# Regeneration of the Periodontal Attachment in Humans

MICK R. DRAGOO

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Dedicated to

ROBERT S. SCHALLHORN

*Periodontist, Researcher, Teacher, and Special Friend*

# PREFACE

For the past five or six decades, the pendulum of periodontal therapy has generally swung toward surgical methods. Most therapists base their evaluation of clinical results on imprecisely arrived at general impressions. This has not been helped by the plethora of new techniques, which has given rise to considerable confusion. With the introduction of linear studies, however, in addition to histologic evaluation of results, a certain amount of skepticism has been introduced in our approach to method.

The ideal model for research in modes of treatment is the human being since he readily and naturally encounters periodontal disease and reflects the variables that complicate our treatment. To this end, all material presented in this book will be from human research subjects.

The impetus motivating this effort is the desire to create a manual that will place in proper perspective the clinical and histologic courses of wound healing that follow the various therapeutic procedures that are used to treat chronic destructive periodontitis. I have also hoped to help develop a rationale for treatment goals in the field of periodontology. Emphasis will be made on follow-up care to periodontal therapy, and data will be presented through sequential studies which demonstrate the success or failure of this care.

The book is designed for general practitioners and specialists, as well as researchers in the field of dentistry. The material presented should be useful in teaching institutions as well as in the everyday practice of periodontology.

This book contains findings obtained from human studies designed to delineate the wound healing of the periodontium following various modes of treatment. Although a multitude of clinical, animal, and in vitro studies on this subject have appeared in the literature, reports regarding the sequential histology of wound healing in human beings have been meager owing to the difficulty of obtaining adequate research material.

It is not within the scope of this book to review and evaluate the literature on each aspect of the subject. However, sufficient references are cited in discussions of specific issues, and these, as well as additional sources, are fully cited in the bibliography.

It is my hope that readers of this book will become more secure about selecting an appropriate mode of treatment for each of their patients. In addition, the level of understanding of the technical considerations of each type of periodontal treatment should be extended.

*Reno, Nevada*

Mick R. Dragoo

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I express sincere appreciation to my wife, Mary, who patiently and carefully typed my often-revised manuscript, and, along with my children Jason and Justin, supported me with compassion and encouragement enabling me to accomplish this goal.

Dr. Robert Schallhorn must be credited as the progenitor of this book. His constant encouragement, guidance, and advice were instrumental in my success; and a sincere thanks is due and graciously given him for the many hours he spent editing the manuscript and interpreting the clinical and histologic data.

A master educator, Dr. Saul Schluger, inspired my academic incentive to continue dental education subsequent to my postgraduate studies in periodontics. I sincerely thank him for the help he gave me in editing this manuscript, as well as for the endless hours he has spent educating all his students in the academic discipline of periodontology.

The research protocol used for the studies reported in this book was initially developed by Dr. Harley Sullivan, an astute clinician, teacher, and researcher, who also merits mention for the invaluable contributions he made to my education in periodontology.

I received aid in the postoperative care of research patients at the University of Washington from Dr. Wayne Kaldahl and Dr. Edward Sturdivant, both of whom are excellent students and clinicians.

I was able to continue research while in private practice because of the generosity of Dr. Ben Moffit who made his laboratory facilities available to me. Dr. Moffit also deserves credit for the advice on research and histologic interpretation that he gave unselfishly to me.

Livia Molor processed the histologic material for this book, and her care and expertise in processing the human block specimens made it possible to derive invaluable data.

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Dragoo, M.R. and Irwin, R.K.: A method of procuring cancellous iliac bone utilizing a trephine needle. Journal of Periodontology, *43*:82, 1972.

Dragoo, M.R. and Sullivan, H.C.: A clinical and histological evaluation of autogenous iliac bone grafts in humans: Part I. Wound healing 2 to 8 months. Journal of Periodontology, *44*:599, 1973.

Dragoo, M.R. and Sullivan, H.C.: A clinical and histological evaluation of autogenous iliac bone grafts in humans: Part II. External root resorption. Journal of Periodontology, *44*:614, 1973.

Mick R. Dragoo

# CONTENTS

# PROLOGUE

## SELECTION OF HUMAN RESEARCH PATIENTS AND RESEARCH PROTOCOL

All the histologic material presented in this book was obtained from human patients whose teeth were diagnosed as hopeless, and extracted for various reasons. The patients were informed of the opportunity to utilize their hopeless teeth in research on the treatment of chronic destructive periodontitis. After volunteering for research, the patients were classified into groups on which various therapeutic procedures were to be used. They were fully informed of the procedures involved in, and the possible complications of, the research, and they were told that selected teeth and portions of the periodontium would be removed during the research.

