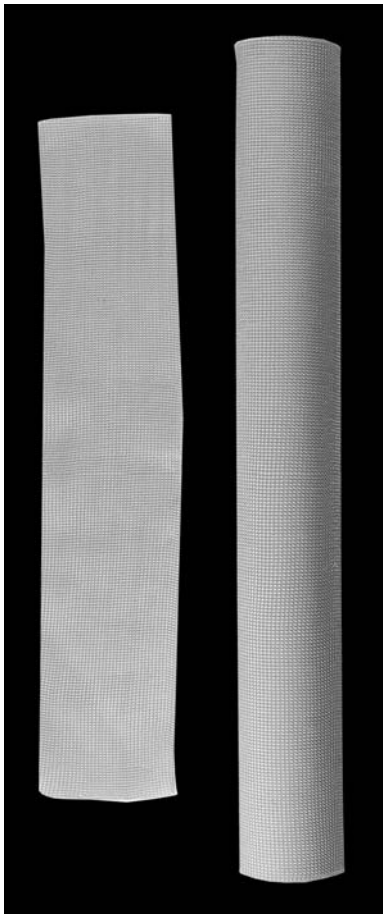

Fig. 2 MUTARS Trevira tube for the capsular reconstruction and for the reattachment of the soft tissue

sign. A prolonged operation time (310–420 min) was necessary to perform the tumor resection and the reconstructive procedures.

Discussion

Proximal/total humerus replacement results in a functional deficit. The endoprosthetic replacement with a modular tumor endoprosthesis and reconstruction with allograft replacement or with composite replacement result in a poor function and a limited range of motion [5, 6, 7, 8, 10] . Using the Trevira tube (MUTARS System), dislocations in proximal/total humerus replacement can be avoided [7].

Bateman [1], Saha [11], and Kotwal et al. [9] used the trapezius transfer to improve function in patients with deltoid paralysis. Gerber [3] and Saha et al. [12] successfully performed the latissimus dorsi transfer in patients to improve shoulder flexion and external rotation after rotator cuff lesions. In our patients, the combination of the Gerber and the Bateman procedures did not improve the shoulder function in patients with proximal/total humerus replacements.

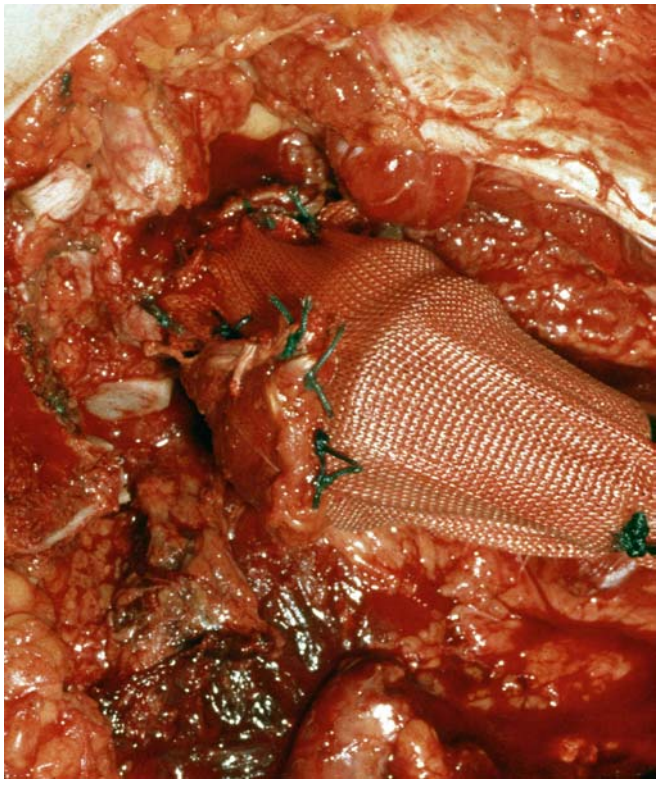

Fig. 3 Reconstruction of the capsule using the Trevira tube and tight fixation of the tube onto the endoprosthesis using Ethibond nonabsorbable sutures. The transferred latissimus dorsi tendon is fixed onto the Trevira tube in the superolateral area of the endoprosthetic device

