

Kenneth W. Wright
Peter H. Spiegel
Lisa S. Thompson *Editors*



Handbook of Pediatric Strabismus and Amblyopia



Springer

Kenneth W. Wright
Peter H. Spiegel
Lisa S. Thompson *Editors*



Handbook of Pediatric Strabismus and Amblyopia



Springer

Handbook of Pediatric Strabismus and Amblyopia

Handbook of Pediatric Strabismus and Amblyopia

Edited by

Kenneth W. Wright, MD

Director, Wright Foundation for Pediatric Ophthalmology
Director, Pediatric Ophthalmology, Cedars-Sinai Medical
Center, Clinical Professor of Ophthalmology, University of
Southern California—Keck School of Medicine, Los Angeles,
California

Peter H. Spiegel, MD

Focus On You, Inc., Palm Desert, California
Inland Eye Clinic, Murrieta, California
Children's Eye Institute, Upland, California

Lisa S. Thompson, MD

Attending Physician, Stroger Hospital of Cook County,
Chicago, Illinois

Illustrators

Timothy C. Hengst, CMI

Susan Gilbert, CMI

Faith Cogswell



Springer

Kenneth W. Wright, MD
Director, Wright Foundation for
Pediatric Ophthalmology
Director, Pediatric Ophthalmology,
Cedars-Sinai Medical Center,
Clinical Professor of
Ophthalmology, University of
Southern California—Keck School
of Medicine
Los Angeles, CA
USA

Peter H. Spiegel, MD
Focus On You, Inc.
Palm Desert, CA
Inland Eye Clinic,
Murrieta, CA
Children's Eye
Institute
Upland, CA
USA

Lisa S. Thompson, MD
Attending Physician
Stroger Hospital of Cook County
Chicago, IL
USA

Library of Congress Control Number: 2005932932

ISBN 10: 0-387-27924-5 e-ISBN 0-387-27925-4

ISBN 13: 978-0387-27924-4

Printed on acid-free paper.

© 2006 Springer Science+Business Media, Inc.

Reprinted from Wright and Spiegel: Pediatric Ophthalmology and Strabismus, second edition, 2003 Springer Science+Business Media.

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher (Springer Science+Business Media, Inc., 233 Spring Street, New York, NY 10013, USA), except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden. The use in this publication of trade names, trademarks, service marks, and similar terms, even if they are not identified as such, is not to be taken as an expression of opinion as to whether or not they are subject to proprietary rights.

While the advice and information in this book are believed to be true and accurate at the date of going to press, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed in the United States of America. (BS/EB)

9 8 7 6 5 4 3 2 1

springer.com

Preface

The *Handbook of Pediatric Strabismus and Amblyopia* is a practical, easy-to-understand resource on the diagnosis and management of both common and the more esoteric forms of strabismus. Emphasis is placed on the understanding of the basis of the strabismus, not rote memorization of strabismus patterns. Concepts regarding sensory adaptations and sensory testing are described in a simple way to elucidate rather than confuse the reader. An in-depth chapter on visual development and the pathophysiology of amblyopia is included.

The goal of the *Handbook of Pediatric Strabismus and Amblyopia* is to make this often confusing subject simple and easy to understand. This book should make an excellent resource for board review. Chapters are reader friendly. They are organized with clear sub-headings that allow the readers to quickly find their area of interest. Diagrams and drawings are prevalent throughout the book to help illustrate otherwise difficult or complex concepts. Composite strabismus photographs are included to demonstrate the strabismus as it actually appears in the clinical setting and to help with pattern recognition. These composite strabismus photographs are very useful for board review. Each chapter is fully referenced to provide evidence-based practice guidelines and further in-depth reading.

An important use of the handbook is patient and family education. Families are rightfully concerned about the strabismus and they have often been told conflicting and confusing information about it. Information, including diagrams and photographs from the handbook, can be shared with the families to clarify their specific type of strabismus. This important information is often lacking in general texts on ophthalmology.

I hope you will find the *Handbook of Strabismus and Amblyopia* to be an invaluable adjunct to your practice and for board review.

