The following tables can be used as a guideline in planning strabismus surgery. These numbers have been derived from Marshall Parks, with modifications from the surgical experience of Kenneth W. Wright. The numbers are only a guide and should be modified as necessary.

**BINOCULAR SURGERY**

*Esotropia*

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<th>ET</th>
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* When a lateral rectus resection is done for residual esotropia after large medial rectus recession (6.00 mm or larger), these numbers should be lowered.

*Exotropia*

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**MONOCULAR SURGERY**

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THREE-MUSCLE SURGERY

For large horizontal deviations, surgery on three muscles may be planned for the primary operation. The amount of surgery can be judged from the above tables. This works especially well in adults, where one muscle can be placed on an adjustable suture. The adjustable suture should be done on the eye for which two muscles are being operated.

VERTICAL NUMBERS

A rule of thumb for vertical surgery is 3 prism diopters of vertical correction for every millimeter of recession. Inferior rectus recessions are notorious for late overcorrections; therefore, consider using nonabsorbable sutures or long-lasting absorbable sutures. Superior rectus recessions for dissociated vertical deviation (DVD) must be large, with the minimum recession of approximately 5 mm and a maximum of 9 mm (fixed-suture technique).

KESTENBAUM PROCEDURE FOR NYSTAGMUS

Face-turn to the RIGHT

To correct the right face-turn (eyes shifted to a left null point), move the eyes to primary position by moving both eyes to the right.

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<td>Classic +60%</td>
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Pediatric Ophthalmology and Strabismus

Second Edition

Editors

Kenneth W. Wright, MD
Clinical Professor of Ophthalmology,
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With 838 Illustrations in 1197 Parts, 694 in Full Color

Illustrators
Timothy C. Hengst, CMI
Susan Gilbert, CMI
Faith Cogswell
To my beautiful wife Donna
and my children
Jamie, Matthew, Lisa, Michael, and Andrew
for their unselfish love that allows me to pursue my passion:
pediatric ophthalmology and strabismus
and
To my mother, Mary Jo, and my father, Harvey,
for their steadfast support that gave me the opportunity
to fulfill my dream.

Kenneth W. Wright, MD

To my wife, Lori, for her love and support.

Peter H. Spiegel, MD
The editors of this excellent balanced text of Pediatric Ophthalmology and Strabismus requested a foreword to the first revised edition to inform the younger readership about the historical details of pediatric ophthalmology and how strabismus became joined to pediatric ophthalmology. I accepted the editors’ challenging invitation with the understanding that the reader should realize that history is notorious for being recorded according to its author’s memory, research, and point of view. This foreword is no exception to that observation.

Ophthalmology was one of the first specialties. Having evolved from surgery, it was welcomed as a specialty because ophthalmology was concerned with other sciences and instrumentation unfamiliar to general surgeons. Refraction, assessment of the alignment and motility of the eyes, and attempting to comprehend the complex neurology of vision were so far outside the scope of knowledge expected of a general surgeon that the development of ophthalmology as a specialty brought a sense of relief to its progenitors.

In contrast to ophthalmology, pediatrics evolved from general practice with only a minimal difference in the basic knowledge between practitioners of the two fields, except for their experience with different age groups. This difference proved to be inadequate to convince the medical community that pediatrics was needed, so that it was difficult for pediatrics to gain the status of a specialty. However, the force that eventually drove the development of pediatrics came from a social thrust outside the medical profession. By the beginning of the 19th century, children first became recognized as the irreplaceable and essential treasure of any nation wishing to ensure its success. In both Europe and North America, the new attitude encouraged excellent education and medical care for all children. Within a few years, children’s hospitals became established in almost every metropolitan area of significance. The new social demand for improved medical care for children swept the struggling specialty of pediatrics into prominence and acceptability. The resentment of general practitioners gradually disappeared and for good reason. Medicine, sooner or later, inevitably smothers any trace of self-interest and shortsightedness by invariably asking the question, What is in the best interest of the patient? This attitude is the ingredient that makes medicine such a laudable profession. The answer was obvious, because time showed that pediatricians had raised the standard of care for infants and children.

