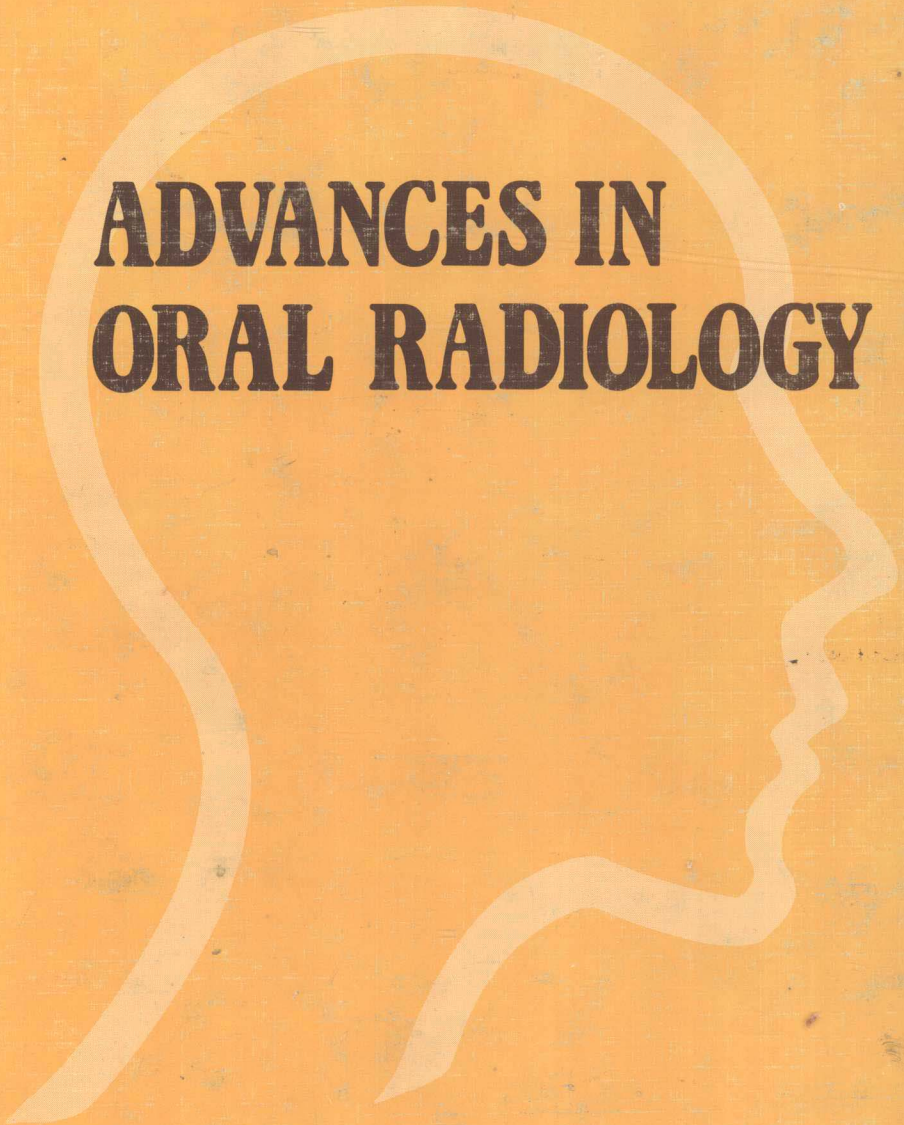
Postgraduate Dental Handbook



ADVANCES IN ORAL RADIOLOGY

Allan B. Reiskin

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Postgraduate Dental Handbook Series, Volume 12

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Pharmacology is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required. The editors and the publisher of this work have made every effort to ensure that the treatment and drug dosage schedules herein are accurate and in accord with the standards accepted at the time of publication. Readers are advised, however, to check the product information sheet included in the package of each drug they plan to administer to be certain that changes have not been made in the recommended dose or in the indications and contraindications for administration. This recommendation is of particular importance in regard to new or infrequently used drugs.

FOREWORD

During the past decade there has been a gratifying increase in new knowledge in the art and science of dentistry from general practitioners of dentistry and dental specialists. The biological and dental sciences are in a period of explosive growth whose rate has been particularly increased in basic dental sciences with clinical applications and in clinical dentistry by the diversification of experimental methods in dental procedures.

