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Effect of topical dexamethasone in reducing dysfunction after facial nerve crush injury in the rat

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ABSTRACT

Objective: To date, the effect of topical steroid after a crush injury to rat facial nerve has rarely been reported on. The aim of this study was to investigate the effects of topical dexamethasone on recovery after a crush injury to the rat facial nerve, by functional, electrophysiological, and morphological evaluation.
Materials and methods: We investigated the effects of topical dexamethasone on recovery after a crush injury to rat facial nerve by functional, electrophysiological and morphological evaluation.
Results: The functional recovery using vibrissae movement was significantly high scores in the experimental group than control group at two and three weeks post-crush. The recovery of the threshold of muscle action potential was significantly lowered in the experimental group compared to the control ($p < 0.05$). However, there was no statistical significance in the nerve conduction velocity. The dexamethasone treatment groups showed a larger axon diameter and thicker myelin sheath than the control group.
Conclusion: From our results, topical dexamethasone accelerates recovery of the crush-injured facial nerve.

1. Introduction

The facial nerve may be subjected to crush injuries in a variety of circumstances, including motor vehicle accidents, fractures, dislocations, and surgery. After injury to the peripheral nerves, a sequential pattern of axonal degeneration and myelin degradation, followed by rapid regeneration, is initiated [1]. The inflammatory process and its mediators have been implicated in the regulation of both the axonal degenerative and regenerative processes after injury [2,3]. The main purpose of administering steroid medication is to reduce postoperative edema after surgery. Steroid medication inhibits the inflammatory response and consequently the recruitment of macrophages [4]. The presence of such cells close to the site of damage and along an injured rat sciatic nerve has been shown to accelerate nerve regeneration in the short-term (6 days) as tested with the pinch reflex test [5]. It has generally been accepted that systemic steroid accelerates functional recovery after a crush injury to rat sciatic nerve [6,7].

To date, the effect of topical steroid after a crush injury to rat facial nerve has rarely been reported on. Gallowy et al. [8] studied the effect of topical steroids in sciatic nerve injury. However, they observed sciatic functional index only and without histological or electrophysiological evidence. In this study, we investigated the effects of topical dexamethasone on recovery after a crush injury to rat facial nerve by performing a functional, electrophysiological, and morphological evaluation. If effective, topical dexamethasone might be provide a clinically useful treatment for facial nerve crush injury.

2. Materials and methods

Fourteen male Sprague-Dawley rats (weighing 250–300 g) with normal eardrums were used. The rats were housed in rooms with a constant temperature of 22 °C, humidity of 50%, and an ambient noise level <40 decibels. All animal experiments followed a protocol approved by the Committee for Animal Experimentation at Chonnam National University, Korea (CNUIACUC-H-2012-27). Rats were anesthetized by the intraperitoneal injection of Zolletil®

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(a 1:1 combination of tiletamine and zolazepam, Virbac, Carros, France) and xylazine hydrochloride.

A postauricular incision was made at the left side. Under an operating microscope, the main trunk of the facial nerve was exposed, at its exit from the stylomastoid foramen, before branching of the main trunk. The main trunk was identified by electrical stimulation for the entire hemifacial movement. The nerve was crushed with a microvascular clamp for 1 min. The standard crush performed ensured that all nerve fibers were crushed, and the axonal sheath remained intact [9]. Lesion effectiveness was tested by the absence of vibrissae movement in response to electric stimulation of the proximal end of the lesioned site. Immediately after the crush injury, rats were divided into two groups. In the control group ($n = 7$), gelfoam impregnated with 200 μl phosphate buffered solution (PBS) was topically applied to the crush site and sterile petroleum jelly was used to seal the gelfoam to avoid leakage. In the experimental group B ($n = 7$), gelfoam impregnated with 200 μl dexamethasone (5 mg/ml) was topically applied to the crush site and sterile petroleum jelly was used to seal the gelfoam to avoid leakage. Surgical wounds were then sutured using 4-0 silk.

