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Analysis of immediate vascular reconstruction for lower-limb salvage in patients with lower-limb bone and soft-tissue sarcoma☆

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Summary *Background:* Limb amputation has historically been the first choice of treatment for patients with bone or soft-tissue sarcomas involving major blood vessels. However, recent advances in surgical technique have allowed limb-salvage surgery. We reviewed our experiences with limb-salvage surgery and immediate vascular reconstruction following *en bloc* resection of bone or soft-tissue sarcomas of the lower extremity.
Materials and method: We reviewed 23 patients (15 male and eight female; mean age, 43.6 years) who underwent limb-salvage surgery and immediate vascular reconstruction. Details of surgical factors and postoperative complications were evaluated.
Results: Reconstructed vessels remained patent in 21 cases. The rate of limb oedema was higher in patients who underwent only arterial reconstruction after arteriovenous resection. Twenty patients could walk well without crutches a few months after reconstructive surgery. All patients avoided amputation. Two patients died of disseminated disease within 3 years after surgery.
Conclusion: The high rate of limb oedema suggests that venous reconstruction is necessary after arteriovenous resection. Vascular reconstruction and musculocutaneous flap techniques are useful in limb-salvage surgery and are indicated for patients who have achieved good disease control.
Evidence Rating Scale for Therapeutic Studies: Level III.

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Surgical excision by amputation has historically been the mainstay of management for soft-tissue sarcomas of the extremities. For example, in 1976, Simon et al. showed that achieving local control at the primary site by surgical means alone required radical local resection or amputation.[1] Recently, however, surgical resection of soft-tissue sarcomas with adequate margins, with or without adjuvant radiation therapy, is effective in achieving local disease control, and limb-salvage procedures have been accepted because they achieve survival rates comparable to those of amputation and allow better quality of life.[2–4] However, in some patients a wide surgical margin is difficult to achieve without sacrificing major vessels because of their size and location. Vascular reconstruction might allow limb-sparing surgery and avoid amputation in patients with malignant tumours involving major vessels.[5–8] In the present study, we reviewed our experiences with limb-salvage surgery and immediate vascular reconstruction following *en bloc* resection of bone or soft-tissue sarcomas of the lower extremity.

Patients and methods

From 1996 through 2010, 819 patients underwent lower-limb-sarcoma treatment, and 23 patients with bone or soft-tissue tumours of the lower extremities underwent wide excision of the tumours and major vascular structures followed by vascular reconstruction at our institution. The patients were 15 males and eight females, with a mean age of 43.6 years (range, 16—78 years). All patients underwent magnetic resonance imaging (MRI) inspection and computed tomography (CT). Subsequently, the patients were biopsy-proven. Liposarcoma was the most common histological diagnosis (nine patients), followed by osteosarcoma (four patients) (Table 1). The most common primary site of tumours was the thigh (15 patients). Ten patients underwent limb-salvage surgery as the only treatment. Other patients were treated with both surgery and radiotherapy or chemotherapy. The tumours were treated with ablative surgery with a wide margin in 12 patients, marginal resection in nine patients and resection with a pathologically positive margin in two patients.

Major arterial resection was performed in all 23 patients (Table 2) and involved the femoral artery in 18 patients, the popliteal artery in two patients, the external iliac artery in two patients and the anterior tibial artery in one patient. The median length of the vascular defect was 13 cm (range, 6—17 cm). Venous resection was also performed in 20 of the 23 patients. After resection, arterial reconstruction was performed in all 23 patients: an autologous saphenous vein graft (SVG) was used in 22 patients and a polytetrafluoroethylene (PTFE) prosthesis (to replace the femoral artery) was used in one patient. In order to divide the graft harvest side from the tumour resection side, the SVG was harvested from the contralateral limb. The maximum length of the SVG available for vascular reconstruction was 32 cm.

Table 1 Preoperative patient characteristics.

Patient	Age (years) /sex	Region	Chemotherapy preop/postop	Radiotherapy	Histological diagnosis/grade	Resection margin
1	20/M	Thigh	Neo/(−)	(−)	Osteosarcoma/low	Marginal
2	42/M	Thigh	Neo/adj	(−)	Osteosarcoma/low	Wide
3	26/F	Thigh	(−)/(−)	(−)	Synovial sarcoma/low	Marginal
4	24/F	Popliteal	Neo/adj	Preop, 40 Gy	Liposarcoma/low	Wide
5	61/M	Groin	(−)/(−)	Preop, 30 Gy	Liposarcoma/low	Wide
6	53/F	Thigh	(−)/(−)	(−)	Myxofibrosarcoma/high	Incisional
7	58/F	Groin	(−)/(−)	(−)	Liposarcoma/low	Wide
8	66/F	Crus	(−)/(−)	Postop, 36 Gy	Chondrosarcoma/low	Marginal
9	17/M	Thigh	Neo/adj	Preop, 50 Gy	Synovial sarcoma/high	Wide
10	29/M	Groin	(−)/(−)	(−)	Myxofibrosarcoma/low	Wide
11	73/M	Thigh	(−)/(−)	(−)	Liposarcoma/low	Wide
12	33/F	Thigh	Neo/(−)	(−)	Synovial sarcoma/low	Wide
13	78/M	Thigh	(−)/(−)	Preop, 50 Gy	Myxofibrosarcoma/low	Marginal
14	55/M	Thigh	(−)/(−)	(−)	Liposarcoma/high	Marginal
15	16/F	Thigh	Neo/(−)	(−)	Osteosarcoma/high	Wide
16	28/M	Groin	Neo/(−)	(−)	Osteosarcoma/high	Wide
17	35/M	Thigh	(−)/(−)	Preop, 50 Gy	Liposarcoma/low	Marginal
18	78/M	Groin	(−)/(−)	(−)	Liposarcoma/low	Marginal
19	38/F	Thigh	(−)/(−)	(−)	Condrosarcoma/low	Wide
20	69/M	Thigh	(−)/(−)	Preop, 40 Gy	Liposarcoma/low	Marginal
21	31/M	Thigh	(−)/(−)	Preop, 40 Gy	Liposarcoma/low	Marginal
22	36/M	Popliteal	(−)/(−)	(−)	Angiomatoid fibrous Histiocytoma/high	Wide
23	36/M	Thigh	(−)/(−)	(−)	Angiomatoid fibrous Histiocytoma/low	Incisional

Preop: before surgery; Postop: after surgery; neo: neoadjuvant chemotherapy; adj: adjuvant chemotherapy; low: low grade tumour; high: high grade tumour; Incisional: disease-positive margin; Marginal: disease-negative but narrower margins (≤2 cm); Wide: wide surgical margins (>2 cm).