A SCANNING ELECTRON MICROSCOPIC STUDY OF ORTHODONTIC ROOT RESORPTION IN HUMAN PREMOLAR TEETH

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

Department of Dental Health
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The University of Adelaide
1977

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SYNOPSIS

It has been shown by Kvam (1972b) that when a human premolar tooth was tipped buccally by a continuous force of 50 grams, the tissue located near the cementoenamel junction was the first affected by pressure, followed by the mid-root area. Resorption started in the cementum after 10 days as small round cavities, approximately 6 micrometres in diameter. Kvam found that the resorption was characterised by extensive shallow resorptions composed of smaller round lacunae.

This project was undertaken to study the effects of the magnitude and duration of an intrusive force on the root surface topography of human premolar teeth. The material consisted of teeth from eleven patients, aged between 10 and 18 years who required the removal of first premolar teeth prior to orthodontic treatment. A metal ribbon arch bracket was directly bonded to the experimental premolar in each arch. The contralateral premolar of the same arch was used as a control, and a similar bracket was bonded to this tooth to rule out the effect of increased cheek pressure on the tooth due to the bracket thickness.

The experimental teeth were intruded with a light round archwire attached to the first molars, incisors and experimental premolar. Magnitudes of force used were 50 grams, 100 grams and 200 grams for durations of 14 days, 35 days and 70 days. The premolar teeth of two patients who had worn a fixed rapid palatal

expansion appliance were also examined for changes in root surface topography. These premolars were also extracted for orthodontic purposes. Following fixation and coating with carbon and gold, all teeth were examined in the scanning electron microscope.

Resorption was noted in all teeth that had been intruded with archwires for longer than 14 days, and was slightly more severe in teeth where heavy intrusive forces had been applied. Teeth that had been attached to the fixed rapid palatal expansion appliance showed severe resorption on the buccal surface of the premolars.

TABLE OF ILLUSTRATIONS

ACKNOWLEDGMENTS

The majority of this project was conducted in the Orthodontic Department of the Royal Adelaide Hospital, and in the Geology Department, University of Adelaide. I am grateful to Dr. P. Burgess, Director Orthodontic Services, Royal Adelaide Hospital, for permission to use the facilities of the Orthodontic Clinic, and to Dr. K. Bartusek, Officer-in-Charge of the Central Electron Optical Laboratory, for very valuable advice and permission to use the scanning electron microscope. I am especially indebted to my supervisor Dr. M.R. Sims, Reader in Orthodontics for continued guidance and instruction over each phase of the preparation of this project.

I would also like to express gratitude to Dr. J.R. Herd, former Reader in Oral Pathology and Oral Surgery, for permission to use the facilities of the Department of Oral Pathology and Oral Surgery, and Mr. D.E. Smale, Senior Laboratory Technician, for his valuable advice. I am also grateful to Professor D.R. Miller for permission to use facilities of the Department of Chemical Engineering, and to Mr. B. Ides for the machining of the specimen holder. Mrs. I. Zaleski gave advice with the photography.

SIGNED STATEMENT

This project report is submitted in partial fulfilment of the requirements of the Degree of Master of Dental Surgery in The University of Adelaide.

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

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INTRODUCTION

Bone may not always be the only hard tissue resorbed during orthodontic tooth movement. Other tissues resorbed have often included cementum and dentine of the root, a phenomenon termed root resorption. Root resorption can be an unfavourable sequel to orthodontic tooth movement (Ketcham, 1929; Reitan, 1969; Newman, 1975; Goldson and Henrikson, 1975). Investigations on the occurrence of resorption in the roots of untreated permanent teeth have demonstrated sites of resorption, particularly the surface facing the direction of physiological movement (Henry and Weinmann, 1951). These authors found a high degree of bilateral similarity in the number of resorption areas per tooth.

The topography of tooth root surfaces has been examined using the light microscope (Reitan, 1974) and the scanning electron microscope (Lester and Boyde, 1970; Jones and Boyde, 1972; Kvam, 1972a). Only two studies (Kvam, 1973a and 1973b) are known in the literature describing a scanning electron microscopic study of changes on the cementum of human teeth following orthodontic tooth movement. Kvam only studied the effect of varying the duration of a fixed force of 50 grams. He found that the cementum located near the cemento-enamel junction was the first affected, followed by the cementum of the mid-root area. Resorption started after 10 days as small cavities in the cementum, and after 30 days extensive resorptions involving dentine had formed.

Many investigations have shown that when a force is applied to a tooth, areas of pressure and tension are created in the periodontium (Schwarz, 1932; Oppenheim, 1942; Moyers and Bower, 1950; Reitan, 1951 and Glickman et al, 1970). Reitan (1960) described the changes occurring in the periodontium during orthodontic tooth movement. He described the sites of pressure and bone resorption occurring in different types of tooth movement. Rygh (1977) showed that the elimination of hyalinized tissue removed the cementoid leaving a raw cementum surface. This raw surface was susceptible to attack by odontoclasts.

Massler and Malone (1954) suggested that there is an individual susceptibility to root resorption during tooth movement. It has also been claimed that there are differences in the susceptibility to root resorption due to local factors (Oppenheim, 1942), anatomical factors related to the maxilla or mandible (Ketcham, 1929; Hemley, 1941), tooth type (Massler and Malone, 1954) and also general causes such as metabolism or endocrine factors (Becks, 1936).

In an excellent study of apical root resorption under orthodontic therapy, Phillips (1955) found no correlation between the degree of resorption and such factors as sex, age at the onset of orthodontic treatment, length or method of orthodontic treatment, or the amount of orthodontic treatment involved. Newman (1975) used the records of forty seven patients, forty-one of whom had been treated orthodontically, in a radiographic investigation of possible aetiologic

factors in root resorption. He found that the maxillary incisors and premolars, and the mandibular premolars showed the greatest incidence of apical shortness.

Kvam (1973b) only studied the effect of duration of applied force on the root surface. In view of the limited nature of Kvam's study, it is apparent that further investigations are required to broaden our knowledge in this field. Hence the present investigation was undertaken to provide additional clinical information on this subject.

AIMS OF THE PROJECT

The purpose of the present investigation was to study the effect of:

1. different magnitudes of intrusive forces on the root surface topography of human maxillary and mandibular premolar teeth
2. different durations of intrusive forces on the root surface topography of human premolar teeth
3. the root surface topography of teeth that have borne a fixed rapid palatal expansion appliance. To compare the topography of these root surfaces with the results of aims 1 and 2 above.