

Angelov et al.

Axonal Branching and Recovery of Coordinated Muscle Activity

Peripheral nerve injury is always followed by attempted regeneration of the injured axons. In everyday clinical practice, however, functional recovery is the exception rather than the rule. Especially after reconstructive surgery on the facial nerve, there inevitably occur partial pareses, abnormally associated movements and pathologically altered reflexes. The main reason for this "post-paralytic syndrome" is the misdirected axonal guidance, which consists of two major components. First, due to malfunctioning pathfinding, a muscle gets reinnervated by a "foreign" axon, that has been misrouted along a "wrong" fascicle. Second, the supernumerary collateral branches emerging from all transected axons simultaneously innervate antagonistic muscles and cause severe impairment of their coordinated activity. Since it is hardly possible to improve the pathfinding of several thousands axons, we concentrated on the second major component and tried to reduce the collateral axonal branching. In this monography we evaluated the efficiency of various treatments in rats by determining (i) the degree of post-operative axonal branching applying different fluorescent dyes to the zygomatic, buccal, and marginal mandibular branches of the facial nerve; (ii) the accuracy of reinnervation as estimated by the number of double-labeled perikarya innervating the whisker-pad muscles before and after surgery; (iii) the recovery of vibrissal motor performance, estimated by a video based motion analysis. The results described in this review reflect our efforts to reduce collateral axonal branching by (i) alterations of the afferent trigeminal input to the axotomized facial motoneurons and by application to the nerve suture site of (ii) neurite outgrowth fostering ECM proteins, (iii) neutralizing antibodies to trophic factors, (iv) suspensions of olfactory ensheathing cells, Schwann cells and bone marrow stroma cells and (v) pieces of autologous olfactory mucosa. All manipulations influenced various parameters of peripheral nerve regeneration. However, only the application of autologous olfactory mucosa yielded an improved recovery of vibrissae motor performance.

ISBN 3-540-25654-7



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GSV EUR:89.95

ISBN
813



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