

Pediatric Ophthalmology 2021

Unmasking Pediatric Ophthalmology and Strabismus by Rethinking, Recreating, and Reimagining

Program Directors

Gena Heidary MD PhD and David K Wallace MD MPH

**In conjunction with the American Association for
Pediatric Ophthalmology and Strabismus and
the American Academy of Pediatrics**

Ernest N Morial Convention Center
New Orleans, Louisiana
Friday, Nov. 12, 2021

Presented by:
The American Academy of Ophthalmology



**Pediatric Ophthalmology
2021 Planning Group**
Gena Heidary MD PhD
Program Director
David K Wallace MD MPH
Program Director
Gil Binenbaum MD
Sergul A Erzurum MD
Sharon F Freedman MD
Jeffrey Hunter MD
Scott A Larson MD
David G Morrison MD
Stacy L Pineles MD
Deborah K VanderVeen MD

Subspecialty Day Advisory Committee
R Michael Siatkowski MD
Chair
Bonnie An Henderson MD
Michael S Lee MD
Jennifer Irene Lim MD
Shahzad I Mian MD
Jody R Piltz MD
Maria M Aaron MD
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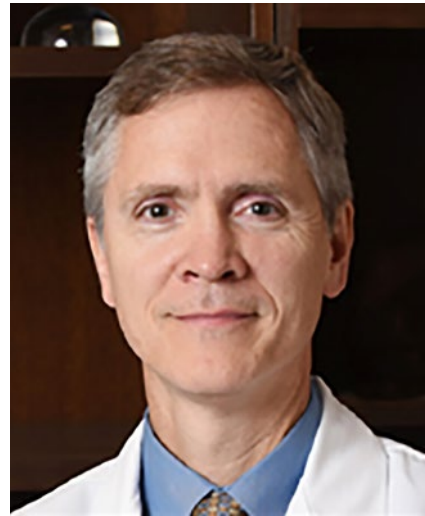
Staff
Melanie R Rafaty CMP, *Director,*
Scientific Meetings
Ann L'Estrange, *Subspecialty Day Manager*
Debra Rosencrance CMP CAE,
Vice President, Meetings & Exhibits
Patricia Heinicke Jr, *Copy Editor*
Mark Ong, *Designer*
Gina Comaduran, *Cover Design*

2021 Pediatric Ophthalmology Subspecialty Day Planning Group

On behalf of the American Academy of Ophthalmology, the American Association for Pediatric Ophthalmology and Strabismus (AAPOS), and the American Academy of Pediatrics (AAP), it is our pleasure to welcome you to New Orleans and Pediatric Ophthalmology Subspecialty Day 2021: Unmasking Pediatric Ophthalmology and Strabismus by Rethinking, Recreating, and Reimagining.



Gena Heidary MD PhD
Program Director
National Eye Institute: S

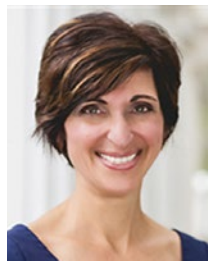


David K Wallace MD MPH
Program Director
National Eye Institute: S

Program Planning Group



Gil Binenbaum MD
Luminopia: C,O
National Eye Institute: S
X Biomedical: O,P



Sergul A Erzurum MD
None



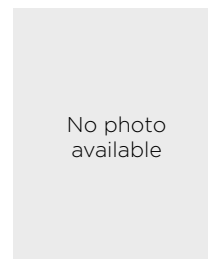
Sharon F Freedman MD
Qlaris Bio: C



Jeffrey S Hunter MD
None



David G Morrison MD
Regeneron Pharmaceuticals,
Inc.: S



Deborah K VanderVeen MD
National Eye Institute: S
Ocular Therapeutix: S
Ophtec: C,S
Traverse Therapeutics: S



Scott A Larson MD
None



Stacy L Pineles MD
None

2021 Subspecialty Day Advisory Committee

**R Michael Siatkowski MD,
Chair (Pediatric
Ophthalmology)**
National Eye Institute: S
OMIC-Ophthalmic Mutual
Insurance Company: C

**Maria M Aaron MD (Secretary
for Annual Meeting)**
None

**Bonnie An Henderson MD
(Refractive Surgery)**
Alcon Laboratories, Inc.: C,L

**Michael S Lee MD (Neuro-
Ophthalmology)**
Horizon: O
Springer: P
Sun Biopharma: C
UpToDate: P

**Jennifer Irene Lim MD
(Retina)**

Aldeyra Therapeutics: S
Allergan, Inc.: C
Aura Biosciences: C
Chengdu Kanghong: S
Cognition Therapeutics: C
CRC Press/Taylor and Francis: P
Eyenuk: C
Genentech: C,S
Greybug: S
Iveric Bio: C
JAMA Ophthalmology
Editorial Board: C
Luxa: C
NGM: S
Novartis Pharma AG: C
Ophthea: C
Quark: C
Regeneron Pharmaceuticals, Inc.:
S,C
Santen, Inc.: C
Stealth: S
Unity: C
Viridian: C

Shahzad I Mian MD (Cornea)
Centrasight: S
Kowa American Corporation: S
National Eye Institute: S

Jody R Piltz MD (Glaucoma)
Aerie Pharmaceuticals: C,L,S

AAO Staff

Ann L'Estrange
None

Melanie Rafaty
None

Debra Rosencrance
None

Beth Wilson
None

Pediatric Ophthalmology 2021 Contents

	Pediatric Ophthalmology 2021 Program Planning Group	ii
	CME	vi
	Faculty Listing	viii
	How to Use the Audience Interaction Application	xii
	Program Schedule	xiii
Section I:	Reconsidering Surgical Strategy—Novel Approaches to Common Strabismus	1
	In These Unprecedented Times . . .	2
Section II:	Reimagining Clinical Practice	4
Section III:	A Renewed Approach to Cataract Management in Kids	10
Section IV:	Childhood Glaucoma—New Approaches to an Enduring Foe	21
Section V:	Looking to the Future—How Clinical Studies Will Impact My Practice	31
Section VI:	Innovations in the OR—Surgical Pearls for Complex Strabismus	47
	Faculty Financial Disclosure	49
	Presenter Index	52

CME Credit

The Academy's CME Mission Statement

The purpose of the American Academy of Ophthalmology's Continuing Medical Education (CME) program is to present ophthalmologists with the highest quality lifelong learning opportunities that promote improvement and change in physician practices, performance, or competence, thus enabling such physicians to maintain or improve the competence and professional performance needed to provide the best possible eye care for their patients.

2021 Pediatric Ophthalmology Subspecialty Day Meeting Learning Objectives

This meeting will enable attendees to:

- Improve their ability to diagnose and manage pediatric ophthalmology and strabismus conditions
- Improve their outcomes in the management of pediatric ophthalmology and strabismus conditions
- Explain recent advances in pediatric glaucoma
- Interpret emerging evidence-based studies and apply them to clinical disease management in pediatric ophthalmology

2021 Pediatric Ophthalmology Subspecialty Day Meeting Target Audience

The intended target audience for this program is pediatric ophthalmologists, comprehensive ophthalmologists, medical professionals, visual physiologists, and orthoptists who are involved in maintaining high-quality health care for the pediatric and strabismus populations.

Teaching at a Live Activity

Teaching instruction courses or delivering a scientific paper or poster is not an *AMA PRA Category 1 Credit™* activity and should not be included when calculating your total *AMA PRA Category 1 Credits™*. Presenters may claim *AMA PRA Category 1 Credits™* through the American Medical Association. To obtain an application form, please contact the AMA at www.ama-assn.org.