All research patients were required to sign an "Informed Consent Form," which was prepared with the guidance of the Human Research Committee at the University of Washington. At no time were patients persuaded to volunteer for projects by offers of financial remuneration or special treatment.

Patients selected had 3 or more similar periodontal osseous defects so that adequate controls in the same patient could be observed. Usually, only one patient was used for each time interval. However, in most cases more than one lesion was used in each patient.

Clinical documentation included pre and postoperative photographic records, pocket charting, and pre and postoperative radiographs.

Presurgical preparations, which were carried out on all patients, consisted of periodontal charting, preparation of study models, oral physiotherapy instruction, occlusal adjustment (when indicated), root planing, and temporary stabilization. Temporary stabilization was performed primarily to aid in block section removal, rather than for occlusal stabilization. Each patient was required to achieve an oral hygiene index (Greene and Vermillion S.O.H.I.) of 0.5 for 3 weeks prior to the procedure, and every effort was made to see that this level was maintained throughout the study.

All patients were placed on erythromycin (250 mg. q.i.d.), beginning the day of the procedure and continuing to the seventh day. Erythromycin was used because it is a broad spectrum antibiotic to which few people have allergies.

A groove in the cementum was made with a modified gold foil instrument as close as possible to the most apical extension of the defect (Dragoo and Sullivan, 1973). This groove established the base of the defect and enabled a histologic assessment to be made following the therapeutic procedure.

At specified time intervals, histologic studies were done on block sections that were removed using a surgical technique that preserved the interproximal tissue (see Figs. A and B). Specified teeth were removed, decalcified, embedded in paraffin, and serially sectioned. Every ninth and tenth section was stained with hematoxylin and eosin. Light microscopy was used to evaluate the slides.

All the block specimens were serially sectioned with approximately 400 sections per block and interpreted by at least 3 dental researchers. Photomicrographs that typify each block specimen are included, since it would have been impossible to include all 400 serial sections.

# PROLOGUE ILLUSTRATIONS

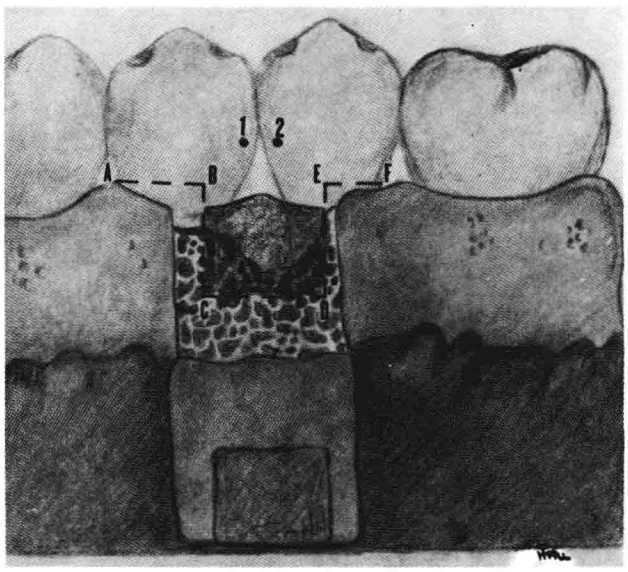


Fig. A. Procedure for removal of tissue specimens. Two vertical soft-tissue incisions are made buccally approximately 2 to 4 mm. to the outside of lines B—C and D—E. Two horizontal incisions are made approximately 1 mm. apical to the free gingival margin so that all interproximal tissues remain intact. A partial-thickness reflection is then made of B-C-D-E, and the remaining flap reflection is full thickness on the buccal and lingual aspects. A reference mark, C-D, which is measured from fixed reference points 1 and 2, is scribed approximately 2 mm. apical to the original defect. A vertical bone-cut is made on the lingual from B-E so that the lingual plate of bone will not be lost during the section removal. A buccal-to-lingual bone cut is then made through the alveolar process and teeth along lines A-B-C-D-E-F. Splinting adjacent teeth facilitates removal of the block section by holding the crowns together. (From Dragoo, M.R. and Sullivan, H.C.: A clinical and histological evaluation of autogenous iliac bone grafts in humans, Part I. J. Periodontol., *44*:599, 1973.)

