

Invasive Cervical Resorption and Associated Endodontic Research

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PRECIS

Studies by the author over the past 40 years are presented in this thesis as two complimentary components. Part 1, consists of a varied collection of works dating from 1959, the majority of which are of endodontic significance. Part 2 represents a study of invasive cervical resorption and its clinical management. Both research components embody the concept of lifetime dental health through the maintenance of the human dentition, which may be affected at some time by developmental defects, disease or trauma.

The research presented in Part 1 consists of 13 original studies in which the author was the sole, principal or co-investigator. The studies include physical dental anthropology, endodontic microbiology, physical properties of dentine, calcium hydroxide in endodontics, orthodontic extrusion of teeth, laser doppler evaluation of traumatised teeth, and endodontic education. Part 1 also details 17 collaborative studies in which the author was not the principal investigator. These have addressed several aspects of contemporary endodontic therapy by *in vitro* studies of root-canal irrigation, intra-canal medication with Ledermix paste— a corticosteroid antibiotic medicament used alone and in combination with calcium hydroxide, and calcitonin – a potential anti-clastic intra-canal medicament. Hydron, a poly-hydroxyethyl methacrylate root filling material has been investigated both *in vivo* and *in vitro* using a new cell culture technique while another *in vitro* study evaluated alternative temporary filling materials. The final studies in Part 1 examined tooth staining and the biochemistry of tooth bleaching.

Part 2 consists of six original publications of which the author was sole or principal investigator. These describe studies of invasive cervical resorption and its management. The clinical radiologic and histopathological features of invasive cervical resorption are detailed with particular reference to diagnosis and the significance of the complex resorptive process to treatment. Potential pre-disposing factors in the development of invasive cervical resorption have been analysed in 222 patients or 257 teeth. Each tooth was designated into one of four classes of severity, to allow a classification at the time of diagnosis which could then be related to the result of treatment. The majority of teeth at diagnosis fell into the third class. While several potential pre-disposing factors were identified, orthodontics, trauma and bleaching were those most frequently recorded in that order. A combination of factors, for example, trauma and bleaching, were considered significant. The incidence of bleaching related resorption was evaluated in a further study of 202 patients treated by a standardised bleaching method. Two patients (1.96%) showed the development of bleaching related invasive cervical resorption.

Tissue responses to the topical application of 90% trichloroacetic acid were assessed in an *in vivo* study in rats. The medicament was applied to the soft tissue of the palate and to wounds created at the tooth gingival margin into the periodontal ligament and adjacent bone. The results confirmed that trichloroacetic acid had properties, which could be utilized in the management of invasive cervical resorption.

A prospective study examined 94 patients with a total of 101 teeth displaying varying degrees of invasive cervical resorption treated by the topical application of trichloroacetic acid, curettage and restoration. Orthodontic extrusion was used as adjunctive therapy in some class 3 and class 4 cases. A minimum of three years follow-up was required unless failure occurred before that time in which case that treatment was included in that study. As a result of the investigation, it was apparent that successful treatment could be carried out in the first three classes of severity while alternative therapy was recommended in the fourth class.

The common link between the two thesis components is orthodontic root extrusion. Of the material presented in Part 1, orthodontic root extrusion is perhaps the most significant, while in Part 2 this adjunctive therapy enhanced the successful management of some of the more advanced cases of invasive cervical resorption. Today orthodontic root extrusion has become a mainstream adjunctive therapeutic measure in endodontic practices world wide.

INTRODUCTION

Over the past century there have been dramatic changes in dental health and dental attitudes within the Australian population. In the early part of the twentieth century indigenous Australian Aborigines generally showed excellent dental health with little evidence of caries or periodontal disease (Campbell 1925). However, with changing dietary patterns due to the contact with non-indigenous civilisation the caries incidence rose by the mid century (Cran 1955). This was confirmed by the author's own studies into the dental state of indigenous Australian Aborigines at Haast's Bluff, Central Australia in 1956 (Heithersay 1959).

By comparison, the dental health of non-indigenous Australians in the early to mid 1900's was generally poor with high caries rates (Cameron 1953) and apparently, but unconfirmed, extensive periodontal disease. "Pyorrhoea" was the reason given by many of the dental profession to justify the complete clearance of countless dentitions. Although conservative restorative dentistry was taught in dental schools, emphasis was placed on exodontia and full or partial denture construction as tooth loss was considered the long-term fate for most of the population.

Root canal therapy was practised to a very limited degree in Australia prior to the 1960's. Until that time treatment was generally confined to maxillary anterior teeth because of the perceived difficulty in cleaning and sterilising the complex root canal anatomy of other teeth in the human dentition.

Reflecting the teaching and practice of the time, Bloomfield (1947) wrote in the Australian Dental Journal:

"The limitations of the operator and the materials employed indicate root canal therapy for the six upper anteriors only; root canal fillings are contraindicated in every other tooth. Posteriors, both upper and lower, are contraindicated because no operator has the skill to work root fillings round corners or to fill elliptical canals with their weird twists, bends or sudden divisions, with any reasonable chance of success. Lower anteriors are contra indicated because the canals are too small and also because I am rather partial to having gravity on my side during draining and dressing."

Posterior teeth with pulp involvement due to dental caries were invariably condemned to extraction.

The introduction of water fluoridation, improved oral hygiene and fluoride toothpastes in the 1960's ushered in an era of preventive dentistry and with it came a change in community attitudes to dental health. The accent in teaching and practice changed to allow conservation, wherever possible, of the natural human dentition. The generations of Australians since that time have shown an extremely low incidence of dental caries (Carr 1982) making life-time retention of natural teeth a realistic expectation for the majority of this section of the population.

Despite the dramatic drop in dental caries, the dental health of an individual may be jeopardised by developmental, traumatic or pathological conditions in single or multiple teeth with trauma being the most common cause. In Australia, the incidence of minor or major dental trauma could be compared to Sweden, a similar society, where a study of 12 year-olds revealed that 39% of the group had suffered trauma to the teeth (Forsberg & Tedestam 1990).

Great advances have been made in the management of dental trauma particularly as a result of research into the areas of tooth and bone resorption. A lifetime commitment to such research and to the clinical management of dental trauma has been given by Dr Jens Andreasen of Copenhagen and his contribution to the study of dental traumatology is without parallel.

The author's own studies, over the past 40 years, have made some contributions to knowledge in the fields of dental epidemiology, pathology, microbiology, material science, pharmacology and particularly clinical endodontics. This thesis contains the principal original works which had as their broad aim the retention of the healthy human natural dentition throughout life. They are presented as two complimentary components. Part 1 consists of a varied collection of works, dating from 1959, the majority being of endodontic significance and Part 2 represents a study of invasive cervical resorption and its clinical management.

The studies presented in this thesis have been carried out solely by the author unless otherwise stated. Collaborative studies are delineated into those in which the author was (1) the principal investigator (2) a co-investigator (3) not the principle investigator. In the last instance the author was generally involved in the conception of the research project, some supervision, evaluation of results and preparation of manuscripts.

Review of authors studies

A chronological list of publications is shown in Appendix 1.