Kenneth W. Wright, MD

Contents

Preface	v
Contributors	ix
1 Pediatric Eye Examination	1
<i>Ann U. Stout</i>	
2 Anatomy and Physiology of Eye Movements	24
<i>Kenneth W. Wright</i>	
3 Binocular Vision and Introduction to Strabismus	70
<i>Kenneth W. Wright</i>	
4 Visual Development and Amblyopia	103
<i>Kenneth W. Wright</i>	
5 The Ocular Motor Examination	138
<i>Kenneth W. Wright</i>	
6 Sensory Aspects of Strabismus	174
<i>Kenneth W. Wright</i>	
7 Esodeviations	217
<i>Kenneth W. Wright</i>	
8 Exotropia	266
<i>Kenneth W. Wright</i>	
9 Alphabet Patterns and Oblique Muscle Dysfunctions	284
<i>Kenneth W. Wright</i>	

10	Complex Strabismus: Restriction, Paresis, Dissociated Strabismus, and Torticollis	323
	<i>Kenneth W. Wright</i>	
11	Strabismus Surgery	388
	<i>Kenneth W. Wright and Pauline Hong</i>	
12	Ocular Motility Disorders	423
	<i>Mitra Maybodi, Richard W. Hertle, and Brian N. Bachynski</i>	
13	Optical Pearls and Pitfalls	520
	<i>David L. Guyton, Joseph M. Miller, and Constance E. West</i>	
	Index	531

Contributors

Brian N. Bachynski, MD

David L. Guyton, MD

Richard W. Hertle, MD, FACS

Pauline Hong, MD

Mitra Maybodi, MD

Joseph M. Miller, MD

Ann U. Stout, MD

Constance E. West, MD

Kenneth W. Wright, MD



1

Pediatric Eye Examination

Ann U. Stout

THE HISTORY AND PHYSICAL EXAMINATION

In the nonpediatric eye clinic, the physician often views the presence of a small child in an examining lane with some anxiety, if not dread. Examination of a child is quite different from that of the adult. The history is largely from a source other than the patient, and the examination requires patience and talent. There are several tricks to make the visit go as smoothly and efficiently as possible (see the box on the following page).

HISTORY

Although ancillary personnel are often relied on to take the history, this is best obtained by the physician who knows how to direct the line of questioning to the most useful information. The old adage that "the patient is always right" is especially true in the case of parents' observations about their children. Most of the history is obtained from the parents or the referring physician, but any input from the child is equally important. Many children will not complain of blurry vision or diplopia, but should they describe these symptoms one must be very alert to an acute process. This is also an invaluable time to observe the child in an unobtrusive fashion and preliminarily assess head position, eye alignment, and overall appearance. Often this may be the extent of the physical examination that one can obtain; once children realize that attention is focused on them, they may become very uncooperative.

The problem precipitating the visit should be stated in the parents' or child's own words and then elaborated. Requisite

questioning for all pediatric eye problems should clarify whether the problem is congenital or acquired and should specify the age of onset in the latter case. If the chief complaint is a visual problem, it is helpful for the parents to specify what the child can or cannot see; that is, does the child respond to lights, faces, toys near or far, very small items? In cases of strabismus, the frequency and stability of the deviation and any associated head posture are important. Precipitating factors may include fatigue, illness, sunlight, and close or distance work. For nystagmus, medications and the past medical history may be pertinent. With cataracts, any history of trauma, medications, or associated medical conditions is important, as well as the family history. Tearing patients need to be questioned about any redness, photophobia, or crusting of the lashes. In ptosis, the stability or variability is important, as is any associated chin elevation or general neuromuscular problems. For difficulties in school, it is helpful to determine if the problem is only visual or is related to a particular subject area (reading, spelling, writing, or math) and if there are any stress factors in the child's extracurricular life.

Important aspects of past history include prenatal and perinatal problems, birth weight, gestational age, and mode of delivery. Any medical problems should be elicited, as well as current medication and allergies. Early development should be assessed by asking about specific developmental milestones, such as rolling over, sitting up, and walking. The Denver Developmental Scale is a good reference for developmental norms.¹⁰ Later development can be ascertained by asking about scholastic level and performance.

The family history is very important because often the young child does not have enough past history to be useful. The focus should be on the presence of strabismus, poor vision, and neurological problems. In the case of possible genetic disorders, the number and sex of siblings, possible consanguinity, and the number and gestational age of any miscarriages should be documented.

PHYSICAL EXAMINATION

Establishing Rapport

If you approach the examination with dread, the child will sense your personal tension and become uneasy. Children can be unpredictable, noncommunicative, and uncooperative, which

may make the examination both time consuming and frustrating for a busy practitioner. However, if extra time is taken initially to gain the trust of the child, the rest of the exam will go much more easily. This “friendship” is often first established in the waiting room, where toys, appropriate books, and even small furniture should be made available. In a general practice seeing children on a fairly regular basis, at least one exam room should be outfitted to make a child feel relaxed and make the exam go more smoothly. A 20-foot lane is best because of the frequent use of single Allen cards and the need for distance measurements in strabismus. Attention-getting distance targets may include a remote control cartoon movie or a motorized animal. Near targets should have variety and appeal, as one frequently finds that “one toy—one look” is the rule.

