

BOOK REVIEW

Applied Laser Medicine

Hans-Peter Berlien and Gerhard J. Müller, 740 pages+xii, ISBN 3-540-67005-x, Springer Verlag, Berlin (2003), \$299 hard-cover.

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A few months after Maiman invented the laser in 1960 it was used by others for medical applications. A ruby laser photocoagulator was first used to photocoagulate the retina of a patient in 1961. Since then the rapid growth and proliferation of both new types of medical lasers and their use in surgical and medical procedures is an indication of their importance in many fields of medicine. *Applied Laser Medicine* provides the reader with a current, comprehensive, well-illustrated, and documented book that covers both the basics of laser physics and their medical applications.

As stated by the editors, *Applied Laser Medicine* is intended for both the advanced specialist and for the clinician interested in the application of lasers in medicine. I strongly concur that both scientists who work in the field of laser medicine and physicians who use lasers in either treatment or diagnostics will benefit from reading this book. Scientists and engineers who develop laser sources and their delivery systems need to know the details of the distinct optical properties, and their reactions to laser light, during and following the application of laser light. For example, variations in hydration, pigmentation, heat conduction, and vascular supply will have large effects on laser-tissue interaction and also on post-treatment wound healing. *Applied Laser Medicine* provides an excellent comprehensive overview of laser-tissue interactions up to about 2002. Similarly, and in balance with these aspects, the book provides a very complete coverage of the medical aspects of the use of lasers in treatment and diagnostics, which will benefit the physician who will use these laser techniques, modify them, and perhaps improve and extend their use. The great detail of both the textual description together with numerous clinical color

photographs for each laser procedure and technique serve as a useful clinical guide for the practicing physician. By covering almost all specialities of clinical medicine, the reader can readily find the details to perform these laser procedures. For each clinical laser technique the reader will learn the parameter guidelines, i.e., type of laser, mode, power, and pulse duration. In general the following outline is presented for each laser procedure: types of laser used for the procedure with their parameter guidelines, indication for the laser procedure, patient preparation, patient aftercare, details of the laser procedure, criteria for exclusion from the procedure, safety considerations, and a comparison with alternative procedures. In addition, there is a discussion of the clinical results as well as the important discussion of complications associated with these procedures.

Applied Laser Medicine is a completely revised English translation of the German loose-leaf book entitled *Angewandte Lasermedizin-Handbuch für Praxis und Klinik*. This book has been used for the training of more than 3,000 physicians in Europe. In 1996, a Russian version was developed that is widely used in the Russian Federation. However, the editors did not simply translate the German volume to produce this new book, but provided up-to-date material on clinical experience and procedures in this new book.

The editors Professor Hans-Peter Berlien and Professor Gerhard J. Müller were assisted by their co-editors Dr. Hans Breuer, Dr. Neville Krasner, Dr. Tetsuya Okunaka, and Dr. David Sliney in the organization and development of the book. The list of contributors comprises a group that includes 70 physicians and scientists; they cover a wide range of medical specialties and the areas of laser physics and biological interactions.

Applied Laser Medicine has several features that increase its value as a textbook. The production quality of the book is of a very high standard. The illustrations are designed to explain many of the concepts of lasers and laser-light interactions to medically trained clinicians. Furthermore, all of the basic science concepts are accompanied by sev-

eral illustrations that function together with the text to explain all of the important principles. The book is replete with graphs and tables that contain actual experimentally derived data, i.e., chemical structures, absorption curves, absorption and scattering coefficients, optical properties of tissues, and light and electron micrographs of tissues prior to and following laser treatment. In addition, there are excellent photographs of the laser sources, delivery systems, and laser tips as well as full-color photographs of actual laser procedures and many photographs of pathology. A chapter on laser safety in medicine by D. H. Sliney is of paramount importance and should be read before any medical laser is turned on. This is followed by a second chapter on "Guidelines for Safe Clinical Laser Applications," which includes a very clear section on practical advice on how to avoid laser hazards by Fuchs, Philipp, and Berlien. A complete subject index is provided. In addition, individual chapters also include sections on their unique aspects of laser safety.

The organization of the book is another strength of *Applied Laser Medicine*. Part I consists of the basic information on the fundamentals of each type of laser system, from Nd:YAG to diode lasers. I found these chapters very useful as they carefully explained both the theory of laser operation and the specifics for each laser system. For example, the reader is introduced to three-level and four-level types of lasers and then to the electronic transitions that are responsible for the laser output. The section on optical resonators clearly explain in text and in diagrams the various modes of optical resonators. Theoretical considerations are well balanced with practical aspects; e.g., the focusing of a Gaussian laser beam by a lens is discussed and illustrated. The next section covers the complex interactions between laser light and biological tissues. This section is required reading prior to the use of medical lasers as it covers the myriad mechanisms of tissue response to intense laser light. Effective medical laser systems require the optimal integration of the laser source and the delivery system together with precise control of the dose that the tissue receives. These topics are well devel-