Scientific Integrity and Disclosure of Conflicts of Interest

The American Academy of Ophthalmology is committed to ensuring that all CME information is based on the application of research findings and the implementation of evidence-based medicine. It seeks to promote balance, objectivity, and absence of commercial bias in its content. All persons in a position to control the content of this activity must disclose any and all financial interests. The Academy has mechanisms in place to resolve all conflicts of interest prior to an educational activity being delivered to the learners.

Control of Content

The Academy considers presenting authors, not coauthors, to be in control of the educational content. It is Academy policy and traditional scientific publishing and professional courtesy to acknowledge all people contributing to the research, regardless of CME control of the live presentation of that content. This acknowledgment is made in a similar way in other Academy CME activities. Though coauthors are acknowledged, they do not have control of the CME content, and their disclosures are not published or resolved.

2021 Subspecialty Day CME Credit

The American Academy of Ophthalmology is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide CME for physicians.

Friday Subspecialty Day Activity: Glaucoma, Neuro-Ophthalmology, Pediatric Ophthalmology, Refractive Surgery, and Retina (Day 1)

The Academy designates this Other (blended live and enduring material) activity for a maximum of 12 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Saturday Subspecialty Day Activity: Cornea, Oculofacial Plastic Surgery, and Retina (Day 2)

The Academy designates this Other (blended live and enduring material) activity for a maximum of 12 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Physicians registered as In Person and Virtual are eligible to claim the above CME credit.

How to Claim CME

Attendees can [claim credits online](#).

For AAO 2021, you can claim CME credit multiple times, up to the 50-credit maximum, through Aug. 1, 2022. You can claim some in 2021 and some in 2022, or all in the same year.

For 2021 Subspecialty Day, you can claim CME credit multiple times, up to the 12-credit maximum per day, through Aug. 1, 2022. You can claim some in 2021 and some in 2022, or all in the same year.

You do not need to track which sessions you attend, just the total number of hours you spend in sessions for each claim.

Academy Members

CME transcripts that include AAOE Half-Day Coding Sessions, Subspecialty Day and/or AAO 2021 credits will be available to Academy members through the Academy's [CME Central web page](#).

The Academy transcript cannot list individual course attendance. It will list only the overall credits claimed for educational activities at AAOE Half-Day Coding Sessions, Subspecialty Day and/or AAO 2021.

Nonmembers

The Academy provides nonmembers with verification of credits earned and reported for a single Academy-sponsored CME activity.

Proof of Attendance

You will be able to obtain a CME credit reporting/ proof-of-attendance letter for reimbursement or hospital privileges, or for nonmembers who need it to report CME credit:

Academy Members

When you claim CME credits and complete the evaluation, you will be able to print a certificate/proof of attendance letter from your transcript page. Your certificate will also be emailed to you.

Nonmembers

When you claim CME credits and complete the evaluation, a new browser window will open with a PDF of your certificate. Please disable your pop-up blocker. Your certificate will also be emailed to you.

CME Questions

Send your questions about CME credit reporting to cme@aao.org.

For Continuing Certification questions, contact the American Board of Ophthalmology at MOC@abpo.org.

Faculty



Cynthia L Beauchamp MD
Dallas, TX



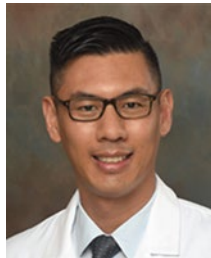
James D Brandt MD
Sacramento, CA



**Alejandra G de Alba
Campomanes MD**
San Francisco, CA



Gil Binenbaum MD
Gladwyne, PA



Ta Chen Chang MD
Miami, FL



Beth Edmunds MD PhD
Portland, OR



Brenda L Bohnsack MD PhD
Chicago, IL



Michael F Chiang MD
Bethesda, MD



Mays A El-Dairi MD
Durham, NC



Erick D Bothun MD
Rochester, MN



Linda R Dagi MD
Boston, MA



Laura B Enyedi MD
Cary, NC



Sergul A Erzurum MD
Poland, OH



Kathryn M Haider MD
Fishers, IN



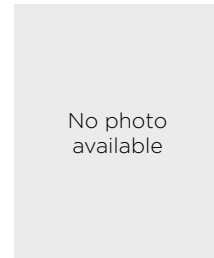
Jeffrey S Hunter MD
Tyler, TX



Alexis M Flowers MD
Nashville, TN



Gena Heidary MD
Cambridge, MA



Anne K Jensen MD
York, PA



Sharon F Freedman MD
Durham, NC



Jonathan M Holmes MD
Tucson, AZ



Natalie C Kerr MD
Memphis, TN



William V Good MD
Kentfield, CA



G Baker Hubbard MD
Atlanta, GA



Scott R Lambert MD
Palo Alto, CA



Katherine A Lee MD PhD
Boise, ID



Scott K McClatchey MD
Jamul, CA



David A Plager MD
Indianapolis, IN



Phoebe D Lenhart MD
Atlanta, GA



David G Morrison MD
Franklin, TN



Bibiana J Reiser MD
Long Beach, CA



Irene H Ludwig MD
Franklin, TN



Christie L Morse MD
Concord, NH



Michael X Repka MD MBA
Baltimore, MD



Justin D Marsh MD
Maitland, FL



Stacy L Pineles MD
Los Angeles, CA



Veeral Shah MD
Cincinnati, OH



Evan Silverstein MD
Henrico, VA



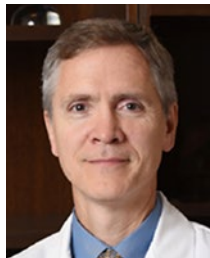
Federico G Velez MD
Durham, NC



M Edward Wilson Jr MD
Charleston, SC



Lois E H Smith MD PhD
Boston, MA



David K Wallace MD MPH
Indianapolis, IN



Jason Yam FRCS(Ed) MBBS
Kowloon, Hong Kong



Deborah K VanderVeen MD
Boston, MA

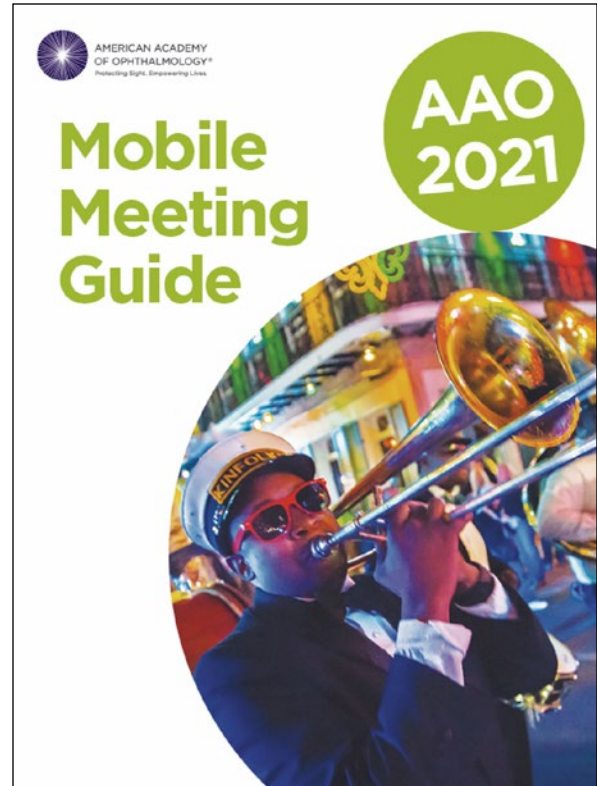


Mary C Whitman MD
Needham, MA

Ask a Question and Respond to Polls Live During the Meeting Using the Mobile Meeting Guide

To submit an answer to poll or ask the moderator a question during the meeting, follow the directions below.