The functional recovery analysis was observed by vibrissae movement. The return of vibrissae function was monitored by comparing the side ipsilateral to the lesioned nerve, to the contralateral intact side, using a modified Gilad's arbitrary score [10] (0, complete paralysis with vibrissae flattened and oriented posteriorly; 1, slight quivering vibrissae movements; moderate quivering vibrissae movements; 3, quivering movements but

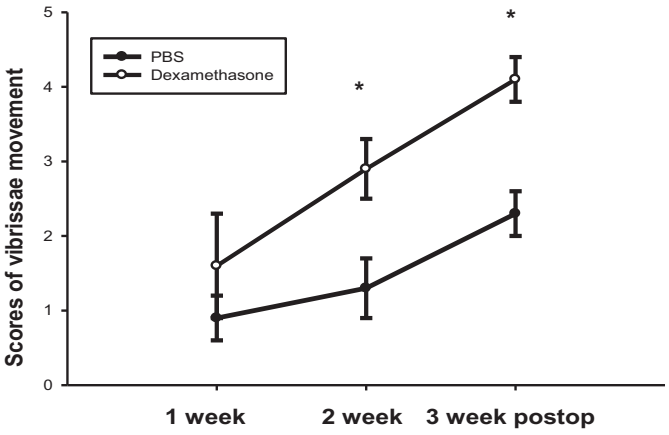

Fig. 1. Functional recovery by vibrissae movement in the experimental group shows significantly higher than control group ($p < 0.05$).

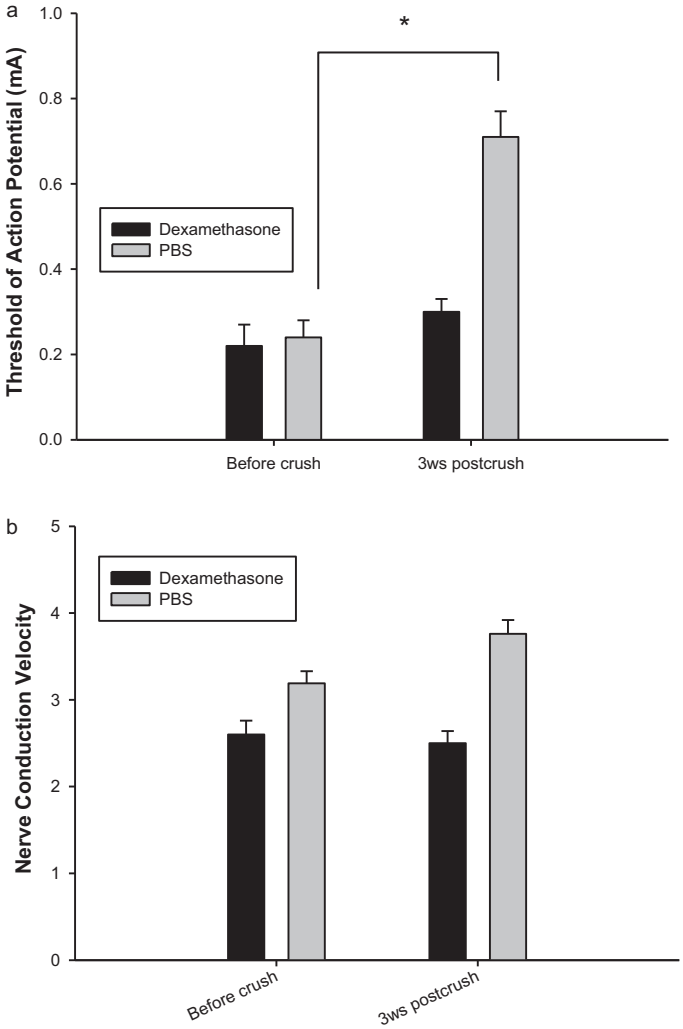

Fig. 2. (A) Topical dexamethasone group shows the recovery of threshold compared to PBS group. Asterisk means the statistical significance ($p < 0.05$). (B) There was no statistically significant between two groups.