



Second Edition

Endodontic Radiology

Edited by Bettina Basrani



 WILEY-BLACKWELL



Endodontic Radiology, Second Edition

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“Every great dream begins with a dreamer. Always remember, you have within you the strength, the patience, and the passion to reach for the stars to change the world.”

Harriet Tubman

This book is dedicated to my children, Jonathan and Daniel, to encourage them to follow their dreams with conviction and hard work, and especially with love.

Contents

About the Editor	ix	6 Radiographic Analysis of Anomalous Tooth Forms and Morphological Variations Related to Endodontics	54
Contributors	x	<i>Jeffrey M. Coil</i>	
Foreword	xiv		
Preface	xvi		
Acknowledgments	xvii		
 		Part 2: Endodontic Disease	79
Part 1: General Principles and Techniques	3	7 Radiographic Expression of Endodontic Disease	81
1 General Principles of Radiology in Endodontics	5	<i>Calvin D. Torneck</i>	
<i>Anda Kfir and Bettina Basrani</i>		8 Image Interpretation of Periapical Abnormalities	101
2 Intraoral Radiographic Principles and Techniques	18	<i>Ernest W. N. Lam</i>	
<i>Mindy Cash and Bettina Basrani</i>		9 Radiographic Interpretation of Traumatic Injuries	129
3 Special Situations	39	<i>Nestor Cohenca</i>	
<i>Bettina Basrani</i>		10 Radiographic Analysis of Acquired Pathological Dental Conditions	153
4 Intraoral Digital Imaging	43	<i>Amir Azarpazhooh</i>	
<i>Ernest W. N. Lam</i>		11 Radiographic Analysis of Periodontal and Endodontic Lesions	166
5 Radiographic Considerations Before the Endodontic Treatment Is Initiated	49	<i>Jim Yuan Lai and Bettina Basrani</i>	
<i>Calvin D. Torneck</i>			

12 Radiographic Imaging in Implant Dentistry <i>Amir Azarpazhooh and Jim Yuan Lai</i>	177	18 Micro-Computed Tomography in Endodontic Research <i>Mana Mirfendereski and Ove Peters</i>	278
Part 3: Sequence of Endodontic Treatment	191	Part 5: Advanced Techniques	285
13 Radiographic Considerations during the Endodontic Treatment <i>Bettina Basrani</i>	193	19 Alternative Imaging Systems in Endodontics <i>Elisabetta Cotti and Girolamo Campisi</i>	287
14 Electronic Apex Locators and Conventional Radiograph in Working Length Measurement <i>Gevik Malkhassian, Andres Plazas, and Yosef Nahmias</i>	218	20 Introduction to Cone Beam Computed Tomography <i>Ernest W. N. Lam</i>	304
15 Vertical Root Fractures: Radiological Diagnosis <i>Anil Kishen and Harold H. Messer</i>	235	21 Interpretation of Periapical Lesions Using Cone Beam Computed Tomography <i>Carlos Estrela, Mike Reis Bueno, and Ana Helena Gonçalves Alencar</i>	307
16 Healing of Chronic Apical Periodontitis <i>Dag Ørstavik</i>	251	Part 6: Clinical Cases	329
Part 4: Teaching and Research	267	22 Clinical Cases <i>Le O'Leary</i>	331
17 Radiographic Consideration for Endodontic Teaching <i>Bettina Basrani</i>	269	23 Clinical Impact of Cone Beam Computed Tomography in Root Canal Treatment <i>Carlos Bóveda Z.</i>	367
		Index	416

About the Editor



Dr. Bettina Basrani is Tenured Associate Professor and Co-Director, MSc Program in Endodontics on the Faculty of Dentistry, University of Toronto, in Ontario, Canada. Dr. Basrani received her D.D.S. degree from the University of Buenos Aires and a Specialty Diploma in Endodontics and Ph.D. from

Maimonides University in Buenos Aires, Argentina. A long-time educator and researcher, she began her teaching career at the University of Buenos Aires. In 2000, she moved to Canada to serve as Head of the Endodontic Program at Dalhousie University, Halifax, Nova Scotia. In 2004, she moved to Toronto, where she has continued her academic and clinical work, nurturing two careers in parallel—those of educator/researcher and practicing clinician. Internationally recognized as a leading authority in endodontics and as an excellent lecturer, effectively combining clinical and scientific information, Dr. Basrani has received many teacher awards throughout her career and has international courses and lectures, over 30 peer-reviewed scientific publications, textbook chapters, and abstracts to her credit. She serves as an Editorial Board Member for the *Journal of Endodontics* and *International Endodontic Journal*. Dr. Basrani is a member of many endodontics societies around the world, and also serves on the special committee to develop researchers of the American Association of Endodontics. She makes her home in Toronto, where she is married to Canadian psychiatrist Dr. Howard Alter and spends her leisure time taking their sons, Jonathan and Daniel, to soccer practices, chess tournaments, skating lessons, and piano recitals.