Dental sciences are currently considered as multidimensional with great individual differences. Dental scientists and practitioners know that the adaptation of techniques from other fields of science is not simple, usually indirect, and inapplicable unless radically revised, extended, or reformulated for dentistry. The basic experimental methods originating in the clinical dental sciences may now be joined by the methods of the biological and physical sciences, and made technically feasible by the introduction of modern electronics and computers.

It is the goal of the Postgraduate Dental Handbook Series to present critical analyses, based on impressive clinical and research experience. This series provides basic dental sciences with clinical applications and clinical dental sciences in a correlated fashion. Similarly, it provides the most current concepts in clinical dentistry of direct value to practitioners, specialists, students, and hygienists throughout the world. By bringing together all of our knowledge, volumes in the Postgraduate Dental Handbook Series will fill a critical need felt by many clinicians and investigators.

Dr. Allan B. Reiskin, Professor of Radiology and Head of the Division of Oral Radiology in the Department of Oral Diagnosis of the School of Dental Medicine at the University of Connecticut Health Center, presents the methods and techniques for the most effective solutions to the clinical problems in oral radiology confronting the dental practitioner. He is a dental educator and researcher who has succeeded in producing an eminently readable, comprehensive work in the field of dental radiology.

The present work reveals fresh insights based upon knowledge of the latest research in the field of radiology. Dr. Reiskin has directed his insights in radiology to the general practitioner of dentistry, and has selected stimulating and informative topics in radiology for discussion which are both scientific and consistently practical. All of the topics receive highly critical attention with the most important areas clearly emphasized. The discussions of the mechanisms of radiologic diagnosis are highly critical, yet concise, with numerous important relationships based upon fundamental radiologic principles. In this monograph, the author has come to grips with the problems which have plagued the dental practitioner taking the radiographs of the dental patient, thereby providing the general practitioner of dentistry with a specialized assessment of the most important features and problems in modern dental radiology.

Sophisticated modern dental radiology techniques are presented not as isolated disciplines or free-standing entities but from the viewpoint of their usefulness and limitations in dental practice.

It is hoped that this up-to-date monograph on modern dental radiology, together with future radiologic research, will provide the bridge to a new era in the holistic treatment of the dental patient. The editor of the Postgraduate Dental Handbook Series expresses his gratitude and appreciation to the author and to the contributors who assumed this vital task for dentistry.

Alvin F. Gardner, Series Editor

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INTRODUCTION

The interpretive and technical aspects of dental radiology have necessarily suffered on several accounts. First, radiology is not a recognized specialty within the dental profession. Compared to the recognized disciplines, it receives relatively little attention in the undergraduate curriculum. Second, every dentist provides his own x-ray services and will have a depth of experience which is directly related to the characteristics and size of his own patient population. Third, most disease found in the jaws is chronic and benign, rarely leading to procedures that require histologic examination. Confirmation of a radiographic diagnosis is, therefore, infrequent. Fourth, the dental marketplace is quite small and has not provided a significant economic stimulus to manufacturers to apply today's space age technology to designing equipment for dental radiographic procedures.

Expertise in dental radiology is, therefore, limited. A few individuals in large institutions have had an opportunity to analyze thousands of patient examinations each year. Unfortunately, even within institutions, the ability to record, confirm, catalog, and study the results of many patient examinations is severely restricted.

Although dental radiography has not changed dramatically in the last 70 years, we are on the threshold of major alterations in practice patterns. There is a growing consciousness about the potential hazards of exposure to ionizing radiation, and there is increasing recognition of the limitations of currently used technical procedures. This book will attempt to provide a limited insight into developing trends in dental radiology, from a technologic and interpretive point of view. It is our hope and expectation that the information contained within these pages will be of value to practitioners, who will find it necessary to modify their practice patterns in the future.