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oped in the section on medical laser systems. Beam handling systems using both articulated or quartz fiber light guides and various types of endoscopes are discussed in great detail with many examples of actual medical devices. Between the beam handling system and the biological tissue is the optical applicator. Many types of applicators are discussed and illustrated: gas and liquid flushed endoscopy light guides, contact tips, cutting tips, vaporizing tips, and coagulation tips. Subsequent sections include a good discussion of the experimental techniques to determine the optical properties of biological samples. This is followed by block diagrams that show the steps in the inverse Monte Carlo simulation to calculate the absorption coefficient, the scattering coefficient, and the anisotropy factor from the measured data. The optical properties of various tissues in normal and pathological states, blood, and organs is presented in a series of graphs that show the wavenumber dependence.

Part II develops the principles of laser applications in medicine. The chapter on therapeutic guidelines is a useful and compact series of tables that present suggested settings of wavelength, pulse width, exposure time, and power for each type of medical procedure. These tables of therapeutic guidelines are useful for comparing several laser procedures to obtain a given therapeutic effect. The importance of photodynamic therapy in laser medicine is indicated by the chapter that discusses the theory, the chemistry of photosensitizers, and the side effects of this application to medicine. This chapter succeeds in presenting the photophysics of molecular sensitizers in terms of molecular orbitals, chemical bonds, and radical formation. Their molecular spectra and properties are discussed in terms of quantum mechanical selection rules, spin-forbidden electronic transitions, spin-orbital coupling and its consequences, the Born-Oppenheimer approximation, and the use of molecular orbital theory. This discussion on the photophysics of photosensitizers is covered in a clear and nonmathematical format, which is a wonderful way to teach these concepts to scientists and clinicians who are not observed in the theory of quantum mechanics.

Part III is devoted to the clinical areas of application, from dentistry to urology. The chapters in this section contain many details of the laser procedure as viewed in a clinical setting. Numerous color images of various stages of the laser procedures serve to guide the reader. In some cases the color clinical photographs are augmented by gray-level illustrations that help to understand the clinical images. While all medical-surgical specialities are covered in separate chapters, two areas of laser medicine are given larger coverage: ear, nose, and throat (ENT) and laser treatment in plastic surgery and dermatology.

In order to cover the total field from the fundamentals of the theory and the laser systems to the clinical procedures and their various clinical effects in a single volume the editors had to limit the pages given to each medical speciality. However, this reviewer concludes that the topic of medical diagnostics is not adequately covered in the book. While a chapter on diagnostics is included, its coverage of optical coherence tomography, laser Doppler perfusion imaging, and fluorescence analysis is too brief to be useful. A more extensive chapter would be more in line with the high quality of the remaining chapters in the book. Furthermore, if one is limited to a specific medical speciality, e.g., ophthalmology, then perhaps a book on laser applications limited to that speciality would be more appropriate. However, these are minor criticisms, and presented in the hope that future editions can expand their discussion of medical laser diagnostics.

Applied Laser Medicine is an excellent book that should be read by everyone who uses lasers in clinical medicine. I suggest that scientists and engineers who are involved in the design of medical laser systems, from the laser source to the delivery system, would also find this book useful. The very good integration of theory and clinical practice, high-quality graphics, color medical images, and useful summary tables all combine to provide the reader with a clear, well-organized, practical, and useful book. I highly recommend *Applied Laser Medicine*.



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a fellow of both the Optical Society of America and SPIE—The International Society for Optical Engineering. He received a BSc degree from the Polytechnic Institute of Brooklyn, and MSc degree from Florida State University (Institute of Molecular Biophysics), and a PhD degree from the Weizmann Institute of Science in Israel. Dr. Masters continued his research at the Max Planck Institute for Biophysical Chemistry at Göttingen, Columbia University, the Rockefeller University, the University of Pennsylvania, Emory University, and the Georgia Institute of Technology. He was formerly a research professor at the Department of Anatomy of the Uniformed Services University of the Health Sciences in Bethesda. Dr. Masters was also a program director for biological instrumentation and instrumentation development at the National Science Foundation. He is the editor of several books. Dr. Masters has published 77 research papers in refereed journals, 105 book chapters, numerous papers in conference proceedings, and 103 scientific abstracts. Dr. Masters has been chair or co-chair of 44 international symposia and meetings on biomedical optics. He taught many short courses on three-dimensional confocal microscopy and visualization in the United States and abroad. Dr. Masters has presented over 300 lectures on biomedical imaging. His research interests include the development of in vivo confocal microscopy of the human eye and skin, cell biology of differentiation and proliferation in epithelial tissues, the application of and development of multiphoton excitation microscopy to deep tissue imaging and spectroscopy, diagnostic and functional medical imaging, optical Fourier transform methods for cellular pattern recognition, and fractal analysis of biological branching structures.