### Background

Approximately 40,000 Americans are living with a major upper extremity amputation. An estimated 5-25% develop painful neuromas and up to 67% experience phantom limb pain, which can severely limit prosthetic tolerance and increase narcotic usage rates. Targeted muscle reinnervation (TMR) is a surgical procedure that reroutes transected peripheral nerves to the motor unit of freshly denervated muscle. First primarily utilized to improve myoelectric prosthetic signal generation, TMR has recently been advocated for the treatment of painful neuromas. We report the advantages of targeted muscle reinnervation performed at the time of index amputation rather than as previously reported mainly at delayed setting.

### Methods

A retrospective study of targeted muscle reinnervation performed on upper extremity amputees was undertaken. Data reviewed included reason for amputation, amputation level, patient age, postoperative neuroma and phantom limb pain rates, and time to prosthetic use.

### Results

Thirteen patients with upper extremity amputations were identified (2 forequarter, 6 trans-humeral, 5 trans-radial). Oncologic resection and skeletal trauma were the most common indications for amputation. Only two patients had TMR performed secondarily for nerve pain, all others were concurrent with amputation. Ages ranged from 22-63 years with average follow up of 13 months (range 1-29). None of the 13 patients developed a painful neuroma. Phantom limb pain at 1, 3, 6, and 12 months was 62%, 33%, 25%, and 20% (Figure 1). Patients began using their prosthetic 2-6 months after surgery. Six patients are using a myoelectric prosthetic and three more are undergoing fitting (Figure 2). Average signal capture rates are greater than 96%.

### Conclusions

Our data suggests that regardless of the cause of or level of amputation, upper extremity targeted muscle reinnervation prevents the formation of painful neuroma postoperatively compared to previous methods. Similarly, the prevalence of phantom limb pain is lower than reported rates in the literature and decreases precipitously over time. Throughout our entire cohort of targeted muscle reinnervation patients we have found significantly lower pain scores when compared to a control amputee population, leading to better tolerance of the prosthetic, and less narcotic use. In addition to the improved control of myoelectric prosthetics, the prevention of painful neuromas and reduction in phantom limb pain warrant the addition of targeted muscle reinnervation at the time of index amputation.

### References