- Access at www.aao.org/mobile
- Select Program, Handouts & Evals
- Filter by Meeting – Pediatric Ophthalmology Meeting
- Select Current Session
- Select “Interact with this session (live)”
Link to open a new window
- Choose “Answer Poll” or “Ask a Question”



Pediatric Ophthalmology Subspecialty Day 2021: Unmasking Pediatric Ophthalmology and Strabismus by Rethinking, Recreating, and Reimagining

In conjunction with the American Association
for Pediatric Ophthalmology and Strabismus
and the American Academy of Pediatrics

FRIDAY, NOV. 12, 2021

7:00 AM	Continental Breakfast		
8:00 AM	Welcome and Introductions	Gena Heidary MD PhD	
Section I: Reconsidering Surgical Strategy—Novel Approaches to Common Strabismus			
	Moderators: Gena Heidary MD PhD and Stacy L Pineles MD		
8:01 AM	Case 1: Large Infantile Esotropia	Alejandra G de Alba Campomanes MD*	1
8:21 AM	Case 2: Duane/CN VI Nerve	Linda R Dagi MD	1
8:41 AM	Case 3: Consecutive Exotropia	Irene H Ludwig MD*	1
9:01 AM	Case 4: CN IV Palsy	Jonathan M Holmes MD*	1
9:21 AM	Q&A		
9:30 AM	In These Unprecedented Times . . .	Christie L Morse MD*	2
Section II: Reimagining Clinical Practice			
	Moderators: Gil Binenbaum MD* and David G Morrison MD*		
9:35 AM	Imagine: A Papilledema Calculator	Alexis M Flowers MD*	4
9:45 AM	Q&A Session		
9:50 AM	Imagine: Home Vision Apps	Evan Silverstein MD*	5
10:00 AM	Q&A Session		
10:05 AM	Imagine: Practical Solutions to Practical Barriers to Care	Alejandra G de Alba Campomanes MD*	6
10:15 AM	Q&A Session		
10:20 AM	Imagine: New Billing Guidelines	Anne K Jensen MD	8
10:30 AM	Q&A Session		
10:35 AM	REFRESHMENT BREAK		
Section III: A Renewed Approach to Cataract Management in Kids			
	Moderator: Deborah K VanderVeen MD* and David G Morrison MD*		
11:05 AM	IOL Implantation for Infants: Where Are We in 2021?	Erick D Bothun MD	10
11:17 AM	Envision: Dropless Cataract Surgery	M Edward Wilson Jr MD*	11

* Indicates that the presenter has financial interest. No asterisk indicates that the presenter has no financial interest.

11:25 AM	Optimizing Postoperative Refractive Outcomes	Scott K McClatchey MD	12
11:37 AM	How I Work Up New Cataract Patients	Deborah K VanderVeen MD*	14

Pearls and Tips for Cataract Surgery: How I Do It

11:45 AM	Video 1	Phoebe D Lenhart MD	15
11:50 AM	Video 2	Eric Joseph Kim MD	16
11:55 AM	Video 3	M Edward Wilson Jr MD*	17
12:00 PM	Video 4	Bibiana J Reiser MD*	18
12:05 PM	Video 5	Scott R Lambert MD	19
12:10 PM	Video 6	Deborah K VanderVeen MD*	20
12:15 PM	LUNCH		

Section IV: Childhood Glaucoma—New Approaches to an Enduring Foe

Moderator: Deborah K VanderVeen MD* and David A Plager*

1:15 PM	How to Interpret/Utilize OCT for Management of Childhood Glaucoma	Mays A El-Dairi MD	21
1:22 PM	Toward an Evidence-Based Future for Childhood Glaucoma Surgery (and a New MIGS Video)	James D Brandt MD*	22
1:34 PM	Don't Forget Me: Strabismus and Glaucoma	Ta Chen Chang MD	24
1:41 PM	Glaucoma Following Cataract Surgery: What Have We Learned?	Sharon F Freedman MD*	25

My Glaucoma Surgery and How I Do It

1:48 PM	My Preferred Angle Surgery: Goniotomy	Brenda L Bohnsack MD PhD	26
1:53 PM	My Preferred Angle Surgery: Circumferential Schlemm Canal Surgery	Ta Chen Chang MD	27
2:00 PM	Beyond Angle Surgery: Pearls for Trabeculectomy	Beth Edmunds MD PhD	28
2:05 PM	Beyond Angle Surgery: The Role for Cycloablation	David A Plager MD*	30
2:10 PM	Q&A Session		

Section V: Looking to the Future—How Clinical Studies Will Impact My Practice

Moderators: Sergul A Erzurum MD and David K Wallace MD MPH*

2:15 PM	NEI Goals and Pediatric Ophthalmology	Michael F Chiang MD*	31
2:20 PM	Intermittent Exotropia Overminus Therapy and Myopia Progression	Justin D Marsh MD	32
2:25 PM	Intermittent Exotropia Prism Therapy	Veeral Shah MD	33
2:30 PM	How Intermittent Exotropia Studies Will Change My Practice in 2021	Katherine A Lee MD PhD	34
2:35 PM	Atropine Usage in Myopia	Jason Yam FRCS(Ed) MBBS	35
2:40 PM	Multifocal Contact Lens Use in Myopia and DIMS Lenses	Michael X Repka MD MBA*	36
2:45 PM	How I Am Treating Myopia in 2021	Laura B Enyedi MD	37
2:50 PM	ROP Prevention Studies	Lois E H Smith MD PhD	38
2:55 PM	ROP Treatment Studies	Kathryn M Haider MD	39
3:00 PM	Recurrent ROP Treatment Studies	G Baker Hubbard MD*	41
3:05 PM	How ROP Studies Have Changed My Practice	William V Good MD	43
3:10 PM	How to Diagnose and Treat Optic Neuritis in 2021	Stacy L Pineles MD	44
3:15 PM	Q&A Session		

* Indicates that the presenter has financial interest. No asterisk indicates that the presenter has no financial interest.

3:20 PM REFRESHMENT BREAK

Section VI: Innovations in the OR—Surgical Pearls for Complex Strabismus

Moderators: Jeffrey S Hunter MD and David G Morrison MD*

3:50 PM	Case 1	Natalie C Kerr MD	47
4:00 PM	Q&A Session		
4:05 PM	Case 2	Federico G Velez MD*	47
4:15 PM	Q&A Session		
4:20 PM	Case 3	Mary C Whitman MD	47
4:30 PM	Q&A Session		
4:35 PM	Case 4	Cynthia L Beauchamp MD	47
4:45 PM	Q&A Session		
5:00 PM	Closing Remarks	David K Wallace MD MPH*	47

* Indicates that the presenter has financial interest. No asterisk indicates that the presenter has no financial interest.

Section I: Reconsidering Surgical Strategy— Novel Approaches to Common Strabismus

Moderators: Gena Heidary MD PhD and Stacy L Pineles MD

Alejandra G de Alba Campomanes MD, Linda R Dagi MD, Irene H Ludwig MD, Johathan M Holmes MD

NOTES

In These Unprecedented Times . . .

2021 Pediatric Ophthalmology Subspecialty Day

Christie L Morse MD

The COVID-19 pandemic has impacted us in many ways, including our ability to effectively raise critical funds used to protect sight and empower lives. This objective requires active participation and commitment to advocacy from every ophthalmologist. Contributions to the following three critical funds are a part of that commitment:

- OPHTHPAC®
- Surgical Scope Fund (SSF)
- State Eye PAC

During AAO 2021 in New Orleans, invest in OPHTHPAC and Surgical Scope Fund at one of our two booths in the convention center or [online](#). You may also invest via phone by texting MDEYE to 41444 for OPHTHPAC and SCOPE to 51555 for the Surgical Scope Fund.