Allan B. Reiskin

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SECTION I

TECHNOLOGY

1 The X-Ray System

In selecting x-ray equipment for an office, several important factors should be taken into account. First, one can rarely afford the luxury of choosing individual pieces of equipment. Rather, the entire system, including the radiation source, the image receptor, the devices used for processing the image, and all of the accessories or devices used for controlling or interconnecting these major components, should be considered as a unit. Second, the specific diagnostic needs of the practice should be identified. Equipment required in an orthodontic practice may be unsuitable for a general dentist. The needs of one oral surgeon might vary dramatically from those of his colleagues, depending upon whether the practice is restricted to exodontia and minor surgical procedures or includes a broad range of problems such as orthognathic surgery, chronic progressive diseases, and trauma. The needs of the periodontist may vary to a small but significant degree from those of an endodontist. Third, there is a growing recognition by both professionals and health care consumers that the risks associated with exposure to ionizing radiation may be significantly greater than have been estimated in the past. Therefore, patient exposure or system speed, as well as other safety features, are considerations that cannot be overlooked.[1]

Proprietary recommendations would be inappropriate here. Furthermore, data needed for such recommendations do not exist. No data bank is available to consumers that specifies the frequency-of-repair record for any particular brand or model of any component of any x-ray system. It is necessary, therefore, to rely on a careful analysis of the specifications that manufacturers are legally obligated to provide and to weigh judiciously the experience of colleagues and dealers. In the latter case, however, a prospective purchaser should remember that colleagues may be reluctant to acknowledge publicly what they themselves regard as an error in judgement, and that dealers are motivated by the profitability of a sale, as well as by such considerations as the long-term prospects that accrue from the acquisition of a new and regular customer.

X-RAY SYSTEMS

The potential importance of x-ray diagnosis in the healing arts was recognized immediately by Roentgen and his contemporaries. Medical and dental applications were demonstrated within a period of two weeks following the reported discovery of x-rays.[2] Unfortunately, the power of this diagnostic modality was so overwhelming that many health professionals remained satisfied for decades with the performance of devices that did not differ significantly in concept from those described by Roentgen, Edison, and Coolidge. However, we are now in a period of transition. Dental radiology is beginning to incorporate many of the technologic advances that have been applied in medicine. This technology should be evaluated within the context of cost, safety, and effectiveness, as well as in terms of convenience.

The most common type of x-ray system in dental practice today employs a single phase generator using self-rectified tube and stationary anode. Such generators are used with a variety of films as image receptors. Essentially all films require postexposure manual processing in wet chemicals. In practices with larger numbers of patients or with special needs, the use of panoramic x-ray equipment is more common, although some evidence suggests that this modality may not be well understood by its users (Reiskin, In preparation). A growing trend exists toward the use of machine processing of films rather than wet tanks or manual development.

In dealing with this major factor, the x-ray system, characteristics known to be of significant technical importance in currently used systems will be described. Brief descriptions of devices used in other branches of the healing arts, and in nondestructive industrial testing, that may soon find its way into dentistry will follow.

X-RAY GENERATORS

The most common type of x-ray generator uses alternating current as its power source. Current is supplied to the filament in the x-ray tube. Electrons from the filament are drawn to a target by a high voltage placed between the filament and the target (Figure 1-1). Alternating current is produced by electromagnetic induction and, as the name implies, the polarity or direction of the current is constantly changing, or alternating. The flow of alternating current graphs as a sine wave with each pulse or cycle having a positive and a negative component (Figure 1-2). The flow of electrons from the filament to the target in an x-ray tube depends upon

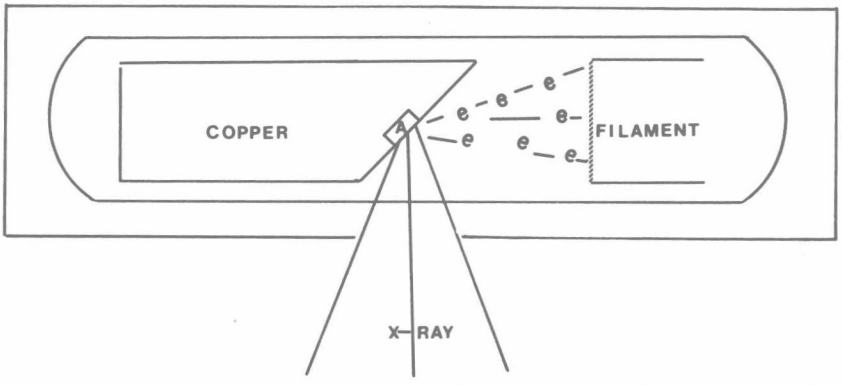

Figure 1-1 Schematic representation of a dental x-ray tube. Electrons from the heated filament are drawn to the target or anode (A) by a high potential difference. As electrons strike the anode, x-rays are produced.

