



Significant improvement in phantom limb pain after targeted muscle reinnervation: A case report

Johnson S. Ho, MD; Jonathan Zhou, BS; Sonny Ahluwalia, DO; Nima Yazdanpanah, DO; Derek John Ho, DO; Susan Stickevers, MD

Department of Orthopedic Surgery & Rehabilitation Medicine, SUNY Downstate Medical Center, Brooklyn, NY

Case Description

52 year-old man with no history presents to acute inpatient rehabilitation 2 weeks following right traumatic transhumeral and transtibial amputations sustained in a motorcycle accident. He had suffered disabling postoperative complications including traumatic lateral-sided wound dehiscence of his transtibial residuum, and wound breakdown and severe phantom limb pain (PLP) of his transhumeral residuum not responsive to opiates, gabapentin and mirror box therapy. Orthopedics was consulted for evaluation and possible surgical intervention. He subsequently underwent right leg complex wound closure, and right arm revision surgery with excision of multiple distal neuromas and targeted muscle reinnervation (TMR) of his median, ulnar, upper and lower radial, and musculocutaneous nerves to his pectoralis major and deltoid muscles (Figure 1). By one-month follow-up, he noted 50% improvement in PLP in the right upper extremity residuum with reduced use of opiates for pain control.

Discussion

Post-amputation pain can manifest as residual limb pain (RLP) and/or PLP¹. Prevalence rates for RLP in amputees are reported to be 10 – 76%, and up to 85% of amputees have been described to be affected by PLP². Both RLP and PLP may be related to neuroma formation³. Neuromas are abnormal nerve fibers resulting from disorganized fibroblast and Schwann cell proliferation. Patients who have had major limb amputation without TMR can be expected to have multiple neuromas. TMR is a surgical peripheral nerve transfer procedure originally developed for improved motor control of advanced myoelectric prostheses that has since been found to reduce post amputation pain (Figures 2 and 3)^{4,5}. The technique surgically transfers amputated peripheral nerves to nearby motor nerves, reestablishing muscle innervation and amplifying electromyographic signals to prevent muscle atrophy, symptomatic neuroma, and PLP. Studies have shown that patients who underwent TMR achieved statistically significant reductions in RLP and PLP when compared to patients who received standard post-operative pain management³.



Figure 1 – Posterior (left) and frontal (right) views of right upper residual limb status post traumatic transhumeral amputation, and subsequent revision surgery with excision of multiple distal neuromas and targeted muscle reinnervation.

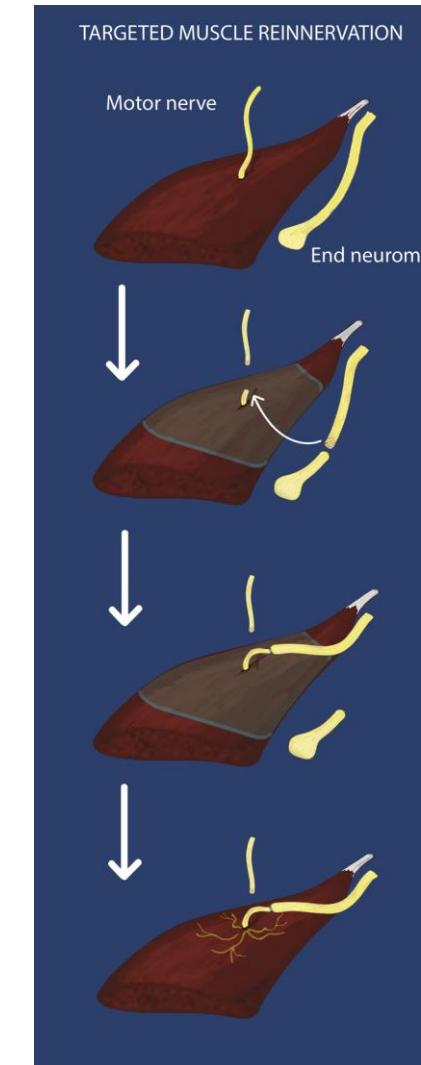


Figure 2 – Illustration of targeted muscle reinnervation principles⁴.