We should be proud that ophthalmology fulfilled the leadership role in the specialty movement by initiating a certification process. Conceived in 1916, this was the beginning of the American Board to certify that candidates were adequately trained in their specialty and had passed an examination given by peers and superiors that validated competence to practice that specialty. Before certification, the public was victimized by self-proclaimed specialists inadequately trained and incapable of rendering quality care. Such a bold new order in the specialty movement was met with resistance, not only by some ophthalmologists but also by the other specialties. Approximately 25 years passed before certification became accepted by all ophthalmologists and 35 years before all specialties instituted their own boards. The American Board of Ophthalmology must have considered itself vindicated by the fact that all boards of the more than two dozen specialties copied the model it established.

Since the middle of the 20th century, subspecialization has become the second part of the specialties movement. Subspecialization was the natural outgrowth of the specialty to contend with its ever-expanding base of knowledge and technology. Although subspecialization fragments the specialty, it will never be reversed because subspecialization is in the best interest of the patient. All specialty boards must contend with the current subspecialization certification problem they now face.

As the ophthalmology subspecialties were formally introduced, pediatric ophthalmology was not included. The trend was to specialize by type of
ocular tissue and major pathology, such as cornea, retina, strabismus, glaucoma, oculoplastics, neuro-opthalmology, and ophthalmic pathology. Despite this impressive list of subspecialties, general ophthalmology prevailed as the dominant group delivering eye care to children. Neither the generalists nor the subspecialties initially welcomed pediatric ophthalmology into the recognized subspecialty group. The often-heard comment was “we can do everything a pediatric ophthalmologist does,” a repetition of the identical comment by the general practitioners one century earlier when pediatrics was becoming a specialty. But during the 1950s, ophthalmology consistently revealed its unawareness of the social policy (not a medical policy) established a century earlier that children should receive special care. The understanding that a special environment was needed to render the highest quality care resulted in the spread of children’s hospitals through the world’s developed countries within just a few years. This policy decisively established the specialty of pediatrics and charged it with the responsibility to control and develop the best care for infants and children. For pediatrics to remain in control of the environment in which children are treated, pediatrics realized it needed to attract trained personnel from all other specialties willing to devote their professional lives to children’s care. Almost all specialties responded to this need, and soon there was pediatric surgery, anesthesiology, cardiology, neurology, urology, otolaryngology, hematology, oncology, and so on. Ophthalmology, however, remained unresponsive. This unfortunate attitude left ophthalmology on the losing side of the issue, because the answer to the inevitable question, “What is in the best interest of the patient?” was obvious.

As subspecialties in ophthalmology were becoming recognized, strabismus, like glaucoma, easily fit the criteria of acceptance. Almost immediately, strabismologists became the strong proponents for pediatric ophthalmology to be accepted as a subspecialty. In the 1950s it became clear that the predominant pathology of strabismus had its onset during infancy and early childhood. In addition, strabismologists became aware that the best results of treatment were obtained by the most minimal duration allowed between onset and initial treatment of the disorder. This fact coincided with the pediatric ophthalmologists’ realization that strabismus was the predominant pathology. It became obvious that strabismologists needed to have pediatric skills and pediatric ophthalmologists needed to have strabismus skills. The natural outcome was a marriage of the two subspecialties. The unacceptability of pediatric ophthalmology as a bona fide subspecialty within ophthalmology terminated with this marriage.

The overriding issue regarding ophthalmology being originally perceived as a geriatric specialty changed with the acceptance of pediatric ophthalmology as a subspecialty. This change brought balance to the mission of ophthalmology. The original mission seemed to be saving vision from disorders that resulted from the ravages of aging. It then became obvious that ophthalmology’s mission was actually twofold: (1) to foster the development of vision in the pediatric population and (2) to preserve and restore vision once it has developed, with a primary focus on the adult and geriatric population.

The one outstanding exception in attempting to define the limits of pediatric ophthalmology is adult strabismus. It is practical for the entire subspecialty of strabismus to be within the combined subspecialty of pediatric ophthalmology and strabismus. As stated previously, the pediatric ophthalmologist must also be a trained strabismologist. As the knowledge base and the technology involved in investigating and treating strabismus are practically the same for pediatric and adult patients, the need for an adult strabismus subspecialty is lacking, especially in light of the successful marriage of the two subspecialties.

