

# Single and Double Reinnervation of the Gastrocnemius Muscle in Rats -

## Experimental Model

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**INTRODUCTION:** Muscle contraction generated by electrical impulses originated simultaneously from two different neural sources may be an interesting alternative for facial palsy and brachial plexus injury treatment.<sup>1-4</sup> We hypothesized that double reinnervation leads to better muscle functional recovery. Thus, an experimental model was created to assess double and single muscle reinnervation of the gastrocnemius muscle in rats.

**MATERIALS AND METHODS:** Fifty adult Wistar rats after having their right peroneal nerve sectioned were allocated into 5 groups: (C) control; (TS) in which the right tibial nerve was also sectioned and not repaired; (EE) where after section, the right tibial nerve was immediately repaired by primary neurorrhaphy; (ES) where after section, the right tibial nerve was immediately repaired by end-to-end neurorrhaphy associated to end-to-side neurorrhaphy of the peroneal nerve to the tibial nerve distal to the primary neurorrhaphy site; and (CEE) where after section, the right tibial nerve was immediately repaired by convergent end-to-end neurorrhaphy between the proximal stumps of the tibial and peroneal nerves to the distal stump of the tibial nerve. The outcomes were assessed 12 weeks after the experiment by walking track, electromyography, gastrocnemius muscle weight ratio and histomorphometric analysis of distal tibial nerve.

**RESULTS:** Compared to simple innervation group (EE), the double innervation groups had higher functional results in walking track ( $p < 0.05$ ). When compared to the EE group, the CEE group showed greater amplitude ( $p = 0.006$ ) and higher latency ( $p = 0.041$ ) to electromyography. Regarding muscle weight index, there was no difference between groups of single and double innervation ( $p > 0.705$ ). Histologic analysis revealed higher axonal density in the CEE group compared to the EE group ( $p = 0.001$ ) and the ES group ( $p = 0.002$ ).

**CONCLUSION:** Both double innervation techniques (ES and CEE) showed earlier and greater functional recovery of the gastrocnemius muscle when compared with simple innervation technique (EE). Animals of the CEE group showed higher number of regenerated axons in the distal stump of the repaired nerve than animals of the others experimental groups.

## REFERENCES:

1. Furukawa H, Saito A, Mol W, Sekido M, Sasaki S, Yamamoto Y. Double innervation occurs in the facial mimetic muscles after facial-hypoglossal end-to-side neural repair: rat model for neural supercharge concept. *J Plast Reconstr Aesthet Surg*. 2008;61(3):257-64.
2. Terzis JK, Wang W, Zhao Y. Effect of axonal load on the functional and aesthetic outcomes of the cross-facial nerve graft procedure for facial reanimation. *Plast Reconstr Surg*. 2009;124(5):1499-512.
3. Farber SJ, Glaus SW, Moore AM, Hunter DA, Mackinnon SE, Johnson PJ. Supercharge nerve transfer to enhance motor recovery: a laboratory study. *J Hand Surg Am*. 2013;38(3):466-77.
4. Sforza C, Frigerio A, Mapelli A, et al. Double-powered free gracilis muscle transfer for smile reanimation: A longitudinal optoelectronic study. *J Plast Reconstr Aesthet Surg*. 2015;68(7):930-9.