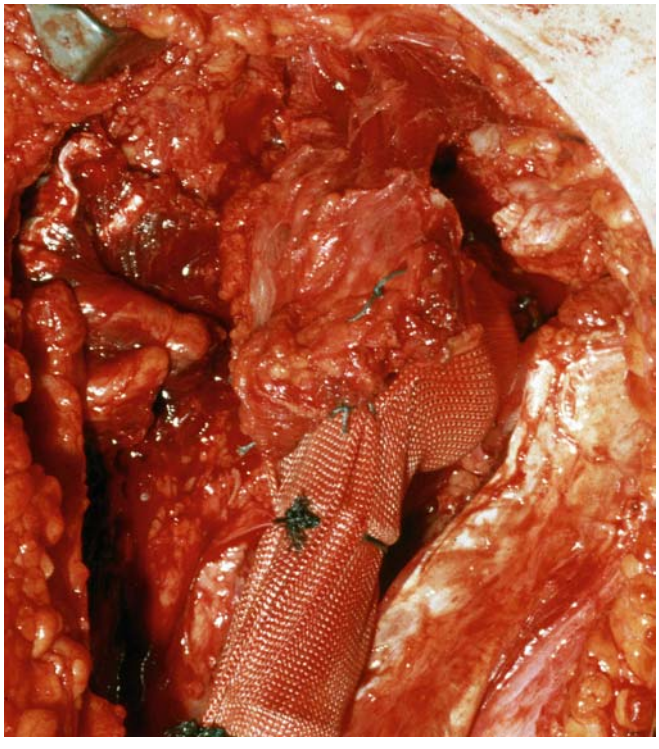

Fig. 4 The trapezius is rerouted to the endoprosthesis using the Trevira tube. Multiple crushing of the acromion helps coaptation with the curve of the endoprosthesis

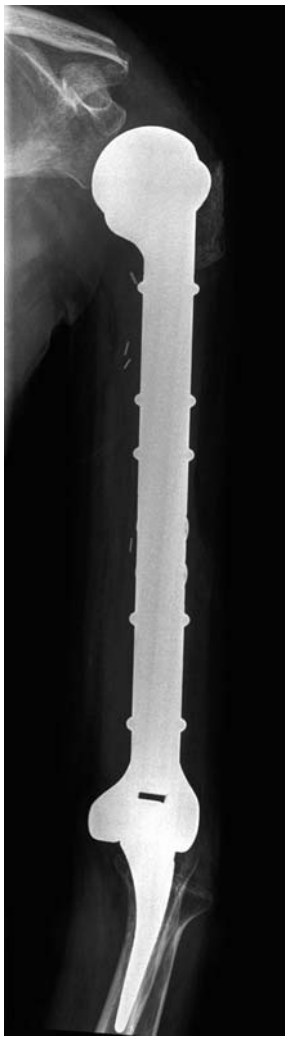

Fig. 5 Radiographic follow-up 6 months after surgery of a total humerus replacement (patient no. 2): a bony ingrowth of the transposed acromion/clavicle onto the Trevira tube is shown

The reason for lack of improvement in shoulder function with the combined procedure could be the missing rotator cuff. The necessity for a properly functioning rotator cuff seems to be very important, causing compression of the articular surfaces so that a transposed trapezius muscle could function as an abductor in a stable joint. The Trevira tube as a static stabilizer did not provide sufficient joint stability for the abductory function of the transposed trapezius.

Therefore, the functional results do not justify two separate approaches and a prolonged operation time. Further investigations should concentrate on the design of endoprostheses in order to improve the functional outcome after proximal/total humerus replacement.

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