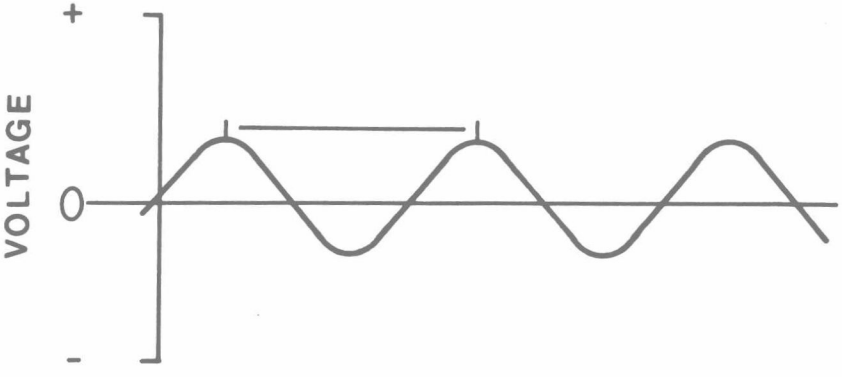

Figure 1-2 Polarity of household electric current varies as shown. A full cycle (wave crest to wave crest) occurs 60 times per second.

the polarity of both the target and filament. Like charges repel each other and unlike charges attract. Negatively-charged electrons are drawn from the filament to the target only when the target has a positive charge. Since the bombardment of the target by electrons generates x-rays, they are produced only when the target is positive, or for half of each cycle. Furthermore, the power fluctuates as the polarity changes, so that peak voltage exists for a limited period during each half cycle. This type of system is not efficient, since most of the energy from the bombardment of the target with electrons produces heat, with a relatively insignificant amount of energy being transformed into x-rays. In order to obtain a sufficient number of x-ray photons of adequate energy, the x-ray tube must be able to dissipate the heat. If the heat is not dissipated quickly enough, the tube will fail. On the other hand, if the power is reduced to avoid overheating, long exposures are needed, which permit motion that may distort the final image.

Distance is also an important factor to consider. As shown in Figure 1-3, the intensity of the x-ray beam decreases as the inverse square of the distance from the target to the film. Accordingly, to switch from a short cone bisecting angle technique (4 inches) to a long cone right angle technique (16 inches), the output would have to be increased by 16 times to maintain the same exposure time. Even if the exposure time could be increased, heat production might become one problem and patient movement another.

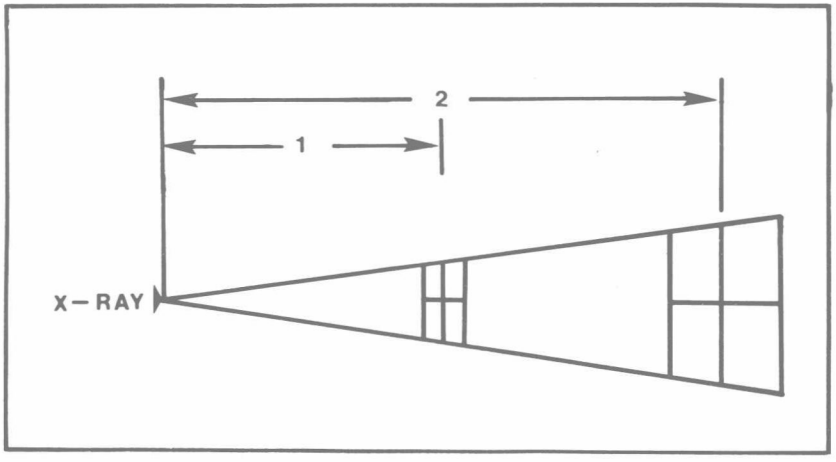

Figure 1-3 The inverse square law. X-rays from a point source diverge. Notice that the number of photons within a given area at one unit of distance are dispersed over an area four times as large when the distance doubles.