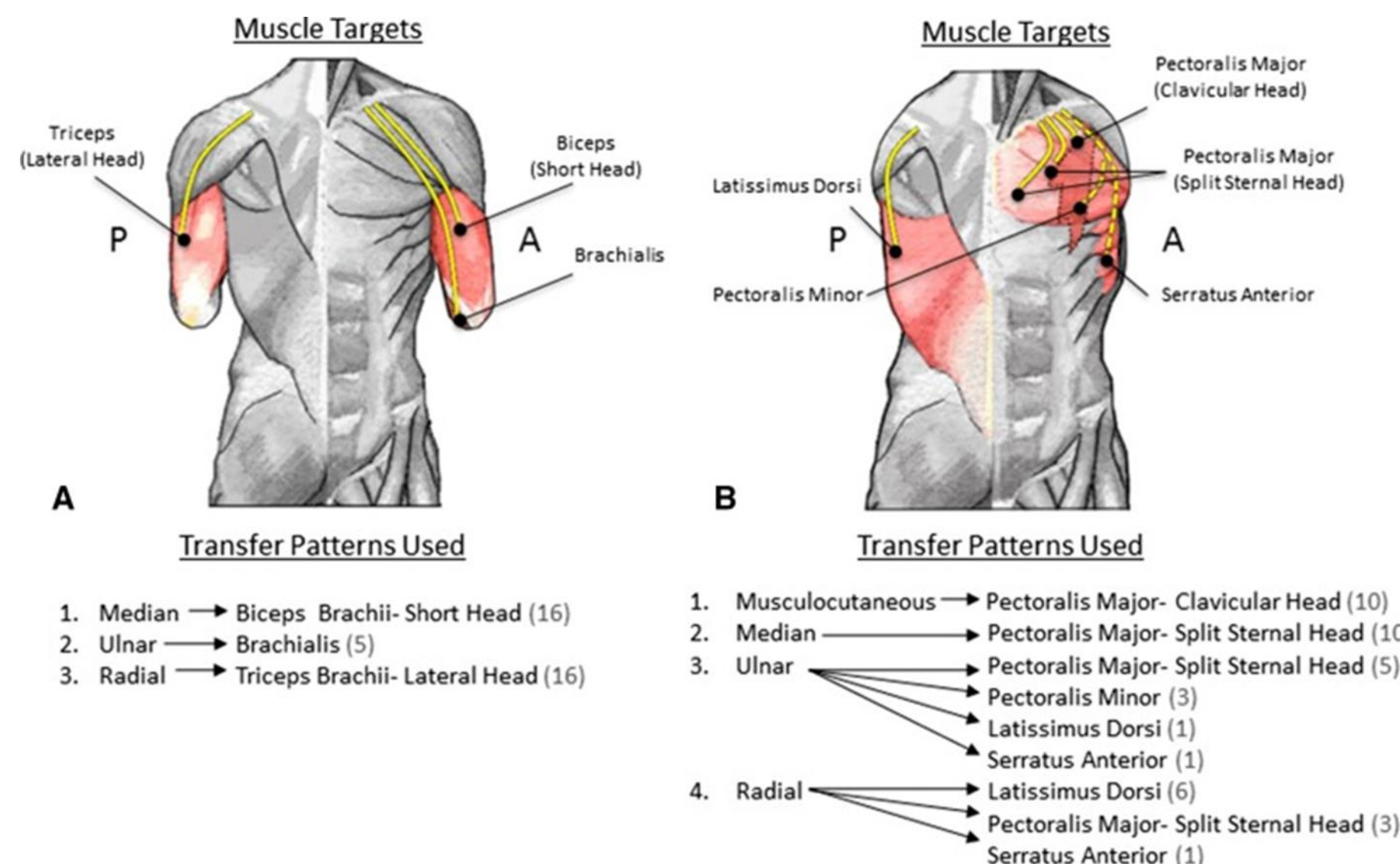


Figure 3 – Illustrations of nerve transfer patterns used in a multicenter study by Souza, et al. for (A) transhumeral and (B) shoulder disarticulation procedures⁵. Donor nerves are coapted to the motor nerves of the target muscles via small recipient motor nerve branches.

Conclusions

RLP and PLP pain may be related to neuroma formation⁶. Pain may have secondary effects on sleep, mood, ADL, prosthetic use, and quality of life⁷. TMR is a procedure that restores physical continuity to nerves involved in amputation and has been shown to prevent or significantly improve RLP and PLP, resulting in significantly pain scores compared with the general amputee population⁴. The evolving medical literature suggests that TMR may present a new paradigm for the management of post amputation related pain syndromes.

References

1. Santosa KB, Oliver JD, Cederna PS, Kung TA. Regenerative Peripheral Nerve Interfaces for Prevention and Management of Neuromas. *Clinics in Plastic Surgery*. 2020;47(2):311-321.
2. Fitzgibbons P, Medvedev G. Functional and Clinical Outcomes of Upper Extremity Amputation Peter Fitzgibbons. *Journal of the American Academy of Orthopedic Surgeons*. 2015 Dec;23(12):751-60.
3. Valerio IL, Dumanian GA, Jordan SW, Mioton LM, Bowen JB, West JM, Porter Kyle, Ko JH, Souza JM, Potter BK. Preemptive Treatment of Phantom and Residual Limb Pain with Targeted Muscle Reinnervation at the Time of Major Limb Amputation. *Journal of the American College of Surgeons*. 2019;228(3):217-226.
4. Mioton LM, Dumanian GA. Targeted muscle reinnervation and prosthetic rehabilitation after limb loss. *Journal of Surgical Oncology*. 2018;118(5):807-814.
5. Souza JM, Cheesborough JE, Ko JH, Cho MS, Kuiken TA, Dumanian GA. Targeted muscle reinnervation: a novel approach to postamputation neuroma pain. *Clinical Orthopaedics and Related Research*. 2014;472(10):2984-90.
6. Bowen JB, Wee CE, Kalik J, Valerio IL. Targeted Muscle Reinnervation to Improve Pain, Prosthetic Tolerance, and Bioprosthetic Outcomes in the Amputee. *Advances in Wound Care*. 2017;6(8):261-267.
7. Chappell AG, Jordan SW, Dumanian GA. Targeted Muscle Reinnervation for Treatment of Neuropathic Pain. *Clinics in Plastic Surgery*. 2020;47(2):285-293.

*Images do not reflect the condition of the patient and are for illustration purposes only.