We also encourage you to stop by our booth in the Hall B Lobby to learn more about [OPHTHPAC Direct](#), a unique program that lets you decide who receives your political support.

Please help us in these unprecedented times to continue to protect quality patient eye care for everybody. Two Academy committees made up of your ophthalmology colleagues are working hard on your behalf to ensure this outcome. The OPHTHPAC Committee continues to identify Congressional Advocates in each state to maintain close relationships with federal legislators to advance ophthalmology and patient causes. The Surgical Scope Fund Committee is raising funds to be used to protect Surgery by Surgeons during scope battles at the state level.

Our mission of “protecting sight and empowering lives” requires robust funding of both OPHTHPAC and the Surgical Scope Fund. Each of us has a responsibility to ensure that these funds are strong so that ophthalmology continues to strive, especially in these unprecedented times.

OPHTHPAC®

OPHTHPAC represents the profession of ophthalmology to the U.S. Congress. OPHTHPAC’s most recent victories include the following:

Physician Relief

- ✓ Securing access to COVID-19 relief, including Provider Relief Funds and forgivable small business loans
- ✓ Pushing Congress to enact a provider-friendly “surprise” medical billing law

Medicare Payment

- ✓ Mitigating drastic Medicare cuts
- ✓ Obtaining a one-year moratorium extension on the 2% Medicare budget sequestration cut

Research & Relationships

- ✓ Increasing vision research funding by \$11.6 million
- ✓ Helping get three new physicians elected to Congress, including an ophthalmologist

However, facing ophthalmology’s federal issues is a continuous battle, and OPHTHPAC is always under pressure to ensure we have strong political connections in place to help protect ophthalmology, its members, and their patients.

The support OPHTHPAC receives from invested U.S. Academy members helps build the federal relationships that advance ophthalmology’s agenda on Capitol Hill. These relationships allow us to have a seat at the table with legislators willing to work on issues important to us and our patients. We also use these congressional relationships to help shape the rules and regulations being developed by federal health agencies.

Get engaged with OPHTHPAC and help strengthen ophthalmology’s voice on Capitol Hill as we address the following legislative and regulatory issues this year:

- Improving Medicare physician payments
- Fighting optometric scope expansion in the Veterans’ Health Administration
- Obtaining relief from prior authorization and step therapy requirements that delay patient care
- Seeking solutions for rising drug prices and access to drugs in shortage
- Ensuring fair reimbursements for Part B drugs

At the Academy’s annual Congressional Advocacy Day, the Academy and the **American Association for Pediatric Ophthalmology & Strabismus (AAPOS)** and the **American Academy of Pediatrics – Ophthalmology Section** ensure a strong presence of pediatric ophthalmologists to support ophthalmology’s priorities. AAPOS and AAP-Section on Ophthalmology also support participation of young ophthalmologists via the Academy’s Advocacy Ambassador Program. Ophthalmologists visit members of Congress and their key health staff to discuss ophthalmology priorities as part of Congressional Advocacy Day. The AAPOS and AAP-Section on Ophthalmology remain crucial partners with the Academy in its ongoing federal and state advocacy initiatives.

Surgical Scope Fund (SSF)

The Surgical Scope Fund (SSF) provides grants to state ophthalmology societies to support their efforts to protect patient safety from dangerous optometric surgery proposals. Since its inception, the Surgery by Surgeons campaign and the SSF, in partnership with state ophthalmology societies, has helped 41 state/territorial ophthalmology societies reject optometric scope-of-practice expansions into surgery.

If you already have made a SSF contribution, please go to safesurgerycoalition.org to see the impact of your gift.

Dollars from the SSF are critical to building complete, cutting-edge political campaigns, including media efforts (TV, radio, and social media), educating and building relationships with legislators, and educating the voting public to contact their legislators. These political campaigns help the SSF to protect patient safety by defeating optometry’s surgical initiatives.

Each of these endeavors is very expensive, and no one state has the critical resources to battle big optometry on their own.

Ophthalmologists must join together and donate to the SSF and to fight for patient safety.

The Secretariat for State Affairs thanks the AAPOS and AAP-Section on Ophthalmology, who have joined state ophthalmology societies in the past in contributing to the SSF, and looks forward to their 2021 contributions. These ophthalmic organizations complete the necessary SSF support structure for the protection of our patients' sight.

State Eye PAC

It is increasingly important for all ophthalmologists to support their respective State Eye PACs because campaign contributions to legislators at the state level must come from individual ophthalmologists and cannot come from the Academy, OPHTHPAC, or the Surgical Scope Fund. The presence of a strong State Eye PAC providing financial support for campaign contributions and legislative education to elect ophthalmology-friendly candidates to the state legislature is critical, as scope-of-practice battles and many regulatory issues are all fought on the state level.

ACTION REQUESTED: Support ophthalmology's advocacy efforts

Academy Surgical Scope Fund contributions are used to support the infrastructure necessary in state legislative/regulatory battles and for public education. State PAC and OPHTHPAC contributions are necessary at the state and federal level, respectively, to help elect officials who will support the interests of our patients. Contributions to each of these three funds are necessary and help us protect sight and empower lives. Surgical Scope Fund contributions are completely confidential and may be made with corporate checks or credit cards. PAC contributions may be subject to reporting requirements.

Please respond to your Academy colleagues and be part of the community that contributes to OPHTHPAC, the Surgical Scope Fund, and your State Eye PAC. Please be part of the community that ensures ophthalmology has a strong voice in advocating for patients.

OPHTHPAC Committee

Jeffrey S Maltzman, MD (AZ)—Chair
Janet A Betchkal, MD (FL)
Mark J Gallardo MD (TX)
Thomas A Gaul MD (NE)
Sohail J Hasan MD PhD (IL)
S Anna Kao MD (GA)
Julie S Lee MD (KY)
Stephanie J Marioneaux MD (VA)
Dorothy M Moore MD (DE)
Stephen H Orr MD (OH)
Niraj Patel MD (WA)
Michelle K Rhee MD (NY)
Linda Schumacher-Feero MD (ME)
Frank A Scotti MD (CA)
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Ex-Officio Members:

Tamara R Fountain MD (IL)
David B Glasser MD (MD)
David W Parke II MD (CA)
Michael X Repka MD MBA (MD)
George A Williams MD (MI)

Surgical Scope Fund Committee

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Vineet ("Nick") Batra MD (CA)
Robert L Bergren MD (PA)
Gareth M Lema MD PhD (NY)
Darby D Miller MD MPH (FL)
Amalia Miranda MD (OK)
Christopher C Teng MD (CT)

Ex-Officio Members:

John D Peters MD (NE)
George A Williams MD (MI)

Surgical Scope Fund	OPHTHPAC®	State Eye PAC
To protect patient safety by defeating optometric surgical scope-of-practice initiatives that threaten quality surgical care	Working across the political spectrum to advance ophthalmology and protect its members and patients at the federal level. Support for candidates for U.S. Congress.	Support for candidates for state House, Senate, and governor
Political grassroots activities, government relations, PR and media campaigns	Campaign contributions, legislative education	Campaign contributions, legislative education
No funds may be used for campaign contributions or PACs.		
Contributions: Unlimited.	Contributions: Limited to \$5,000	Contribution limits vary based on state regulations.
Individual, practice, corporate, and organization	Personal and corporate contributions are accepted.	
Contributions are 100% confidential.	Contributions \$200 and above are on the public record.	Contributions are on the public record depending upon state statutes.

