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Functional reconstruction of the deltoid muscle following complete resection of musculoskeletal sarcoma

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KEYWORDS

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Summary Although the deltoid muscle has been assumed to be an essential shoulder muscle, the full extent of postoperative functions of the upper extremity following its complete resection due to sarcoma has not been thoroughly investigated. In this study, we review patients who underwent wide resection for sarcoma in the deltoid muscle, followed by functional reconstruction using pedicled latissimus dorsi (LD) muscle transfer. Four patients with sarcoma arising in the deltoid muscle were reviewed. Tumor resection with a wide surgical margin resulted in loss of the entire deltoid muscle together with the axillary nerve. For reconstruction, the ipsilateral pedicled LD muscle was transferred on its neurovascular pedicle for use as a functional substitute. One case had local recurrence and the transferred LD myocutaneous flap was resected. There were no serious complications after the operation, and all flaps survived perfectly. Wound healing at both the recipient and donor sites was uneventful. Active abduction of the shoulder joint was $>160^\circ$ in all patients. The muscle manual test of shoulder flexion was good to normal and abduction was fair to good. Musculoskeletal Tumor Society scores were excellent in all cases and the average score was 92% (range, 87–93%). Our results suggest that removal of the entire deltoid muscle resulted in a slight impairment of function. Pedicled LD musculocutaneous flaps are useful for covering the defect that results from resection of the deltoid muscle and they contribute additional function to the affected shoulder.

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Introduction

Musculoskeletal sarcomas can occur around the shoulder joint, in the deltoid muscle, which is frequently the site of origin of this soft-tissue sarcoma.¹ Wide surgical resection of the tumor with the deltoid muscle often results in large and complex defects.^{2,3}

The deltoid muscle is the prime mover and the most powerful with regard to elevation of the shoulder joint. Together with the rotator cuff muscles, it is also responsible for stabilization of the humeral head.¹⁸ Although the deltoid has been assumed to be an essential shoulder muscle, the full extent of postoperative functions of the upper extremity following its complete resection due to sarcoma has not been thoroughly investigated. Only a few studies have so far reported on functional reconstruction of the deltoid muscle.^{2,4,5}

In this study, we review patients who underwent wide resection for sarcoma in the deltoid muscle, followed by functional reconstruction using pedicled latissimus dorsi (LD) muscle transfer. Our aim was to investigate the oncological and functional outcomes for these patients. We also discuss whether functional reconstruction is necessary following oncological resection of the entire deltoid muscle.

Patients and methods

We reviewed the clinical outcome of four patients with sarcoma arising in the deltoid muscle. The clinical data for these patients are shown in Table 1. All four patients were male and their mean age during the time of operation was 68 years (range, 60–76). Two cases were diagnosed with high-grade undifferentiated pleomorphic sarcoma and two with liposarcoma. The Enneking surgical staging⁶ was IIb for two patients and Ib and III for the others. Only one case received chemotherapy. Because the sarcomas occupied the deltoid muscles, tumor resection with a wide surgical margin resulted in the loss of the entire deltoid muscle together with the axillary nerve. For reconstruction, the ipsilateral pedicled LD muscle was transferred on its neurovascular pedicle for use as a functional substitute. Humeral insertion of the LD was kept in three patients and reattachment to the deltoid tuberosity in one patient. The donor site was closed without any complications.

Each patient was evaluated for oncological, surgical, and functional outcomes. The functional results were

Table 2 Clinical and oncological outcome after surgery.

Case	Status	Active abd (degree)	MMT ^c flex/abd	Complication	Individual MST ^d score	MST ^d score (%)
1	AWD ^a	160	4/3	Local rec.	5 3 5 5 5 3	87
2	NED ^b	170	5/4	None	5 5 5 5 5 3	93
3	AWD ^a	160	5/4	None (meta)	5 3 5 5 5 5	93
4	NED ^b	170	5/4	None	5 3 5 5 5 5	93

^a AWD; alive with disease.

^b NED; no evidence of disease.

^c MMT; muscle manual test.

^d MST; Musculoskeletal Tumor Society scoring based on six categories; pain, functional activities, emotional acceptance, manual dexterity, positioning of the hand, lifting activity, with a maximum of five points for each category.

assessed at final follow-up using the Musculoskeletal Tumor Society (MTS) score for the upper extremity.⁷

Results

At the final follow-up, two cases showed no evidence of disease and two were alive with the disease. No local recurrences were seen in three cases. Case #1 sustained a seventh local recurrence of liposarcoma and the recurrent lesion was multiple. Then, he had an eighth local recurrence during the primary resection in our hospital. The transferred LD myocutaneous flap was resected and replaced with a pectoralis major myocutaneous flap during the second operation. During operation, minor tears of the rotator cuff were found in two patients.

There were no serious complications after operation, and all LD flaps survived perfectly. Wound healing at both the recipient and donor sites was uneventful. Active abduction of the shoulder joint was >160° in all patients. The muscle manual test of shoulder flexion was good to normal and abduction was fair to good. Muscle contraction of the transferred LD was recognized during shoulder abduction. MTS scores⁷ were excellent in all cases and the average score was 92% (range, 87–93%; Table 2).

Case presentation (case #4)

A 63-year-old man was referred to our hospital with a diagnosis of undifferentiated high-grade pleomorphic

Table 1 Characteristics of four patients with sarcomas in the deltoid muscle.

Case	Gender/age	Pathology	Surgical Stage	Chemotherapy	Rotator cuff tear	MC flap	Flap size (cm)	FU (month)
1	73/M	Liposarcoma	IIB	No	Minor	Pedicled LD ^b (no function)	12 × 4	106
2	60/M	Liposarcoma	IB	No	Intact	Pedicled LD ^b	17 × 9	78
3	76/M	UPS ^a	III	No	Intact	Pedicled LD ^b	20 × 5	22
4	63/M	UPS ^a	IIB	Yes	Minor	Pedicled LD ^b	17 × 5	12

^a UPS; undifferentiated pleomorphic sarcoma.

^b LD; Latissimus dorsi.

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