Pediatric ophthalmology and strabismus is now firmly established as a single subspecialty. The clinical society of the American Association of Pediatric Ophthalmology and Strabismus is 25 years old and publishes a journal. The specialty is well served by several excellent texts available in this field. With a rapidly expanding trained personnel base distributed around the world, the subspecialty of pediatric ophthalmology and strabismus has become an essential component of ophthalmology. Its success is attributable to an obvious fact: it is in the best interest of the patient.

Marshall M. Parks, MD
I would like to take this opportunity to pay tribute to Marshall M. Parks, MD. Over the past several decades, Marshall Parks has been the major driving force that has led to the development and maturation of our specialty, pediatric ophthalmology and strabismus. Some may be surprised to learn that many of our previous leaders in ophthalmology strongly resisted recognizing pediatric ophthalmology as a specialty. Using his elegant power of persuasion and leading by example, Dr. Parks won the battle against those who felt there was no need for this specialty. His scientific papers, books, innumerable lectures, and leadership have been essential to the field of ophthalmology recognizing that eye care for children involves much more than just caring for little eyes. It was Dr. Parks who was instrumental in bringing together the many diverse factions interested in pediatric ophthalmology and strabismus to establish the American Association of Pediatric Ophthalmology and Strabismus. Appropriately, he was the first president of this very important organization.

It is noteworthy that his monumental accomplishments were achieved from solo private practice in Washington, DC. During my fellowship, I had the privilege to watch Dr. Parks administer his duties as president of the American Academy of Ophthalmology, examine patients, and train fellows from a single exam lane office that was attached to his home.

Dr. Parks is highly respected by his colleagues for his clinical and surgical acumen, but, even more important, he is admired for his unyielding ethics and integrity. I know his professional modesty would not allow him to take the credit, but, without his leadership, pediatric ophthalmology would not exist as it is today.

Thank you, Dr. Parks, for all you have done for our specialty and our children.

Kenneth W. Wright, MD
Preface
to the Second Edition

There have been significant changes in pediatric ophthalmology and strabismus since the first edition. Great effort has gone into incorporating recent advances into this second edition. Each chapter in the book has been revised, and over half of them have been completely rewritten. In addition to updating and revising the entire book, we have added three new chapters: Chapter 7 on electrophysiology and the eye, Chapter 17 on strabismus surgery, and Chapter 56 on congenital syndromes with ocular manifestations. Chapter 17 is the definitive work on pediatric ocular electrophysiology, bar none, and was finished just weeks before the untimely death of its author, Dr. Tony Kriss (see tribute in Chapter 17).

Chapter 56 by Maya Eibschtz-Tsimhoni, MD, is a wonderful contribution to the literature, as it reviews 235 important ocular disorders that have systemic manifestations, and it includes a detailed glossary of terms.

As with the first edition, our goal is to present a comprehensive textbook of pediatric ophthalmology and strabismus written in a clear, reader-friendly style. Our hope is that the reader will find the second edition of Pediatric Ophthalmology and Strabismus to be scientifically informative, clinically useful, and enjoyable to read.

Kenneth W. Wright, MD
Peter H. Spiegel, MD
Preface to the First Edition

Pediatric ophthalmology and strabismus has come into its own as a bona fide subspecialty of ophthalmology. This evolution did not take place without a struggle. In the 1960s and 1970s, there was resistance to establishing a pediatric ophthalmology specialty. Many leaders at that time felt that general ophthalmologists and adult subspecialists could and should manage children’s eye disorders, so there was no need for “pediatric ophthalmology.” Fortunately, others saw the importance of establishing such a specialty. Through gentle but firm persuasion, pioneers such as Frank Costenbader, Jack Crawford, and Marshall Parks demonstrated how patient care, resident training, and clinical research are enhanced by having a specialty devoted to pediatric ophthalmology and strabismus. Pediatric ophthalmology involves much more than just treating “small adult” eyes. The management of pediatric eye diseases requires intimate knowledge of embryology, eye development, genetics, neuro-visual development, amblyopia, and strabismus. Special skills are also required for examining and treating children. Visual acuity testing, visual field testing, slit lamp examination, and applanation tonometry are easily obtained in adults, but require special expertise in children and infants. Now that the specialty of pediatric ophthalmology and strabismus is well established, its beneficial effects are obvious, the most important being improved eye care for children.

