

Functional neuro-vascularized muscle transfer for oncological reconstruction of extremity sarcoma

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Introduction

The strategy of limb salvage following surgical resection of skeletal tumor has led to an increased demand for more complex reconstructive options in order to achieve better functional outcomes. Functional neuro-vascularized muscle transfer (FMT) is a beneficial tool for restoring joint movement involving the reconstruction of “movement” in the affected extremity. Until now, however, the clinical application of FMT was mainly limited to trauma cases and to date, very few studies have focused on musculoskeletal oncology. In this study, we reviewed patients who underwent wide resection for extremity sarcoma and functional reconstruction using FMT and discussed the advantages, indications and complications of the procedure.

Materials and methods:

We reviewed 32 patients who underwent wide resection and subsequent reconstruction by FMT. The patients comprised 20 males and 12 females and average of patient age was 48 years (9-77). Soft tissue sarcoma was 26 and bone sarcoma was 6. Mean follow-up periods was 64 months. Reconstructed muscles were 4 deltoid, 14 quadriceps and 4 hamstrings. Donor muscles were 27 LD and in 20 cases, free transfer was performed. 5 gracilis muscles were all free transfer. Latissimus dorsi muscle was transferred in 23 patients and gracilis muscle was in 5. After tightly attaching both stumps of the muscle, microsurgical anastomosis of the vessels was performed. Finally, nerve repair was performed as close as possible to the muscle in order to decrease the denervation period. (Figure)

Results:

Three patients (11%) died of metastatic disease and local recurrence occurred in three. One case developed venous thrombus immediately after surgery and was

rescued by re-anastomosis of the vein. Postoperative infection was not observed at the donor and recipient site. We confirmed re-innervation of FMT in 23 cases by electromyogram and its average period was 4.7 months. We couldn't find relationship with age and use of chemotherapy. Muscle power was improved to an MMT score of 2 in average after re-innervation of the transferred muscle. This increase in MMT resulted in a meaningful QOL improvement.

Discussion

Conventional myocutaneous flap transfer (non-neurotized) is a beneficial tool for achieving stable wound closure and successful soft tissue coverage in one step, prevention of lymphedema, thus decreasing the infection rate. Besides these advantages, neuro-vascularized functioning muscle transfer achieves the additional benefit of restoring joint movement. Donor muscle should be selected by location of recipient site. In the upper arm, the first choice is pedicled LD. In the forearm, free gracilis FMT and free LD might be indicated. In the femur, free LD FMT is the best choice but still muscle volume is small. (Table) For reconstruction of knee extension, we have to discuss tendon transfer of biceps or sartorius. Innocenti reviewed cases with functional LD muscle transfer. As similar to our cases, MMT was improved 2 levels and concluded that it is indicated with 3 or entire head resection. Finally we raised four points for successful FMT. 1) Tight fixation at origin and insertion to minimize stretching, 2) Ensure normal resting tension of the donor muscle, 3) Select suitable vessels and motor nerve, 4) Nerve repair as close to muscle as possible to minimize time of denervation

Conclusion: Microsurgical reconstruction following resection of soft tissue sarcoma provides adequate functional and coverage reconstruction, together with better local control by allowing wider surgical margins. Transfer of free functional neuro-vascularized muscle is a safe and reliable technique for the reconstruction of “movement” of the affected extremity.

Table. Location of recipient site and selection of donor muscle

	<i>Donor of functional muscle transfer</i>	
	<i>First choice</i>	<i>Second choice</i>
<i>Upper arm</i>	Pedicled latissimus dorsi	Gracilis, pectoralis major

<i>Forearm</i>	Gracilis	Free latissimus dorsi
<i>Femur</i>	Free latissimus dorsi	Rectus femoris
<i>Leg</i>	Gracilis	Free latissimus dorsi Rectus femoris

Figure. The 53-year-old female with malignant fibrous histiocytoma. The entire quadriceps femoris muscle including four head was resected along with the tumor. Ipsilateral latissimus dorsi with cutaneous flap was transferred for reconstruction of knee extension. The natural resting tension was marked by stitches applied on the muscle at 5 cm intervals

The transferred latissimus dorsi muscle bridged between the proximal portion of the quadriceps and the patella tendon. Motor unit potentials were detected at 5 months after surgery and power of knee extension was recovered from MMT 0 to 3 at 12 months. The patient could walk without support in home and sometimes used a static knee extension brace outside.

