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Role of free functioning muscle transfer in improving the functional outcomes following replantation of crush avulsion amputations of the forearm☆

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ABSTRACT

Replantation still remains the best form of reconstruction following major upper limb amputations. Regaining a functional limb is a challenge in avulsion amputations when there is entire loss of a compartment as it happens in proximal third of forearm amputations or when the avulsion occurs through the musculotendinous junction. In these circumstances, primary repair of the long flexors or extensors is not possible and options of secondary tendon transfers do not exist due to lack of donor tendons. These factors could weigh in negatively in making the decision for replantation at the time of presentation. We are presenting a series of 5 cases of avulsion amputation of the forearm wherein the functional outcome was enhanced by secondary Free Functional Muscle transfers (FFMT) using gracilis for finger flexion. Outcome scores improved from Chen IV to II in three patients and to III in two patients. The feasibility of gaining useful outcome through secondary procedures like FFMT should serve as an encouragement to extend the indications for replantation in avulsion amputations of the forearm.

Introduction

Major Crush avulsion amputations have been considered as relative contraindications for replantation due to technical difficulties and the possibility of poor outcomes. Sabapathy et al. reported acceptable outcomes after replantation of such major crush avulsion amputations with technical refinements like radical debridement, considerable bone shortening, and proximate nerve repair leading to intrinsic muscle recovery [1]. In avulsion amputations of the forearm one of the challenges is the inability to primarily reconstruct the long flexors and extensors. Most avulsion amputations cause disruption of the flexor mechanism at the musculo-tendinous junction with severe injury to the proximal muscles making direct repair impossible. In some instances, the segment of the muscles at the site of the neuromuscular junction could be injured or could be lost during debridement leaving no possibility of recovery of the long flexors. Without the long flexors, the function of the replanted limb is very limited. Secondary reconstruction of flexor muscle function with free functioning muscle transfer (FFMT) could improve hand function in these patients.

Chuang et al. also highlighted the challenge of reconstruction of these injuries [2]. They classified traction avulsion amputation into four types- Type I- Avulsion at or close to the musculotendinous aponeurosis with the muscle remaining intact and functional; Type II- Avulsion within muscle bellies but distal to the neuromuscular junction with the proximal muscle still being innervated; Type III- Avulsion within the muscles but at or proximal to the neuromuscular junction, with the entire muscles being denervated and/or destroyed; Type IV- Avulsion through the joint (elbow disarticulation) [3]. They found that the FFMT was required to reconstruct the long flexor function in 16% of Type I; 43% of Type II; 100% of Type 3 and 70% of Type IV avulsion amputations [2]. The other option of reconstruction of finger flexors in flexor compartment loss is secondary tendon transfer of wrist extensors to finger flexors [3]. In crush avulsion amputations the extensors also suffer similar injuries and so are not available for reconstruction. That leaves FFMT as the only solution for reconstruction of finger flexors.

We have used FFMT for secondary reconstruction of finger flexion in 5 patients following replantation of crush avulsion amputations of forearm with acceptable outcomes. The possibility of

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