This book was written to fulfill the need for a comprehensive textbook on pediatric ophthalmology and strabismus. It is written in a style to be lucid and easily understood by the initiate, yet at the same time provide current detailed information, so that even the most accomplished pediatric ophthalmologist will find new and useful information. The book covers a broad spectrum of important pediatric eye disorders, but also presents chapters on fundamental core subjects such as ocular embryology and postnatal ocular development. Practical aspects of pediatric ophthalmology, including examination techniques, ocular trauma, and communication techniques for “breaking the news,” are also covered. Since a major part of pediatric ophthalmology involves the management of strabismus, a section devoted to amblyopia and strabismus is included. Many comprehensive pediatric ophthalmology texts include a section on strabismus, but usually present an overview. Herein we provide a thorough strabismus section, representing a text within a text. After sections on ocular development, practical aspects, and strabismus, the book is organized by anatomic and functional subspecialties within pediatric ophthalmology. With this format the reader can either review a subspecialty topic, such as pediatric neuro-ophthalmology, pediatric retina, or pediatric anterior segment abnormalities, or work through the index to look up a specific disease entity.

A major emphasis was placed on presenting a wealth of illustrations and clinical photographs to support the text. Clinical photographs are a vital part of the book because the diagnosis of many ophthalmic conditions depend on pattern recognition that is difficult to communicate with words alone. The contributors, section editors, and reviewers of this textbook, true experts in their fields, with extensive clinical experience, have provided richness and depth to this work. I would like to personally thank all who contributed to this fine work for their expertise, knowledge, and passion. A variety of readers should find the text useful, including ophthalmology residents, general ophthalmologists, pediatric ophthalmologists, and pediatricians. The editors sincerely hope that the reader will find this text complete, informative, and enjoyable.

Kenneth W. Wright, MD
We would like to thank the following sponsors for their support and ongoing commitment to furthering education and research in pediatric ophthalmology and strabismus:

- Discovery Fund for Eye Research
- Gustavus and Louise Pfeiffer Research Foundation
- Henry L. Guenther Foundation
- Wright Foundation for Pediatric Ophthalmology and Strabismus

Kenneth W. Wright, MD  
Peter H. Spiegel, MD

I would like to express my sincere gratitude to Tina Kiss for her expert help in preparing the second edition. Ms. Kiss was involved with virtually every aspect of the project including editing manuscripts, formatting references, communicating with contributors (gentle persuasion), organizing art, and overseeing the overall book. Without her energy, enthusiasm, and fortitude this book would never have been completed.

Also, a very special thanks to Paula Hong, MD, my Pediatric Ophthalmology and Strabismus Fellow at Cedars-Sinai Medical Center during the final production phases of this book. I appreciate all of her time and effort in reviewing hundreds of manuscript pages required to publish this textbook.

I would like to acknowledge two mentors who greatly influenced my career in pediatric ophthalmology and strabismus: Marshall M. Parks, MD, and David L. Guyton, MD. Thank you, Dr. Parks, for the insightful Foreword you wrote on the history of pediatric ophthalmology and strabismus. I will always be grateful for the tremendous pediatric ophthalmology fellowship afforded me in Washington, DC, that, above all, emphasized the importance of excellence. Also, I thank Dr. Guyton for his contribution to the strabismus section. I am forever indebted to him for the stimulating fellowship training in strabismus at Johns Hopkins Hospitals and for encouraging me to think "outside the box."

Finally, I sincerely thank Dr. Steven J. Ryan. Dr. Ryan was my ophthalmology residency chairman and subsequently my faculty chairman at Doheny–USC Keck School of Medicine. His unselfish support made my first book project possible and started me on the avocation of writing textbooks.

Kenneth W. Wright, MD

We are grateful to the following talented and generous individuals for their support and contributions to this textbook: Theresa Kramer, MD, Julia Stevens, MD, Jonathan Song, MD, Timothy Stout, MD, PhD, David V. Leaming, MD, Robert B. Guss, MD, Lari Wyman, S. Maughan Parkinson, R. Michael Duffin, MD, Barratt Phillips, MD, Robert Sorensen, MD, PhD, Christina Flaxel, MD, Elvin Rodriguez, and Rita Tindell.

Peter H. Spiegel, MD
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