Imagine: A Papilledema Calculator

**Alexis M Flowers MD, Reid A Longmuir MD, Yuhan Liu MS,
Qingxia Chen PhD, and Sean P Donahue MD PhD**

- I. Papilledema and pseudopapilledema have remained challenging diagnoses to differentiate clinically, despite the importance of doing so due to difference in evaluation, treatment, morbidity, and mortality.
- II. Previous diagnostic tools have been evaluated for their ability to distinguish these two groups, such as OCT, OCT angiography, ultrasonography, and fluorescein angiography. So far, these tests report only a modest sensitivity and specificity or are not ubiquitously available to all ophthalmology practices.
- III. Imagine if there were data already available on the OCT optic nerve report that could be utilized to differentiate papilledema from pseudopapilledema. We hypothesized that the variability in the OCT clock hour data could be utilized to classify these two entities.
- IV. We recently showed that a linear combination model was able to do so in adults (22 patients with papilledema and 36 with pseudopapilledema) with high specificity and sensitivity, with an area under the curve (AUC) for the receiver operating characteristics curve of 98.4%, with optimized sensitivity of 95.5% and specificity of 88.9%.
- V. We then analyzed a second cohort of adults (23 patients with papilledema and 65 with pseudopapilledema) and validated this linear combination model on an independent data set. We found an AUC of 97.1% (unpublished data).
- VI. The next step is validating this linear model in children and expanding its utility to this population.
- VII. The calculator tool is available at a free website, at www.opticdiscedema.com.

Selected Readings

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2. Chang MY, Velez FG, Demer JL, et al. Accuracy of diagnostic imaging modalities for classifying pediatric eyes as papilledema versus pseudopapilledema. *Ophthalmology* 2017; 124:1839-1848.
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Imagine: Home Vision Apps

Evan Silverstein MD

I. Pre-COVID Vision Screening

A. Vision screening apps

1. GoCheck Kids
 - a. Matching game
 - i. HOTV (≤ 6 years)
 - ii. Early Treatment Diabetic Retinopathy Study (ETDRS) (>6 years)
 - b. Verbal answers
 - i. HOTV
 - ii. ETDRS
2. Peek Acuity: Tumbling E
3. EyeChart Pro
 - a. Sloan
 - b. Tumbling E
 - c. Landolt C
 - d. Numbers
4. Kay iSight Test Pro: Kay Pictures

B. Computer visual acuity

1. Jaeb Visual Acuity Screener
2. ATS-Protocol
3. Computer-based visual acuity devices
4. EyeSpy 2020
5. Dyop

C. Paper-based visual acuity

1. ABCD-Vision: HOTV box
2. PDF documents

II. COVID Era: Measuring Vision for Telemedicine (Synchronous Telemedicine)

- A. Screening for requirement for in-person visit
- B. Follow-up appointments
 1. Intermittent exotropia
 2. Chalazion
 3. Amblyopia
 4. Etc.

III. Post-COVID Era

A. Clinic efficiency

1. Pre-visit acuity
2. Dilate prior to visit

B. Synchronous telemedicine: Diagnoses as above

C. Asynchronous telemedicine

1. Glaucoma: iCare Home
2. Amblyopia
 - a. Amblyopia Tracker: ETDRS-distance based
 - b. Amblyopia Home: Fully integrated amblyopia follow-up

Imagine: Practical Solutions to Practical Barriers to Care

Alejandra de Alba Campomanes MD

Acknowledgments: Frank Brodie MD, Sabhyta Sabharwal MPH, April Nakayoshi MPH CHES, and Sandra Perez BS collaborated in these projects.

Uncorrected refractive errors account for the majority of visual impairment experienced by children around the world, including the United States. Refractive error is a major cause of amblyopia (ARF). Adequate refractive correction and compliance with prescribed glasses is a central issue in pediatric ophthalmology clinical practice; the key to their effectiveness is that they are worn constantly. Spectacle wear in children is often long term and very visible. The outcome of many invasive and complex interventions is often limited by difficulties with adherence to refractive correction and amblyopia treatment. Known barriers to adherence to spectacles include access, affordability, proper fit, need for frequent replacements, etc.

- Children with craniofacial syndromes and other anatomical abnormalities often need to wear glasses. Fitting them with comfortable glasses is almost impossible.
- We have shown that pediatric ophthalmologists can leverage existing, easy to access technology to create custom-fit, patient-specific glasses that can be designed and manufactured using commercially available 3-D printers and fitted with traditional lenses.
- We previously showed that CT/MRI 3-D reconstructions of the face and skull provide excellent visualization of the anatomical landmarks needed for computer-assisted design of frames.
- More recently we developed an in-office surface scanning workflow using Smartphone 3DSI that provides sufficient

resolution for the 3-D designing and subsequent 3-D printing of custom spectacles for children.

- Coupling these technologies provides a new way to help spectacle-dependent patients who are not well served by current offerings.
- We have also studied factors that influence glasses wear and compliance in preschoolers newly diagnosed with ARF.
- Important practical lessons include the following:
 - Once compliance with glasses is achieved, it remains stable throughout the observation period; continuous interventions are not necessary.
 - Simple interventions, like having 2 pairs of glasses, greatly improves full-time wear compliance.
 - Children need frequent replacements of frames and lenses.
 - Comfortable fit, ability to choose design, and color are important factors that should not be overlooked.
 - Continuous agency engagement and parent/teacher involvement are also very important to encourage spectacle wear.
- Our findings support the urgent need to adjust current policies on vision coverage for children.
- Programs involving school-based screening and eyeglass delivery may lessen disparities in accessing pediatric vision care.
- Simple or small interventions, in the context of the complexity of what pediatric ophthalmologists do, are often overlooked but play major roles in our clinical outcomes.



Figure 1



Figure 2

Selected Readings

1. Brodie FL, Nattagh K, Shah V, et al. Computed tomography-based 3D modeling to provide custom 3D-printed glasses for children with craniofacial abnormalities. *J AAPOS*. 2019; 23(3):165-167.e1.
2. Horwood A. Compliance with first time spectacle wear in children under eight years of age. *Eye* 1998; 12(pt 2):173-178.
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Imagine: New Billing Guidelines

Billing and Coding Update

Anne K Jensen MD

I. Changes to Outpatient (99202-99215) Billing and Coding Guidelines

- A. Effective January 1, 2021
- B. Includes both *new* and *established* outpatients
- C. Identifies the appropriate level of E&M services based on
 - 1. Level of medical decision making as defined for each service *or*
 - 2. Total time for E&M services performed on the date of the encounter
- D. Medically appropriate history and/or physical examination are still required, but details are in no way related to billing level.

II. Medical Decision Making (MDM)

- A. Four levels of MDM
 - 1. Straightforward (level 2)
 - 2. Low (level 3)
 - 3. Moderate (level 4)
 - 4. High (level 5)
- B. Requires 2/3 components to reach a given level (or middle component)
 - 1. Problems (number, complexity)
 - 2. Data (amount, complexity)
 - 3. Risk (of complications, morbidity, mortality)
- C. MDM requirements are identical for *new* and *established* patients
- D. Moderate (level 4) requirements (remember: you need 2/3)
 - 1. Problems
 - a. One or more chronic illnesses with exacerbation, progression, or side effects of treatment, *or* “Problem with expected duration of at least one year or until death that is acutely worsening, poorly controlled, or progressing” (ie, getting worse or not getting better)

“*Stable* for the purposes of categorizing MDM is defined by the specific treatment goals for an individual patient. A patient that is not at their treatment goal is not stable, even if the condition has not changed and is there is no short-term treat to life or function.”

- b. Two or more stable chronic illnesses *or* “problem with expected duration of at least one year or until death” that is stable (ie, getting better or doing well and not changing)
- c. One undiagnosed new problem with uncertain prognosis *or* “problem . . . that represents a condition likely to result in a high risk of morbidity without treatment”
- d. One acute illness with systemic symptoms *or* “illness that causes systemic symptoms and has a high risk of morbidity without treatment”
- e. One acute complicated injury: “an injury which requires treatment that includes evaluation of body systems that are not directly part of the injured organ, the injury is extensive, or the treatment options are multiple and/or associated with risk of morbidity”

2. Data

At least 1/3 categories must be met.

