Targeted Muscle Reinnervation (TMR) – Literature Summary

Major Findings

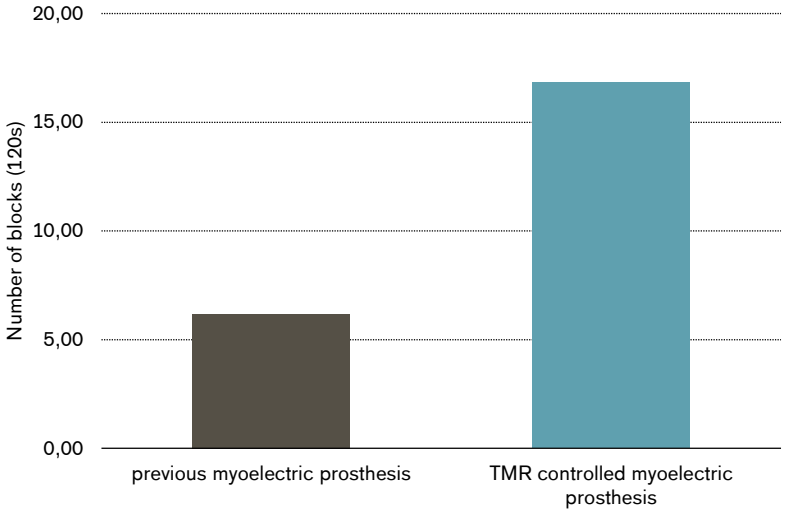
The effect of Targeted Muscle Reinnervation (TMR) on the use of myoelectric prostheses in upper-extremity amputees:

- → **88% of patients who underwent TMR surgery were able to operate a myoelectric prosthesis.**
- → **The performance with myoelectric prostheses assessed with the Box and Bocks and Clothespin Tests was increased by two to six times.**
- → **The speed measured in the Clothespin Test with myoelectric prostheses during task execution was increased by 26%.**
- → **Myoelectric prostheses were easier to use and felt more natural.**

The effect of Targeted Muscle Reinnervation (TMR) on residual limb neuroma pain in upper-extremity amputees:

- → **None of the patients who underwent TMR demonstrated evidence of new neuroma pain after the procedure.**
- → **93% of patients who presented with preoperative neuroma pain experienced complete relief of pain.**

Box and Blocks test



Performance with the pre-surgical myoelectric device and the TMR controlled myoelectric prosthesis was compared with a modified Box and Blocks test (patients were standing instead of sitting while duration of the test was 120s instead of 60s). With the new prosthesis patients showed marked improvement (on average 177%) (Miller et al., 2008)

Clinical Relevance

Achieving a high level of function with prosthetic limbs remains challenging, especially for higher upper extremity amputation levels, where the disability is greatest. Targeted muscle reinnervation (TMR) is a new technique that employs a series of novel nerve transfers to enable better control of upper limb prostheses mostly for above elbow amputees. Recent experience has suggested that TMR may also inhibit symptomatic neuroma pain formation.

Summary

Targeted muscle reinnervation may be considered in the acute trauma setting to prepare patients for myoelectric prosthesis fitting and to prevent neuroma pain. This procedure has been performed successfully on people with shoulder disarticulation and transhumeral level amputation. Performance and task execution speed with myoelectric prostheses after TMR surgery has increased on average 177% (Miller et al., 2008) and 26% (Kuiken et al., 2004), respectively, as compared to pre-surgical myoelectric prostheses. Patients reported that it was easier, faster and felt more natural to use the myoelectric prosthesis after TMR surgery (Kuiken et al., 2004, Miller et al., 2008; Cheesborough et al., 2015). Perceived ease in performing activities of daily living with the myoelectric prosthesis after TMR was reported for: eating, drinking from a bottle, cooking, cleaning, housework, yard work, and home maintenance (Miller et al., 2008; Cheesborough et al., 2015). In respect to pain relief, the TMR procedure brought complete relief of neuroma pain in 93% of patients, while none of the patients demonstrated evidence of new neuroma pain after the procedure (Souza et al., 2014).

References of summarized studies

Cheesborough, J., Smith, L., Kuiken, T., & Dumanian, G. (2015). Targeted Muscle Reinnervation and Advanced Prosthetic Arms. Seminars in Plastic Surgery, 29(01), 62–72. doi:10.1055/s-0035-1544166

Kuiken, T., Dumanian, G., Lipschutz, R. D., Miller, L. A., & Stubblefield, K. A. (2004). The use of targeted muscle reinnervation for improved myoelectric prosthesis control in a bilateral shoulder disarticulation amputee. Prosthetics and Orthotics International, 28, 245–253.

Miller, L. A., Stubblefield, K. A., Lipschutz, R. D., Lock, B. A., & Kuiken, T. (2008). Improved Myoelectric Prosthesis Control Using Targeted Reinnervation Surgery: A Case Series. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 16(1), 46–50. doi:10.1109/TNSRE.2007.911817

Souza, J. M., Cheesborough, J. E., Ko, J. H., Cho, M. S., Kuiken, T. A., & Dumanian, G. A. (2014). Targeted Muscle Reinnervation: A Novel Approach to Postamputation Neuroma Pain. Clinical Orthopaedics and Related Research®, 472(10), 2984–2990. doi:10.1007/s11999-014-3528-7