Approach young children as though you had come to play with and entertain them, and you will receive a lot of useful information in the process. Find out what they like to be called and use their name frequently, but speak softly and keep a respectful physical distance from them until they warm up to you. Also, find out from parents their favorite imaginary or cartoon characters and refer to these during your exam. Make a game of the exam; play peek-a-boo with cover testing, swoop near targets around like an airplane to evaluate the range of motility, refer to glasses and lenses used as “magic” or “funny

Useful Items for Pediatric Eye Exams

- Allen cards (single and linear)
- Wright figures (single and linear)
- Tumbling E (single and linear)
- Eye patches
- Interesting distance and near fixation targets
- Accommodative near targets (finger puppets, wiggle pictures)
- Portable slit lamp
- Papoose board
- Wire lid speculums (infant and child size)
- Loose retinoscopy lenses
- Loose prisms
- Fusional tests (Worth 4-Dot, Titmus or Randot, Bagolini lenses)
- 28-diopter lens
- Handheld tonometer (Perkins or Tonopen)
- Calipers

sunglasses," make funny sounds to get their attention. Do the noncontact things first: cover testing, fixation testing, pupillary and red reflex exam. Many small children object to physical contact by a stranger and once they are upset it is usually the end of the exam for the day. Sometimes they will more readily tolerate their parents placing glasses or a patch than a strange doctor. Remember, if you find yourself getting frustrated or impatient with a child in one area, stop and go on to some other aspect of the exam.

With older children, asking direct questions about their hobbies, school, and family shows an interest in them and often distracts them from the anxiety of the exam. They often appreciate a handshake or pat on the knee. Explain to them what you are doing before you do it and be honest; avoid talking down to them. If they ask, do not tell them the mydriatic drops will not hurt, but explain that they will only sting for a minute, like swimming in a pool with chlorine.

Examination of the Uncooperative Child

Sometimes, despite the best efforts, a child simply will not cooperate, and urgency of the problem or the need for further information may require physically restraining or sedating the child. A papoose board can be used to control a child up to around 5 years of age, depending on their size and strength. A lid speculum can then be used with a topical anesthetic to force the eyes open, although Bell's phenomenon of the eyes often makes a thorough examination difficult, and crying can affect intraocular pressure measurements.

SEDATION

For the child in whom relaxation is important, or when physical restraint seems too psychologically traumatic, as in older children, sedation should be used. The common modes of outpatient sedation include chloral hydrate (oral or suppository), Propofol infusion, or a combination injection of Demerol, Phenergan, and Thorazine (DPT). The first has the advantage of good sedation with a low level of respiratory depression and no effect on intraocular pressure (IOP). The latter two have analgesic as well as sedative properties, which may be useful in painful procedures, but there is slightly more respiratory depression and Propofol will lower IOP.^{24,37}

Although chloral hydrate is often not effective if the children are more than 2.5 years old, Propofol and DPT can be used in older children. Whenever sedatives are given, the child's vital signs including pulse oximetry must be monitored until awake, ventilatory equipment must be available, and appropriately trained personnel should be in attendance. Any sedative may have a greater effect in children with underlying neurological abnormalities.

CHLORAL HYDRATE

The minimal effective dose of chloral hydrate is 50mg/kg, but often 80 to 100mg/kg is needed if manipulation of the eyes is anticipated or if prolonged sedation is needed for electrophysiological testing.^{9,45,46} Half the initial dose can be repeated up to a maximum of 3g if the child is not sedated in 30 min.²² Any sedative is best given on an empty stomach (4h since eating) to increase absorption and decrease the risk of aspiration.

DPT

DPT is given in a dose of 2:1:1 mg/kg, not to exceed 50:25:25. Because of the better analgesic effects, this is probably a better choice for painful procedures (laceration repairs, chalazion excisions, cryotherapy). Potential complications include respiratory depression, apnea, dystonic reactions, hypotension, seizures, and cardiac arrest.³⁷ This mode of sedation should only be used when the child is under the supervision of a physician with appropriate training to manage complications, as in the emergency room.

EXAMINATION UNDER ANESTHESIA

If it is impractical to sedate the child in the office, or if surgery is anticipated based on the exam findings, than examination under anesthesia should be arranged in the operating room. Modern anesthetic practices make general anesthesia a very safe procedure, even when done repeatedly. A disadvantage of general anesthesia is the purported intraocular pressure-lowering effects of inhalational anesthetics. Pressures taken under inhalational anesthetics have been lower than those measured in awake children, but this is probably a result of increased overall relaxation.¹³ Propofol has a similar effect on IOP.²⁵ The pressure may actually increase several points after intubation.⁴⁰ Use of laryngeal mask airways may eliminate this transient pressure rise.⁴³ It is probably best to record the pressure both before and after intubation.