Category 1: Tests, documents, or independent historian(s)

- i. Any combination of 3 from the following:
 - (a) Review of prior external note(s) from each unique source
 - (b) Review of the result(s) of each unique test
 - (c) Order of each unique test
 - (d) Assessment requiring an independent historian(s)
 - (i) Parent/guardian
 - (ii) Interpreter ??

Category 2: Independent interpretation of tests

Category 3: Discussion of management or test interpretation with external physician/QHP/ appropriate source

- i. Discussion must be a two-way conversation (telephone, email, EMR messaging)
- ii. Letters do not count

Note: Tests included in the data section (reviewed, interpreted, or ordered) cannot be tests you separately bill (OCT, Humphrey visual field, fundus photos, etc.)

3. Risk

- a. Prescription drug management
 - i. Does not require a change
 - ii. *Does* require prescription
 - iii. Glasses don't count.
- b. Decision regarding minor surgery with identified patient or procedure risk factors
- c. Decision regarding elective major surgery without identified patient or procedure risk factors

Note: Whether a surgery is considered minor or major is determined by the physician, not by the global period.

- d. Diagnosis or treatment significantly limited by social determinants of health
 - i. The following ICD-10 Z codes, while *not* primary paying diagnosis codes, may convey to the payer specific social determinants of health.
 - ii. However, some payers will deny the claim if these codes are included even as secondary codes.
 - (a) Z59.0 Homelessness
 - (b) Z59.1 Inadequate housing
 - (c) Z59.5 Extreme poverty
 - (d) Z59.8 Insufficient social insurance and welfare support
 - (e) Z59.8 Other problems related to housing and economic circumstances

III. Time

- A. Defined as total physician time on the date of the encounter
 - 1. Preparing to see the patient (reviewing the chart)
 - 2. Obtaining history

3. Performing the exam

- 4. Counseling
- 5. Order medications or tests
- 6. Documenting clinical information in the EMR
- 7. Communicating with other health-care providers: Can apply to follow-up phone calls or video calls (99212-99215) as long as exam was performed at initial visit (Patient should be informed this is a billed visit.)
- 8. *Don't double dip:* Do not bill time for other tests performed that are billed separately.

B. NPV

- 1. Level 2: 15-29 minutes
- 2. Level 3: 30-44 minutes
- 3. Level 4: 45-59 minutes
- 4. Level 5: 60-74 minutes
- 5. For services 75 minutes or longer, consider prolonged service codes

C. Established

- 1. Level 2: 10-19 minutes
- 2. Level 3: 20-29 minutes
- 3. Level 4: 30-39 minutes
- 4. Level 5: 40-54 minutes

D. Prolonged service

- 1. For time spent beyond level 5
- 2. 99417 for non-Medicare payers
- 3. G2212 for Medicare payers
- 4. Billed in 15-minute increments

IV. Choosing Eye Visit Code (92002-92014) vs. MDM

IOL Implantation for Infants: Where Are We in 2021?

Erick D Bothun MD

In 2021, the decision to primarily implant an IOL in children remains multifactorial. Thankfully, a wave of recent studies and surgical refinements have helped make the consent process and management less complex. This discussion will draw from various multicenter and/or randomized cataract studies in infants, including but not limited to the Infant Aphakia Treatment Study, IOLunder2, and Pediatric Eye Disease Investigator Group cataract registry.

This presentation will outline the considerations, current state of understanding, and surgical options for helping ophthalmologists manage cataracts in infants. Various outcomes and their impact on care will be being discussed, including the following:

- Visual acuity outcomes and amblyopia
- Glaucoma-associated adverse events
- Visual axis opacification
- Other adverse events
- Preoperative risk factors
- Strabismus
- Refractive target

IOL surgical options to maximize success:

- Optic capture options
- Setting the stage with aphakia for later secondary in-the-bag IOL
- Piggyback lenses vs. IOL exchange
- Dropless postoperative care

Envision: Dropless Cataract Surgery

M Edward Wilson MD

Children have more inflammation after cataract surgery and may have a higher chance of endophthalmitis owing to the frequent need for posterior capsulectomy and anterior vitrectomy. However, parental compliance with postoperative anti-inflammatory and antibiotic eye drops is variable, and since children are at very low risk for postoperative cystoid macular edema after cataract surgery, nonsteroidal anti-inflammatory drops are not usually prescribed for children. Further, topical antibiotic drops given after surgery add very little to the overall reduction in infection risk.

Surgeon-directed medications are those that can be given at the conclusion of surgery and thus do not rely on parental compliance. Intracameral antibiotics given at the conclusion of surgery are safe and effective for reducing the risk of endophthalmitis. Recently, both intracameral and intracanalicular slow-release dexamethasone products have appeared and have been FDA approved for adults. These 2 products are both in the early stages of FDA clinical trials for approval in children of all ages. Therefore, we truly are at a point where dropless cataract surgery for children is a real possibility. This would eliminate the uncertainty of parental compliance with children who do not cooperate with postoperative drops.

Optimizing Postoperative Refractive Outcomes

Scott K McClatchey MD

Naval Medical Center, San Diego. The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government.

Introduction

The ideal refractive outcome for adult cataract surgery is emmetropia. For children the outcome goals are two: near-emmetropia at age 21 and ease of amblyopia management. Today, I will discuss the limits of achieving a predictable adult refraction, primarily due to variance in ocular growth. Reaching multiple goals requires multiple interventions.

Background Observations

Numerous studies have reported worse IOL formula accuracy in children than in adults (see Table 1). This accuracy is worse in children less than 3 (see Figure 1) and better when optical biometry is used. The causes of poor accuracy are several: there are greater errors in measurements of axial length and keratometry due to the biometry instruments available for use in the operating room, but the greatest source of error is postoperative refractions. Trivedi et al¹ found a median absolute prediction error of <0.7 D for 4 theoretical IOL formulas in children with a mean age of 3.56 years at surgery; I calculate that this is close to the theoretical minimum error, given current measurement techniques. Thus, modern IOL formulas are not a limiting factor. Far greater variances occur in long-term refractions, with the largest myopic shifts observed in early childhood.

Table 1. Median Absolute Prediction Error (APE) in Diopters, With Studies in Order of Mean Age at Surgery (in Years)

Study	Mean Age (SD)	SRK II	SRK-T	Hoffer Q	Holladay 1	Holladay 2	Haigis	Barrett U II	Notes
Vanderveen, 2013	0.2 (0.1)	2.2	1.3	2.1	1.2	1.4			
Chang, 2020	2.8 (2.1)	0.83	0.75	0.83	0.88	1.00	0.74	0.89	^a
Trivedi, 2011	3.9 (2.9)		0.67	0.56	0.58	0.53			
Li, 2020	4.6 (2.3)	0.95	0.81	0.68	0.70				^a
Eppley, 2020	5.9 (3.6)		0.86	0.88		0.81		0.79	
Nihalani, 2010	6.4	0.90	0.71	0.61	0.64				^b

^a Much greater variance in APE for eyes before age 3 years of age.

^b Biometry done in office resulted in better APE than when done under anesthesia; eg, 0.60 vs. 0.83 D, using the Holladay 1 formula.