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Foreword

The new edition of *Endodontic Radiology* represents a change of generations and the evolutionary process this change encompasses.

The first edition of *Radiología en Endodoncia* was a unique textbook published in Spanish in 2003. It was edited by Prof. Enrique E. Basrani, Dr. Ana Julia Blank, and Dr. Maria Teresa Cañete, all from the Maimonides University in Buenos Aires, Argentina, and included contributions from 21 prominent educators and clinicians from Latin America and beyond. It was the first textbook to provide readers with a comprehensive digest of all aspects of radiology related to endodontic therapy. It explained radiology from the endodontic perspective, and it explained many aspects of endodontics through the radiology perspective. It captured the state-of-the-art radiographic technologies available to clinicians at the beginning of the 21st century. In addition to a comprehensive, detailed description of the basic “bread-and-butter” applications of radiology in endodontics, the first edition included at its end several brief chapters featuring the “cutting edge” technologies of that period, including digital radiography, electronic image processing, and digital subtraction. Little could be known at that time that within one decade, what was cutting edge would become the bread and butter, and that newer technologies would emerge that would revolutionize the applications of radiology in endodontics.

The second edition of *Endodontic Radiology* in front of you has been authored by Dr. Bettina



Professor Emeritus Enrique E. Basrani

Basrani, the late Prof. Basrani’s daughter. She is the representative of the younger generation, but she remains her father’s daughter. An experienced endodontist, she is as dedicated to endodontics and to education as her father was throughout his illustrious career. While in the first edition she coauthored a short chapter with colleagues, she

has since taken it upon herself to update her late father's labor of love and to make it current for the contemporary clinician. True to her generation, she has been able to expand international and interdisciplinary collaborations, allowing the reader to benefit from contributions by 19 foremost educators, researchers, and clinicians from Australia, Brazil, Canada, Israel, Italy, Norway, the United States and Venezuela, spanning across four different disciplines of dentistry. With access to this collective international expertise, the reader gains an in-depth and wide-ranging insight into the current state of radiology applications in endodontics.

With the change of generations in authorship, the second edition's content also has evolved greatly from the original published in less than one decade ago. In this respect it provides the clinician an updated, current, and thorough reference to the critical role of radiology in all steps of endodontic therapy. Accurate diagnosis of endodontic diseases and sequelae after traumatic injury to teeth, appreciation of the sites and extent of associated bone loss, insight into the anatomy of teeth, morphology of the endodontic system and resorptive defects, precise execution of endodontic treatment procedures, assessment of treatment outcome, documentation and effective communication of treated cases among dental professionals, all require sophisticated use of radiology at each step. The second edition of *Endodontic Radiology* will guide the clinician toward achieving the required sophistication in applying the most current radiological tools to benefit their patients.

Another aspect of the generation change and evolution is extension of the availability of the

information to a much wider readership. Whereas the first edition could only benefit readers versed in Spanish, the second edition of *Endodontic Radiology* published in English will benefit numerous clinicians all over the world.

All clinicians, both general dentists and specialists in different disciplines of dentistry including endodontists, will acquire critical knowledge by reading this current textbook. The acquired knowledge, in turn, will provide the clinicians with the basis for sophisticated use of radiological tools when providing endodontic care to their patients, resulting in upgraded quality of treatment.



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Preface

Radiology is an indispensable tool in endodontic practice and provides the clinician with information that is not otherwise accessible. It is also an ever-expanding field driven exponentially by constant changes in technology. It is for these reasons that this textbook, devoted to achieving a mastery of radiographic techniques and understanding in radiographic interpretation as applied to endodontic, is of particular importance to those who teach, study, and practice in this field.

There has been only one textbook dedicated entirely to endodontic radiology that has been published up to now, *Radiologia en Endodoncia*, by my father, Professor Emeritus Dr. Enrique Basrani (1928–2001) in collaboration with his colleagues, Dr. Teresa Cañete and Dr. Ana Blank. Published in Spanish in 2001, it gained wide academic acceptance in many Spanish-speaking countries. This English revised version on the same topic both fills an academic void for those who practice endodontics in non-Spanish-speaking countries and satisfies my personal wish to continue the work originally undertaken by my father. *Radiologia en Endodoncia* was his sixth and last book. He was

a pioneer of our specialty, internationally recognized for his ability to inspire and motivate others to love what he loved: The art of endodontics. Now, eleven years after his untimely death, he is still remembered by his colleagues, peers, and students for his unique vision and passion for knowledge.

