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AN IMMUNOHISTOCHEMICAL INVESTIGATION INTO THE EXPRESSION OF NERVE GROWTH FACTOR AND ITS RECEPTORS IN THE RAT DENTO-ALVEOLAR COMPLEX SUBJECTED TO ORTHODONTIC FORCES

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Summary

The neurotrophins are believed to interact with fibroblasts, endothelial and alveolar bone cells to initiate the process of bone resorption [1] particularly during orthodontic tooth movement. In addition, neurotrophins, including nerve growth factor (NGF), play important roles in neural cell differentiation and survival [2]. NGF is a polypeptide essential for supporting cholinergic innervation in the brain and sympathetic and sensory innervation in the peripheral tissues [3], as well as being required for the development of those neurons. Its presence allows for the neurons to grow and differentiate [4]. NGF is produced and released by target cells, to be transported retrogradely to neurons innervating the target tissue [4]. It has been suggested that endogenous NGF controls sprouting of nociceptive sensory axons in denervated skin of adult rats [5]. The local application of antiserum against NGF (anti-NGF) has been shown to inhibit the collateral sprouting of neurons in the rat sciatic nerve [6]. It is reasonable to propose that periodontal ligament (PDL) remodelling may be influenced by NGF. If so then anti-NGF may block neurochemical changes and inhibit cellular changes that facilitate bone resorption.

The objective of the study was to test whether orthodontic tooth movement induces changes in expression of NGF and/or its receptors in the dento-alveolar complex in rats.

Forty-two 8-week old male Sprague-Dawley rats, equally divided into test and control groups, were used. Orthodontic forces were applied to the right maxillary first and second molars by inserting elastics interdentally [7]. The test group was injected with anti-NGF locally at the site of interest. The animals were sacrificed at days 0, 3, 7 and 14 after placement of elastics. The control and test maxillae were removed and prepared for histologic examination and comparison involving immunohistochemistry for NGF, CGRP, Trk A and p75.

Results obtained showed staining intensity at day 3 increasing to the most intense staining at day 7 for all the labels in control animals. The experimental side demonstrated stronger intensity that the control side. Staining had decreased at day 14. Anti-NGF injected animals showed reduced staining when compared to control animals.

The findings were consistent with present knowledge on neurotrophin and neuroreceptor interactions. The density of CGRP fibre plexus is known to reflect the level of NGF present in the tissues. Increased NGF levels in the PDL and bone corresponded to the expected sprouting response. Localisation of Trk A and p75 also appeared to be consistent with the detection of NGF in the pulp, PDL and bone.

It is thought that the cells responsible for NGF secretion within the PDL, pulp and bone are probably fibroblasts and nervous tissue. The fibroblasts in the PDL do not appear to be reactive for Trk A or p75. Cells at the cementum-PDL and PDL-bone interface were strongly p75 positive and also Trk A positive.

It was speculated that injury induces increased fibroblast expression of NGF within the PDL leading to sprouting and invasion by CGRP positive nerve fibres. Injection of anti-NGF abolishes the NGF expression by the putative fibroblasts within the PDL and prevents the innervation of the PDL by CGRP positive fibres.