J Shoulder Elbow Surg (2017) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Extra-articular shoulder resections: outcomes of 54 patients

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Background: The survival of patients with tumors around the shoulder treated with extra-articular resection, the rates of reconstructions-related complications, and the function of the shoulder cannot be estimated because of limited available data from mainly small published related series and case reports.

Methods: We studied 54 patients with tumors around the shoulder treated with extra-articular shoulder resections and proximal humeral megaprosthetic reconstructions from 1985 to 2012. Mean tumor volume was 549 cm^3, and the mean length of the proximal humeral resection was 110 mm. Mean follow-up was 7.8 years (range, 3-21 years). We evaluated the outcomes (survival, metastases, recurrences, and function) and the survival and complications of the reconstruction.

Results: Survival of patients with malignant tumors was 47%, 38%, and 35%, at 5, 10, and 20 years, respectively. Rates for metastasis and local recurrence were 60% and 18.5%, respectively. Survival was significantly higher for patients without metastases at diagnosis, tumor volume <549 cm^3, and type IV resections. Survival of reconstructions was 56% at 10 years and 48% 20 years. Overall, 19 patients (35.2%) experienced 30 complications (55.5%), the most common being soft tissue failures that required subsequent surgery without, however, implant removal. The mean Musculoskeletal Tumour Society score was 25 points, without any significant difference between the types of extra-articular resections.

Conclusion: Tumor stage and volume as well as type of resection are important predictors of survival of patients with malignant tumors around the shoulder. Survival of the reconstructions is satisfactory; nevertheless, the complication rate is high. The Musculoskeletal Tumour Society score is similar with respect to the type of resection.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Sarcoma; shoulder; resection; Tikhoff-Linberg; extra-articular; outcome

Tumors around the shoulder account for approximately one-third of all tumors[10,28,39]; the proximal humerus, scapula, and clavicle are the most common sites.[47] Until the 1970s, forequarter amputations and shoulder disarticulations were the treatment of choice for most patients with malignant tumors of the shoulder.[47] Current advances in imaging, surgery, and

This study was approved by the Institutional Review Board/Ethics Committee of the authors' institutions.

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1058-2746/$ - see front matter © 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2017.04.019

adjuvant treatments have enabled limb salvage surgery for 80% to 95% of these patients.[2,47] A forequarter amputation is indicated for tumors involving the neurovascular bundle, for recurrent tumors, when bypass surgery cannot be performed or wide repeat resection is not feasible, and for failed limb-salvage resections and reconstructions.[8,23-25,28,30,31,33]

Partial scapulectomy was first reported by Liston in 1819 for an ossified aneurysmal tumor. Most shoulder girdle resections since then were done for low-grade tumors of the scapula and periscapular soft-tissue sarcomas.[27-29] Wide (microscopically negative) resection of a sarcoma that extends to the shoulder joint requires an extra-articular glenohumeral joint resection.[8,23-25,28,30,31,33] Total scapulectomy and extra-articular resection of the glenohumeral joint by an osteotomy inferior to the glenohumeral capsule indicates the Tikhoff-Linberg resection.

After the initial description of the Tikhoff-Linberg resection for osteosarcoma and Ewing sarcoma of the proximal humerus and scapula in the 1980s, modifications of the typical procedure have been developed.[1,3,9,11,14,15,17,21,27,29,32,34-36,38,42-46] The typical Tikhoff-Linberg resection does not preserve the deltoid or trapezius muscles; however, to provide adequate soft tissue coverage for the scapular prosthesis, these muscles must be retained (modified Tikhoff-Linberg resection).[24,27,29,32] Another important modification has been the excision of only the lateral part of the scapula, whenever possible.[8,28]

Malawer et al[28] described 3 techniques for intra-articular shoulder resections (types I, II, and III) and 3 for extra-articular (Tikhoff-Linberg) shoulder resections (Fig. 1). After extra-articular resection, reconstruction options include megaprosthetic or osteoarticular allografts, or both.[6-8,19,40] The extent of tumor resection and remaining muscles for

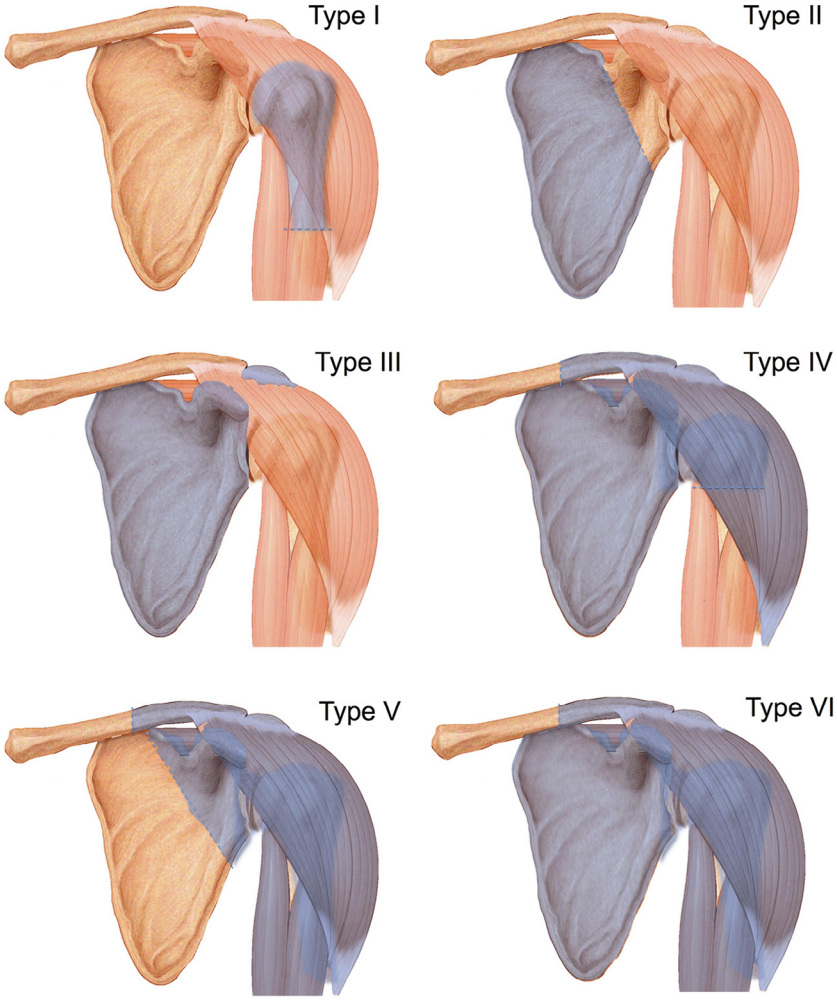

Figure 1 An illustration shows the types of intra-articular (types I, II, and III) and extra-articular (Tikhoff-Linberg) shoulder resections (types IV, V, and VI) according to Malawer et al.[28] Type I includes intra-articular proximal humeral resection, type II includes partial scapular resection, type III includes intra-articular total scapulectomy, type IV includes extra-articular total scapulectomy and humeral head resection, type V includes extra-articular proximal humeral and glenoid resection, and type VI includes extra-articular total scapulectomy and proximal humeral resection. Each type is divided into a subtype A or B depending on whether the abductor muscles are retained (subtype A) or resected (subtype B) with the tumor specimen.