Nerve Regeneration after Radiofrequency Application

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Introduction: A novel technique using bipolar radiofrequency (bRF) has been introduced for chronic tendinosis with excellent clinical results.1 Patients have experienced pain relief a few days after application of bRF.2,3 Since a pathological nerve ingrowth in the tendon has been considered as the possible cause of pain in tendinosis, we have previously reported that acute pain relief by bRF treatment may induce degeneration of those nerve fibers.3 We hypothesized that microtenotomy with bRF-induced degeneration of the nerve fibers would be followed by regeneration. Regeneration of nerve fibers would be necessary to resume normal tendon conditions that lead to long-term effects by bRF, like the process of wound healing.4 The purpose of this study is to evaluate the regeneration potential of bRF application to peripheral nerve fibers using a rat model.

Materials and Methods: Procedure of bRF treatment: 26 male Sprague Dawley rats (300 g) were placed under general anesthesia. Two points of RF were applied to the left two middle foot pads at a distance of 1-3 mm from each other. The TOPAZTM Microdebrider device with system 2000 generator (ArthoCare, Sunnyvale CA) was set at level 4 (175 V-RMS) for 500 milliseconds. Immunohistochemistry: After 7 (n=4), 14 (n=4), 30 (n=6), 60 (n=6) and 90 days (n=6) the foot pads of both hind paws were resected and sectioned at 30 μm on a cryostat (left for study group, right for contralateral control group). The sections were processed by immunohistochemistry using free-floating ABC technique with the following antibodies: (1) Neuralclass III β-Tubulin (TUJ-1 1:500, Convance, Berkeley CA), a general neural marker; and (2) Calcitonin gene-related peptide (CGRP 1:500, ImmunoStar Inc, Hudson WO), a functional neural marker related to pain, and also important for formation of new vessels during wound healing.4

The numbers of TUJ1-immunoreactive (IR) and CGRP-IR fibers were counted for each section per 16.3×10-1 mm2 of epidermis. The numbers per sections were summed up and then averaged for each group. Statistical analysis of the results was performed using a t-test at a level of significance p<0.05.

Results: Line graphs

show the mean value ± standard deviation of TUJ1-IR nerve fibers at 7, 14, 30, 60 and 90 days after bRF treatment. Although there were significant differences in the number of nerve fibers between the contralateral group and bRF-treated group at 7 (P=0.001), 14 (P=0.0002), 30 (P<0.0001) and 60 days (P<0.0001), no significant differences were observed between the contralateral group and 90 days post bRF (P=0.6557). There was also significant difference in the number of nerve fibers among day 30, day 60 and day 90 time periods (day 30 vs. day 60, P=0.0001; day 30 vs. day 90, P=0.0001; day 60 vs. day 90, P=0.0001).

Discussion: In the present study we demonstrated that regeneration of the epidermal nerve fibers occurred gradually from 30 days to 90 days. It became obvious that there was no statistical difference in the number of nerve fibers with the contralateral control groups. Regeneration of TUJ1-IR and CGRP-IR nerve fibers seemed to be similar each other. Clinically, the majority of patients with chronic lateral epicondylitis received at least some pain relief within the first 7 to 10 days that lasted at least 2 years after bRF microtenotomy.2 Although degeneration of sensory nerve fibers would lead to early pain relief,3 our study will explain that the nerve fibers regenerated, along with a healing process, and the potential of no return of the pathological condition.

We concluded that bRF treatment induced degeneration and regeneration of the nerve fibers in the rat sole. These results may explain the rapid pain relief, as well as one of the healing responses, after bRF treatment in tendinosis.

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References:

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