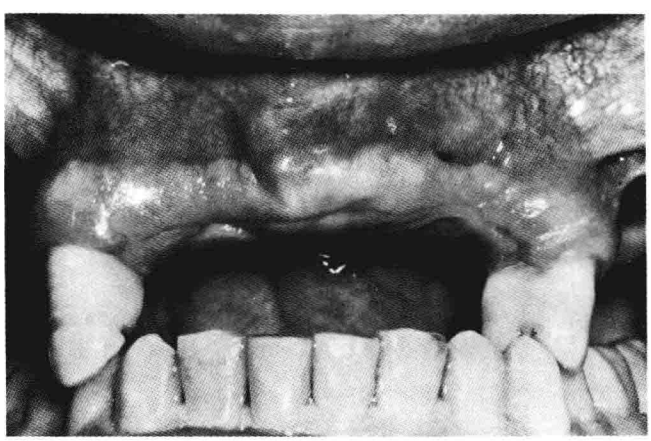

Fig. B. An alveolar ridge 5 months after 4 teeth were removed in block section. Note that minimal morbidity is involved with the block section technique illustrated in Figure A. (From Dragoo, M.R. and Sullivan, H.C.: A clinical and histological evaluation of autogenous iliac bone grafts in humans, Part I. J. Periodontol., *44*:599, 1973.)

Chapter

# 1

# THE PERIODONTAL LESION

As a prerequisite to treatment, one must first identify the problem. Although much information is available on the subject, it is appropriate to review the basic features of the periodontal lesion and its pathway of inflammation since the material relates to studies described in this book.

The typical clinical appearance of uncontrolled chronic destructive periodontitis is shown in Figure 1–1. Gingival exudate, plaque, and calculus are all apparent. Figure 1–2 shows the radiographic appearance of the same lesion. Alveolar bone loss resulting in a poor crown-to-root ratio and subgingival calculus are obvious.

Figures 1–3 and 1–4 are low-power views of a block section of the lower incisors shown in Figure 1–1. One can correlate the histopathology of the periodontal lesion and its clinical and radiographic appearances. Also noteworthy are the pathways of destruction and the relationships of the junctional epithelium and connective tissue attachment to the destructive process and the root surface.

Figures 1–5 and 1–6 show elongated epithelial rete pegs and massive round-cell infiltrate surrounding the bacterial plaque. Although the clinical appearance of the affected area may return to normal after removal of an irritant, it does not necessarily follow that the junctional epithelium and collagen fiber apparatus will return to normal, that is, that the proper relationship will exist between the gingival sulcus, the epithelium, and the connective tissue attachment (see Fig. 8–39).

As seen in Figure 1–4, mature collagen is attached to the root surface near the alveolar crest. If allowed to remain, this collagen has both beneficial and detrimental effects. It may serve beneficially as a barrier to the apical migration of junctional epithelium. However, if the collagen fibers are left intact over the resorbed alveolar crest and the root surface, the potential for alveolar bone apposition may be lost. Figures 4–9 and 5–11 illustrate the difference in alveolar crest regeneration after closed curettage, in which the collagen fibers are not removed, and after open curettage, in which the crestal collagen fibers are removed.

Probing of the gingival sulcus while the periodontium is inflamed may be misleading. The lower incisors shown in Figure 1–1 were probed 7.5 mm. from the free gingival margin to the attachment level. However, the histologic sulcus depth was considerably less, even when shrinkage from histologic preparation of both hard and soft tissue was considered. Therefore, as can be seen in Figure 1–4, the probe apparently took the path of least resistance, which was not next to the root surface, but through the altered epithelium and collagen bundles of the

connective tissue, coming near to the bone. As seen in Figures 1–4 and 1–7 to 1–9, parts of the junctional epithelium and connective tissue fibers are still firmly adhered to the root surface despite massive inflammation, clinical probing, and histologic preparation and sectioning. Therefore, extreme caution should be used when evaluating initial probing measurements prior to root planing and plaque control.

Subsequent chapters describe tissue response to various modes of treatment. For example, Chapter 4 demonstrates that junctional epithelium usually proliferates apically and that alveolar bone responds minimally when closed curettage is used to treat periodontal lesions. Chapters 5 to 8 demonstrate that if various kinds of surgical therapy are utilized, the bone response, the location of the junctional epithelium, and the position of the connective tissue attachment are usually more favorable when open flap procedures are employed. Figure 8–39 shows this healing response of bone grafts.

# CHAPTER 1 ILLUSTRATIONS