# Targeted Muscle Reinnervation in Initial Management of Traumatic Upper Extremity Amputation Injury

Jennifer E. Cheesborough, MD[1], Jason M. Souza, MD[1], Gregory A. Dumanian, MD[1], and Reuben A. Bueno, Jr., MD[2]

*1. Northwestern University, Feinberg School of Medicine, Chicago, IL, 2. Southern Illinois University School of Medicine, Springfield, IL*

## Background

34,000 Americans are living with major upper extremity amputations secondary to trauma. At the time of revision amputation, major mixed nerves are usually treated with traction neurectomy. This technique may lead to painful neuroma formation which will often prevent consistent prosthetic use, further limiting the functional capacity of the amputee.

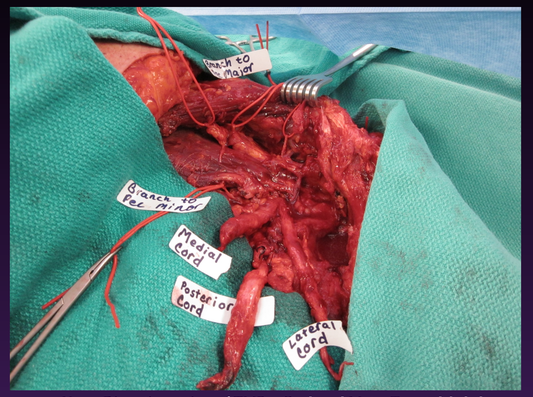
Targeted muscle reinnervation (TMR) was initially developed to permit intuitive control of upper limb prostheses by performing a series of novel nerve transfers in established amputees. Clinical experience has demonstrated TMR to be an excellent treatment for neuroma pain in the amputee. By providing a nerve target for the transected brachial plexus nerve endings, TMR serves to restore continuity of the nervous system. These nerve transfers simultaneously provide the potential for appropriate patients to be fit with cortically-controlled myoelectric prostheses. TMR performed at the time of initial trauma presentation or during the initial hospitalization has not been reported.

## Case Report

A 54-year-old female suffered a traumatic left upper extremity transhumeral amputation due to a motor vehicle accident (Figure 1). The limb was deemed unsalvageable. After staged excisional debridement of devitalized tissues and a shoulder disarticulation due to complete ligamentous disruption, the patient returned to the operating room for definitive coverage and TMR. The brachial plexus nerves demonstrated severe crush injury distal to the cord level, but appeared intact proximal to the cords. The motor nerves to the clavicular and sternal heads of the pectoralis major and the pectoralis minor were identified. The pectoralis minor was dis-inserted and anchored lateral to the pectoralis major to prevent overlapping EMG signals. The individual cords were coapted to the recipient motor nerve targets close to their entry point into the newly denervated muscle segments.

## Surgical Evaluation and Nerve Transfers

Amputated Arm




Nerve Dissection at time of TMR – Cords and Motor Targets labeled

Nerve Coaptations performed with 6-0 prolene and fibrin glue

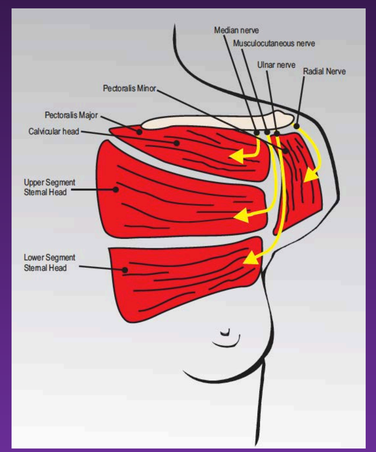
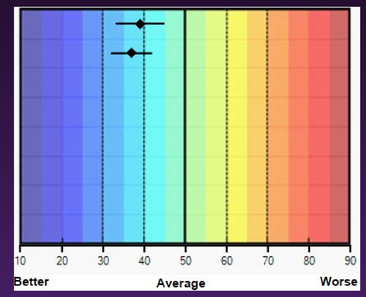



Diagram of Nerve Transfers Performed

## Results

Eight months following the procedure, the patient demonstrates no neuroma pain on clinical exam, and displays minimal pain-related behavior or pain interference as determined by the Patient Reported Outcomes Measurement Information System or PROMIS. The cord level nerve transfers have successfully reinnervated the pectoralis muscles, triggering contraction under cortical control. The patient does report phantom sensations (but not phantom pain), functional limitations, and mood depression consistent with her injury pattern. For financial reasons, she has deferred prosthetic fitting.




Pain Interference Score: 39
Pain Behavior Score: 37
Average American: 50

Post-Operative Evaluation reveals
4 independent motor contractions

## Conclusions

This case demonstrates the feasibility of TMR for pain control in the acute traumatic amputation setting. Despite the traumatic and proximal nature of her amputation, the patient demonstrates no evidence of neuroma pain, as demonstrated by her postoperative clinical exam and PROMIS scores. Additionally, she has four distinct myoelectric control sites, should she decide to proceed with prosthetic fitting in the future.

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