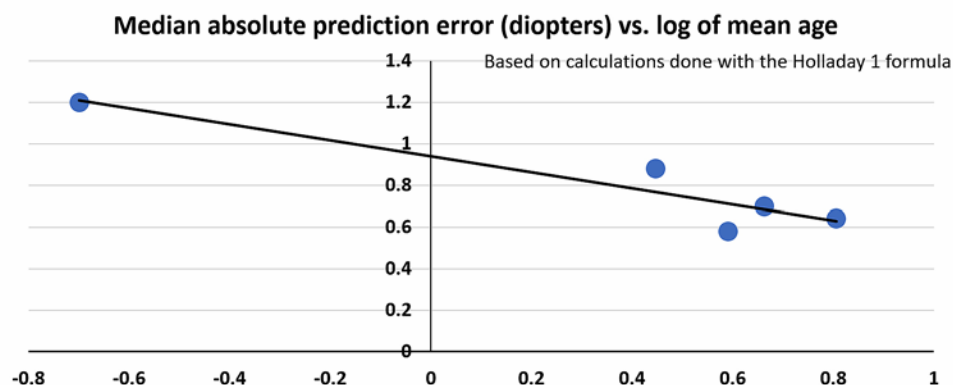


Figure 1. IOL “calculation error” correlates with log of age.

The Logarithmic Growth of the Eye

Studies show that normal, aphakic, and pseudophakic eyes follow a logarithmic growth curve, on average, as does axial length; this growth continues through the teenage years. The useful concept of rate of refractive growth (RRG3) is defined as the slope of a plot of the IOL power needed for emmetropia vs. log of age (adjusted for in-utero growth of the eye by adding 0.6 years).² RRG3 allows prediction of future refractions;³ it is slightly greater in aphakic and pseudophakic than in normal eyes, but data from the Infant Aphakia Treatment Study (IATS) demonstrated that the variance in RRG3 is twice as large after cataract surgery as in normal eyes (see Table 2).³

Table 2. Rate of Refractive Growth in the IATS

	Mean RRG3 (D)	SD
Normal eyes	-15.0	3.0
Aphakic	-17.7	6.2
Pseudophakic	-16.7	6.2

Table 3. Goal Initial Postop Refraction (D)

Surgery Age (yr)	IOL power	Predicted Refractions by Age (Years)				
		Initial	2	4	8	21
1	25	+5.5	+3.3	+0.42	-2.8	-7.8
2	23	+4.0		+1.2	-2.0	-3.5
4	21.5	+2.8			-0.3	-5.0
8	21	+1.0				-3.6

Note: All predictions are based on “typical eyes” and are subject to the large variance in the rate of refractive growth.

Achieving Good Vision and Emmetropia at Age 21

More than one intervention is required to achieve our goal outcomes. I think that a goal of initial postoperative hyperopia that is greater at younger ages is likely to allow ease of amblyopia treatment while still resulting in manageable refractive error in adult life.

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How I Work Up New Cataract Patients

Deborah K VanderVeen MD

I. The Patient

Any atypical physical characteristics, health or developmental problems?

II. The Lens

A. Congenital or acquired?

B. Recognizable lens morphologies of systemic diagnoses?

III. The Tests

A. Needed prior to surgery?

B. Laboratory

C. Imaging

D. Genetic testing

Video 1

Secondary IOL Placement in Pediatric Patients

Phoebe Lenhart MD

This brief video and talk will focus on techniques for placement of secondary IOLs in children. Outcomes of secondary IOL implantation in the Infant Aphakia Treatment Study population will be highlighted. The video will include images and discussion of the ways in which intraoperative anterior segment OCT imaging can be helpful for guidance.

Video 2

Removal of Capsular Bag After Marked Lens Subluxation

Eric Joseph Kim MD, Erick Bothun MD

Visually significant lens subluxation may warrant surgical intervention in children. After removal of the lens contents, various approaches exist for the surgical management of the capsular bag. At times, the capsular bag may be maintained and used for IOL insertion. This approach is often completed with some degree of vitrectomy and sutured scleral fixation. An common alternative is capsular bag removal, typically performed with vitrector and prior to anterior vitrectomy. Each approach carries short- and long-term risks, including refractive error, corectopia and lens-iris capture, decentration, and retinal detachment.

Marfan syndrome is the most common cause of nontraumatic ectopia lentis. Patients with Marfan syndrome carry additional risk for chronic retinal detachment. Because this risk is felt to be elevated after intraocular surgery (3.4%-6%), careful identification and management of the anterior vitreous is warranted.

My typical approach for these cases is careful lens content, capsular bag and anterior vitreous face removal with the vitrector. This can be completed with or without subsequent IOL insertion. If a sutured lens is preferred, I coordinate surgery with a complete vitrectomy.

In this video, I present an alternative option for complete capsular bag removal without disrupting the anterior vitreous face, potentially minimizing long-term retinal detachment risk.

Selected Readings

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Video 3

Consider the Pars Plana Approach When Performing a Primary Posterior Capsulectomy and Vitrectomy After IOL Insertion in a Young Child

M Edward Wilson MD

This video illustrates the key surgical steps that I use when performing a pars plana posterior capsulectomy and vitrectomy during cataract surgery in a child. While an anterior approach to the posterior capsule is a fully acceptable alternative, the pars plana approach has some advantages. These advantages include the following:

1. There is a reduced chance of an inadvertent wick of vitreous at the anterior wound.
2. The IOL can be inserted with the posterior capsule intact and not in an already vitrectomized eye. This helps to ensure the proper placement of the IOL in the capsular bag.
3. The ophthalmic viscosurgical device (OVD) can be removed before the posterior capsule is opened. This helps ensure a complete removal of OVD and reduces the chances of a high IOP on postoperative Day 1 from retained OVD.
4. With the pars plana approach after IOL placement, a larger posterior capsule opening can be made safely. With the anterior approach done before IOL placement, a larger posterior capsule opening would increase the risk of the IOL being delivered through the posterior capsule opening.

As noted in the video, I recommend that the pars plana incision be placed 2 mm posterior to the limbus in infants up to 1 year of age, 2.5 mm from ages 1 to 4, and 3 mm for children at or beyond their fourth birthday.

Video 4

Bibiana J Reiser MD

Strategies for safely extracting cataracts due to amblyogenic persistent fetal vascular or persistent hyperplastic primary vitreous will be demonstrated, from simple isolated fibrovascular sheets to thickened vascular nets and cords.

Video 5

Posterior Optic Capture After In-the-Bag IOL Implantation in Children

Scott R Lambert MD

In 1991 Neuhann first described optic capture to stabilize sulcus-fixated IOLs in adults after a large posterior capsular tear. Gimbel and DeBroff subsequently described performing optic capture through the posterior capsulorhexis in IOLs implanted in the capsular bag.¹ This presentation will discuss the pros and cons of each approach.

Optic Capture

Pros

- Allows capsular bag to become sealed (reduces postoperative visual opacities)²
- Improves IOL centration
- Reduces postoperative rotation of toric IOLs³

Cons

- More difficult to implant a 3-piece IOL in capsular bag
- Sizing of posterior capsulotomy (4.0-4.5 mm) is critical.⁴
- More difficult to perform an IOL exchange

No Optic Capture

Pros

- Easier to implant 1-piece IOL in capsular bag

Cons

- Capsular bag is not sealed.

References

1. Gimbel HV, DeBroff BM. Intraocular lens optic capture. *J Cataract Refract Surg*. 2004; 30(1):200-206.
2. Kaur S, Sukhija J, Ram J. Comparison of posterior optic capture of intraocular lens without vitrectomy vs endocapsular implantation with anterior vitrectomy in congenital cataract surgery: a randomized prospective study. *Indian J Ophthalmol*. 2020; 68(1):84-88.
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Video 6

Dealing with Anterior Pyramidal Cataracts

Deborah K VanderVeen MD

NOTES

How to Interpret/Utilize OCT for Management of Childhood Glaucoma

Mays El-Dairi MD

OCT is now a mainstay tool in managing childhood glaucoma. Although the main principles of OCT in older children who can sit for tabletop OCT are not very different from those in adults, there are always special considerations in image acquisition and interpretation. In infants and young children, options may be limited to hand-held OCT without anesthesia, which has limited quantitative capacities but still provides highly valuable qualitative information.

