Cross-face Nerve Grafting Model for Long Peripheral Nerve Gap Regeneration in Rats

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Cross-face Nerve Grafting Model for Long Peripheral Nerve Gap Regeneration in Rats

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Sir,

A 7-mm facial nerve gap experimental rat model has been established for facial nerve regeneration studies in our previous studies.[1–4] Facial nerve regeneration with various nerve guides has been evaluated by (1) myelinated fiber counts using toluidine blue staining; (2) immunohistologic evaluations using S100, glial fibrillary acidic protein, and neuron-specific class III beta-tubulin (Tuj1) antibodies; (3) retrograde nerve tracing in the facial nucleus; (4) electrophysiologic evaluations using compound muscle action potential; and (5) functional evaluations using rat facial palsy scores.[1–3] The regenerated nerve can be compared with that of the control group with autologous nerve grafting. However, clinically, facial nerve reconstruction needs approximately 15 cm of peripheral nerve.[4] Therefore, a long nerve gap experimental model was necessary. Miniature swine are a suitable experimental model for the study of peripheral nerve regeneration in long gaps of the facial nerve. However, laboratories capable of using miniature swine are limited, and no comparative evaluation of facial nerve regeneration with a rat model had been reported.

The authors devised a cross-face nerve grafting model for the study of regeneration nerve guides in rats. First, a bilateral coronal incision with bilateral marginal mandibular extension was made under inhalation anesthesia. Second, bilateral buccal branches of the facial nerve were exposed and cut bilaterally. Finally, the left side of proximal stumps of the buccal branch and the right side of the distal stump were connected by a nerve guide through the frontal region between bilateral eyes and ears (Fig. 1). This could make an approximately 40-mm gap between the left proximal stump and the right distal stump of the buccal branch. During the peripheral nerve regeneration process, the nerve axons extend from the left side of the proximal stump to the right side of the distal stump. Finally, right-side vibrissal muscle function is recovered. Facial nerve regeneration was evaluated by myelinated fiber counts, immunohistologic analysis, retrograde nerve tracing in the left side of the facial nucleus, electrophysiologic evaluations with compound muscle action potential, and functional evaluations using rat facial palsy scores.

The rat cross-face nerve grafting model (including end-to-side neurorrhaphy and end-to-end neurorrhaphy using autologous nerve graft) was previously reported.[5–7] Nerve fibers reached the distal end of the cross-face nerve grafts 4–8 weeks after grafting of a 30-mm–long nerve in a *Thy1*–green fluorescent protein rat model.[7] However, no artificial nerve guide transplantation by cross-face grafting was reported. The authors have performed 45-mm–long nerve guides with rat dental pulp cells (DPCs) using previously reported methods (Fig. 2).[1–3] However, no nerve regeneration was achieved in this rat model at 12 weeks after transplantation. These results indicated that transplantation of nerve guides with rat DPCs did not reach autologous nerve grafts in long facial nerve gaps (eg, 40 mm), although regeneration induced by nerve guides with rat DPCs was comparable with autologous grafts for 7-mm facial nerve gap regeneration.[3] Further studies are needed to regenerate long nerve gaps in rats. This model may contribute to the study of nerve regeneration using nerve guides.

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DISCLOSURE

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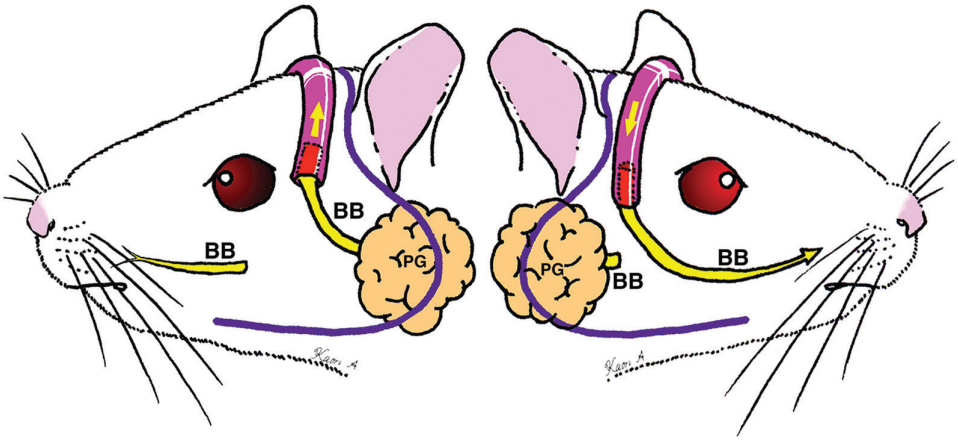

Fig. 1. Schematic diagram of the long peripheral nerve gap model in rats. First, a bilateral coronal incision with bilateral marginal mandibular extension was made (blue line) and bilateral buccal branches of the facial nerve were exposed and cut bilaterally. The left side of proximal stumps of the buccal branch and right side of the distal stump were connected by nerve guide through the frontal region between bilateral eyes and ears. The distance between the left proximal stump and right distal stump of the buccal branch was approximately 40 mm. BB indicates buccal branch of the facial nerve; PG, parotid gland.

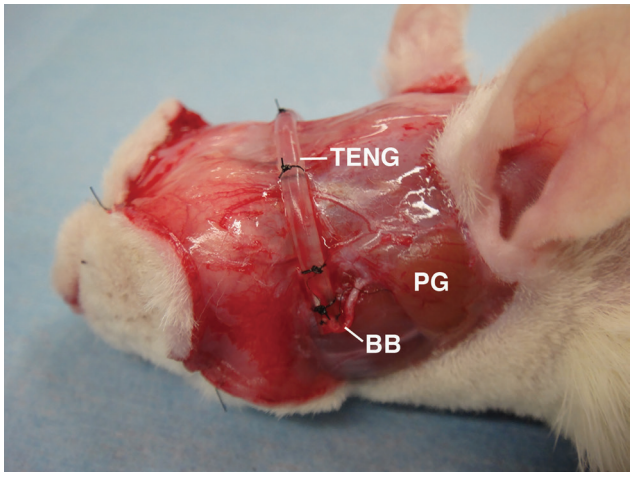

Fig. 2. A photograph of cross-face nerve grafting with a 45-mm–long TENG to the long peripheral nerve gap (approximately 40-mm nerve gap) in a rat. BB indicates proximal stump of the buccal branch of the facial nerve; PG, parotid gland; TENG, tissue-engineered nerve guide.

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