



**T.E.M. STEREOLOGY OF MICROVASCULAR AND NEURAL  
RECONSTITUTION IN MARMOSET INCISOR  
PERIODONTAL LIGAMENT FOLLOWING  
INCISOR DECORONATION, ENDODONTIC THERAPY,  
ORTHODONTIC EXTRUSION, AND LONG TERM RETENTION**

A research report submitted in  
partial fulfilment of the requirements for  
the degree of Master of Dental Surgery

by

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1994

*Awarded 1994*

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## SUMMARY

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Maxillary incisor fracture is a common dental injury. It is frequently treated by endodontic therapy, orthodontic extrusion, and a retention period. The principal aim of the present study was to mimic this regime and test the hypothesis that vascular and neural reconstitution of the periodontal ligament (PDL) was complete after a long term non-human primate retention of 30 weeks in the marmoset, which approximates 3 years in human terms.

This investigation was based on material prepared by Weir (1990), but not utilized in his study which was limited to the apical region. Weir used 7 male and 3 female marmosets (*Callithrix jacchus*) as the model to simulate this treatment regime. However, he finally selected 4 male marmosets to be a study group. His experimental procedure involved the upper left central incisor crown removal, root canal therapy, followed by magnetic extrusion of 1.2 mm. The fractured incisor was retained in the extruded position for 30 weeks. The upper right central incisors acted as the control.

Each animal was then perfusion fixed with 5.6% glutaraldehyde and 0.9% osmium tetroxide mixture. The experimental and control central incisor segments were isolated for TEM processing.

The remaining non-apical segments of the blocks were sectioned at 150 micron levels. Twelve slotted grids were taken at each level and prepared for TEM examination. The zero level was taken as a "streaming" effect of the PDL e.g. orientation of the collagen fibres and cells perpendicular to the tooth surface. The most mesial PDL regions of the control and experimental central incisors were examined. At each level three micrographs were taken across the PDL width, at the bone, middle, and tooth circumferential thirds.

The micrographs were printed for morphometric and stereological analyses. Blood vessels were stereologically quantified, while nerves were



morphometrically quantified due to the limited sample of nerves. The effects of orthodontic extrusion on vascular and neural components of the PDL were assessed to determine if any changes occurred in the experimental PDL.

No significant differences were found in (1) total luminal and abluminal volume, (2) luminal and abluminal volume of each blood vessel type, (3) distribution of blood vessels across the PDL, (4) luminal diameter of each blood vessel type, and (5) nerve volume. These findings indicated that reconstitution of the PDL blood vessels and nerves was essentially complete after extrusion and a long term non-human primate retention period of 30 weeks. However, a significant reduction of the wall thickness of postcapillary-sized venules was present. This outcome suggested that while physiological re-establishment of the vascular system had occurred, the morphological reconstitution of postcapillary-sized venules was incomplete or they had undergone a longer term or permanent change.

The present study revealed that simulated incisor fracture followed by endodontic therapy, orthodontic extrusion, and a long term animal retention period resulted in repair of the PDL microvasculature and neural system. Therefore, it would seem that this procedure is a justifiable clinical treatment rationale.

The results from this study have clinical implications in that determination of the timing of the retention period is orthodontically important. As far as complete reconstitution of the PDL blood vessels and nerves is concerned, on the basis of this animal model, a retention period of between 1 and 3 years in human terms is suggested in order to maximise reconstitution of both systems.

## SIGNED STATEMENT

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This research report contains no material which has been accepted for the award of any other degree or diploma in any university, and to the best of my knowledge and belief, the report contains no material previously published or written by another person, except where due reference is made in text of the report.

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## ACKNOWLEDGEMENTS

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I express sincere appreciation to Dr. M.R. Sims, former Reader in Orthodontics, and Dr. W.J. Sampson, Senior Lecturer in Orthodontics at the University of Adelaide, for their supervision and invaluable advice.

My grateful appreciation is provided to Vicky Hargreaves, Margaret Leppard, of Department of Dentistry, for their technical assistance, advice, and support.

Mr. Ken Crocker offered valuable assistance with the JEOL 100 electron microscope, and Ms. Sandra Pattison helpfully conducted the statistical analyses of this study.

I wish to thank Department of Anatomy, Faculty of Medicine for kindly allowing me the use of their ultramicrotome.

Special thanks are extended to my parents for their continual support and encouragement.

## ADDENDUM

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p8	last para	add 'were used' after 'technique'
p8	2.4	magnetic force systems
p43	para 3	change 'incident to' to 'consequent upon'
p47	para 4	1st sentence, 'was' to 'is'
p60	Fig 3.6	2nd last line corner
p89	para 1	change 'replicating graticule' to 'grating replica'
p91	para 3, 1st line	'vessel' missing after 'blood'