INTERRADICULAR MINERALIZED TISSUE ADAPTATION IN AN ASEPTIC NECROSIS MODEL

A report submitted in partial fulfilment of the requirement for the degree of Doctor of Clinical Dentistry (Orthodontics)

by

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1.5 List of abbreviations

1.5.1 General

H&E- haematoxylin and eosin

VK/H&E- Von Kossa counterstained with haematoxylin and eosin.

BMU- basic multicellular unit

IMVS- Institute of Medical and Veterinary Sciences

Ver- version

CT- computerized tomography

MAR- mineral apposition rates

PDL- periodontal ligament

ID- identification number

Z- coronal plane notation adopted by Dataviewer v1.3.2 (a Skyscan 1072 application software)

SE- standard error

1.5.2 Units of measurements

µm- micrometres

px- pixel

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3. SIGNED STATEMENT

This report contains no new material that has been accepted for the award of any other degree or diploma in any other university. To the best of my belief, it contains no material previously published except where due reference is made in the text.
I give consent for this copy of my thesis, when deposited in the University library, to be made available for loan and photocopying.

Andrew Chang

4. SUMMARY

Key Words:

Ankylosis, Resorption, Labels, Periodontal Ligament, Rats

This study used vital bone markers to investigate mineralized tissue adaptation in the periodontium of rats after a hypothermic insult to their maxillary first molars. This hypothermic insult has been shown in previous studies to induce aseptic root resorption with variable effects on ankylosis. A secondary objective was to assess the pulpal changes that occurred concurrent with the changes in the periodontium.

Four groups of 7, eight-week old male Sprague Dawley rats were assigned to be euthanased at the day 7, 14, 21 and 28 observation periods. At day 0, 4 groups of 6 rats were subject to a single 20 minute application of dry ice on their maxillary right first molar. The remaining 1 rat within each group did not receive the dry ice. All rats were given 2 sequential bone labels, calcein 5mg/kg and alizarin red 30mg/kg, administered intraperitoneally 8 days apart. The timing of the labels was such that all rats were euthanased 2 days after the last label. The rat maxillae were fixed in ethanol and embedded undecalcified in methylmethacrylate. Ten micrometre coronal sections were obtained through the furcation of the first molars with three of each group of ten consecutive sections being unstained, stained with von Kossa/ hematoxylin and eosin counterstain, or decalcified and stained with hematoxylin and eosin, respectively. Unstained sections were viewed under fluorescence, while transmitted light microscopy was used for the other sections. Mineral apposition rates along the bone, root and pulpal surfaces as well as periodontal ligament width were measured using histomorphometry. Semiquantitative measurements of the resorptive surfaces within the periodontium were

also noted. Multivariate and negative binomial regression statistical analyses were used to identify influencing variables.

A focal pattern of ankylosis was observed at days 14 and 21 in 3 rats and was not seen at day 28. In both the treated and control teeth, appositional activity was greatest along bone and least along the root surface. Mineral tissue apposition rates along the bone and root surface displayed an initial spike during day 14 but declined to levels of the control teeth by day 28. A longer time lag was observed with appositional activity in the pulp which also displayed a declining trend towards the control teeth values by day 28. Resorption levels along the root surface continued to remain significantly ($p<0.0001$) elevated. The significantly ($p<0.0001$) wider periodontal ligament width in the treated molars showed a declining trend towards that of the control teeth by day 28.

There was a temporary disturbance of mineralized tissue adaptation on the bone and root surfaces with a recovery of cellular vitality within the periodontium and pulp and a trend towards homeostasis of the periodontal ligament width. The null hypotheses that a single prolonged thermal insult on a rat has no effect on mineralized tissue adaptation within the periodontium and pulp chamber and that the periodontal ligament width within the interradicular region does not change in response to thermal trauma induced by the present study were rejected.