

Primary Targeted Muscle Reinnervation and Regenerative Peripheral Nerve Interface Surgery Reduces Revision Amputations after Limb Amputation

Mathangi Sridharan, Mikayla Romana Mefford, Lauren J Hsue, Emma C Billings, Amanda Perrotta, Charlotte Frances Wahle, Alexander Christ, Nicholas M Bernthal, Lauren Elisabeth Wessel

INTRODUCTION: Addressing neural pathology at the time of index amputation may decrease pain-related complications following limb amputation. This study aims to characterize the effect of Targeted Muscle Reinnervation (TMR) or Regenerative Peripheral Nerve Interface Surgery (RPNI) performed at index amputation on post-operative pain outcomes, specifically the rate of revision amputations performed for pain.

METHODS: All limb amputations performed by orthopedic surgeons at a single institution between 1/1/2012 and 1/1/2025 were retrospectively reviewed. Variables collected were age, gender, insurance status, type of amputation, medical comorbidities, pre-operative gabapentin and narcotic use exceeding 4 weeks. TMR or RPNI performed at index surgery was noted. Primary outcome was revision amputation. Secondary outcomes were nerve or phantom pain in the operative extremity, narcotic or gabapentin use exceeding 6 weeks, neuroma diagnosis, or referral to pain management. Descriptive statistics and logistic regression analysis were performed (Stata). Significance was set at $P < 0.05$. Amputations with less than 6 weeks follow-up were excluded.

RESULTS: 248 amputations from 242 patients were included. 89 (36.8%) female and 153 (63.2%) male. 32 (12.9%) amputations had TMR or RPNI at time of surgery. Average follow-up was 1.75 ± 2.7 years; 40 patients (16.5%) died during the study. Above-knee amputations made up 40.3% (100) of the study population, whereas BKA accounted for 36.7% (91), trans-humeral/above elbow 10.9% (27), forearm/below-elbow 7.7% (19), through-knee 3.6% (9), and hip disarticulation 0.8% (9). There were 51 (20.7%) revision amputation, of which 23 (9.6%) were performed for pain. Two revisions were performed in patients with primary TMR/RPNI, neither for pain. TMR/RPNI was protective against revision amputation overall (OR 0.22, $P = 0.03$) and for pain ($P = 0.047$). TMR/RPNI was not protective for any secondary pain outcome. Patients with diabetic neuropathy trended toward requiring fewer revisions for pain ($P = 0.053$); no patients with diabetic neuropathy required revision amputation for pain. Pre-operative opioid use was associated with increased nerve pain ($P = 0.02$), prolonged narcotic use ($P < 0.001$), and requiring referral to pain management ($P = 0.002$).

DISCUSSION AND CONCLUSION: TMR/RPNI at time of index amputation is protective against revision amputations, specifically those for pain. Routine practice may decrease pain-related complications. Further prospective research is required to elicit its impact on subjective pain measures.

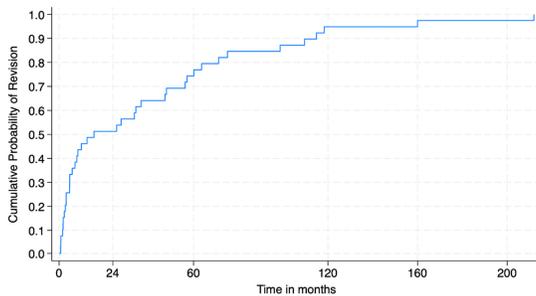


Figure 1: Cumulative Incidence of Revision Amputation over Time

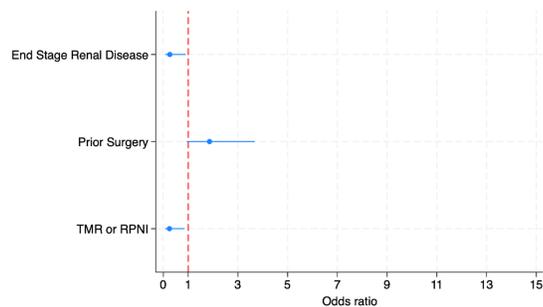


Figure 2: Factors Affecting Rates of Revision Surgery after Limb Amputation