The field of endodontic imaging is changing and expanding rapidly, and it is for this reason that several chapters incorporating the application of the newer technologies and the information gained through them have been included in this edition.

This book is not intended to cover in detail every aspect of dental radiology; its purpose is directed toward improving endodontic treatment outcomes by identifying and expanding the link between endodontic practice and radiographic imaging.

Clarity in endodontics is comprehended through the shadows. As Leonard Cohen put it: "That's how the light gets in." Enjoy the book, and I welcome your feedback at any time.

Bettina Basrani

Acknowledgments

I would like to thank the Dean of the University of Toronto, Faculty of Dentistry, Dr. David Mock, for granting me a sabbatical from my position at the Department of Endodontics to pursue writing this book. This decision was enthusiastically supported by the Head of the Endodontic Department, Dr. Shimon Friedman, who has always been ahead of his time and who constantly inspires all of us who work around him with his knowledge and wisdom.

Special recognitions to my collaborators on this project, all keen, clever, and dedicated specialists who contributed the highest quality of knowledge. Some of the collaborators have a lifetime of experience and others are recent graduates; some are pure academicians while others are pure clinicians. I thank them all for the enthusiasm they brought to the project.

I want to acknowledge Dr. Lyon Schwartzben for his invaluable help in editing the early manuscript.

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My gratitude to Rick Blanchette, Melissa Wahl, and all the team from Wiley-Blackwell, who trusted and honored me with this project and helped me throughout the process.

My final thanks are to my family, starting with my parents Clarita and Enrique Basrani for providing me with the opportunity to be where I am today. They have always been my biggest fans and gave me motivation and inspiration to follow my academic career without limits and with unconditional love. My brother, Dr. Damian Basrani, for his care and support throughout my entire personal life and professional career. To my dear and extraordinary husband, Dr. Howard Alter, for keeping me grounded, and because his encouragement, input, and constructive criticism have been priceless.

Finally, I'd like to conclude by thanking you, the reader of *Endodontic Radiology, Second Edition*, for reading this book, and hope that it has served its purpose of enhancing your clinical practice. Enjoy!

Endodontic Radiology, Second Edition

Part 1

General Principles and Techniques

- Chapter 1 General Principles of Radiology in Endodontics
- Chapter 2 Intraoral Radiographic Principles and Techniques
- Chapter 3 Special Situations
- Chapter 4 Intraoral Digital Imaging
- Chapter 5 Radiographic Considerations before the Endodontic Treatment Is Initiated
- Chapter 6 Radiographic Analysis of Anomalous Tooth Forms and Morphological Variations Related to Endodontics

1

General Principles of Radiology in Endodontics

Anda Kfir and Bettina Basrani

“. . . And God said: Let there be light. And there was light. And God saw the light, which it was good; and God divided the light from the darkness . . .” (Genesis 1:3–4, The Bible, King James version)

Endodontics is the branch of dentistry in which radiology plays a critical indispensable role. Radiology illuminates what otherwise would be dark and hidden zones and allows the dentists to visualize areas not accessible by other diagnostic means. It is the use of oral radiographs which enables visualization of the bone around the apices of the teeth, as well as the results of the root canal treatments, and as such it has allowed turning endodontics into a scientific professional entity (Grossman, 1982).

History of dental radiology

The many developments over the years in the field of dental radiology cannot be adequately appreciated without looking back to the discovery of X-radiation.

The cathode tube

The first step occurred in 1870. Wilhelm Hittorf found that a partially evacuated discharged tube could emit rays able to produce heat and cause a greenish-yellow glow when they strike glass. By placing a magnet within easy reach and changing the path of the rays Varley determined that these rays were negatively charged particles and they were later called electrons. It was Goldstein from Germany who called the streams of charged particles “cathode rays.” He was followed by William Crookes, an English chemist, who redesigned the vacuum tube which subsequently was known as Hittorf–Crookes tube. In 1894, Philip Lenard studied the cathode rays’ behavior with the aid of a tube with an aluminum window. He placed screens with fluorescent salts outside the aluminum window and found that most of the rays could penetrate the window and make the fluorescent screen glow. He noticed that when the tube and screens were separated, the light emitted decreased. When they were separated by 8 cm, the screens would not fluoresce.