Posterior Segment OCT Protocols

Retinal scans

Cross-sectional scans allow the visualization of the macula and all the layers of the retina. These can show retinal abnormalities that might explain a cause for decreased vision. Looking at the ganglion cell layer can help estimate the severity of optic atrophy.

Macular maps

Macular maps are topographical maps centered on the foveal center. These are generated by integrating multiple single-line macular scans. Volumetric analysis of the ganglion cell layer correlates with optic nerve disease severity.

Enhanced depth imaging

Enhanced depth imaging (EDI) allows for better imaging of those layers deep to the retina, such as the choroid and the retrolaminar optic nerve.

Retinal nerve fiber layer (RNFL) scan

The peripapillary RNFL measurement is a circular scan of 3.4–3.5 mm (machine-dependent) that is centered on the optic nerve head. By capturing the axons of the vast majority of retinal ganglion cells, it is an indirect measure of all the retrobulbar optic nerve axons. RNFL measurements correlate with severity of glaucoma.

The majority of commercially available OCT machines do not have an integrated, pediatric normative database. However, pediatric RNFL data are not very different from those of young adults. One should keep in mind that RNFL values in children vary with refractive error, axial length, and race. The RNFL has been shown to be reproducible in children over years; however, a large myopic shift is expected to engender a tilting of the optic nerve which can be accompanied with changes in the RNFL segment or even a small symmetric decrease in the average RNFL.

Optic nerve head map, cup and rim analysis

The optic nerve head map is generated by integrating multiple single-line scans (horizontal, vertical, or radial) through the optic nerve head. It is useful for qualitatively assessing the peripapillary area, especially if a lesion is suspected (eg, pit, peripapillary choroidal neovascularization). The ONH map can be used to calculate disc area, cup area, cup-to-disc ratio, and rim area. This is integrated in some commercial machines.

Pearls and Pitfalls and Masqueraders of Pediatric Glaucoma

- Pay attention to the scan quality and segmentation errors.
- Pay attention to change in axial length with growth spurt and tilting of the optic nerve.
- Pay attention to the macula. Congenital glaucoma, high myopia, and previous intraocular surgery can be associated with potentially visually significant retinal changes.
- Reversal of cupping is accompanied by stability or thinning of the RNFL with time. The apparent change in the nerve cup is probably related to changes in the Bruch membrane position.
- Consider masqueraders of glaucoma, especially if the other signs of glaucoma (elevated IOP, increasing axial length, myopic shift, or an enlarged cornea or haab striae) are not present. Example: Children with history of prematurity or central nervous system disease will likely later develop retrograde peripapillary RNFL loss and cupping, which can mimic glaucoma.

References

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Toward an Evidence-Based Future for Childhood Glaucoma Surgery (and a New MIGS Video)

James D Brandt MD

Prior to the mid-20th century, childhood glaucoma was uniformly blinding and was the leading cause of blindness among children enrolled in schools for the blind. The treatment of primary congenital glaucoma (PCG) was revolutionized mid-century with the introduction of what is collectively called “angle surgery”—first, goniotomy ab interno by Barkan in the 1940s, and subsequently, the introduction of trabeculotomy ab externo developed independently by Harms and Smith in the 1960s. Multiple studies of trabeculotomy and goniotomy among patients with PCG report success rates of 75% to 90%. The high success rate of angle surgery in PCG has led to the consensus that childhood glaucoma is primarily a *surgical* disease,¹ not only because surgery on the angle is highly effective but also because long-term, compulsive adherence to a multidrug medical regimen in young children is frequently impossible.

Conventional goniotomy and trabeculotomy each treat approximately 120° of the anterior chamber angle—if the response to surgery is insufficient, a return to the operating room may be necessary to treat the remaining angle. Current preferred practice is to perform circumferential surgery, cannulating the canal of Schlemm and opening the entire canal; both ab externo and ab interno options exist. Circumferential treatment is advantageous as the entire angle is treated, allowing the surgeon to move on quickly to alternative treatments if the angle surgery fails. Transcorneal ab interno approaches have the added benefit of preserving conjunctival real estate for subsequent fistulizing procedures should the angle surgery fail.

Unfortunately, even in the best of hands some 15%-25% of primary angle surgery performed in PCG eventually fails, due to disease severity, delay in diagnosis, age at which surgery is performed, and even specific disease phenotype. For example, certain mutations only recently identified result in congenital absence of the canal of Schlemm and downstream collector channels,² something that cannot yet be determined clinically. Secondary forms of childhood glaucoma, such as aniridia, Sturge-Weber syndrome, anterior segment dysgenesis syndromes, and glaucoma following cataract surgery, sometimes respond poorly if at all to primary angle surgery. Despite the lower success rate of angle surgery in these secondary forms of childhood glaucoma, angle surgery is still generally attempted first because of its significant safety advantage over the alternatives.

If we define eyes that have failed angle surgery as having “refractory childhood glaucoma,” it is worth recognizing that none of the options currently employed in this setting have been evaluated prospectively prior to widespread adoptions. We are witnessing a revolution of surgical innovation in adult glaucoma; sadly, however, childhood glaucoma remains an orphan disease. Some of the new techniques for circumferential ab interno trabeculotomy such as gonioscopy-assisted transluminal trabeculotomy and Trab360 clearly advance how we do angle surgery.

Minimally invasive glaucoma surgery (MIGS) implants are another story. As MIGS procedures reach the market, surgeons

are always free to use devices and approaches “off label.” The CyPass suprachoroidal stent (Alcon; Fort Worth, TX) was removed from the global market in 2018 out of concern for endothelial damage in the adult pivotal trial, but we have no data for the device in children. I am aware of one European case in a child’s buphthalmic eye where the device migrated into the suprachoroidal space, never to be seen again. Given the long-term consequences in children we should be proactive in collecting data so that clinicians are not treating children in a data-free zone. For MIGS approaches and implants that show potential in treating refractory childhood glaucoma, we should be collecting data in parallel with adult pivotal trials or at least requiring postmarketing device registries to capture outcomes and complications in pediatric eyes.

Conventional angle surgery works extremely well in most patients with PCG. In my mind, failure indicates angle scarring or a dysfunctional downstream collector system. Artificial angle-based implants are unlikely to help here, and leaving a piece of metal in a child’s eye for many decades for limited if any gain seems a bad idea given the lack of any long-term data.

Bleb-forming MIGS may be an attractive interim step for refractory childhood glaucoma before moving on to the more extensive dissection and risk associated with trabeculectomy with mitomycin C (MMC) or plate-based glaucoma drainage devices. Small-lumen tubes that shunt aqueous humor to a subconjunctival space treated with MMC are marketed or in development. We have limited data about the Xen (Allergan; Irvine, CA) implant,³ but the observation that the device may degrade over time should give pause when considering its use in children.

A novel ab externo microshunt (PreserFlo MicroShunt, Santen USA; Emeryville, CA) currently under investigation in the United States and approved outside the U.S.⁵ is fabricated from a polymer (SIBS: styrene-block-isobutylene-block-styrene) with a multidecade history of stability in the form of coronary stents.⁶ The long-term stability of the material and the safety profile of the device in adults suggest this approach may be particularly suitable in young children. In 2019, I approached the FDA for compassionate use/early access permission to use this microshunt in a pediatric cohort. Permission to proceed was granted in late 2019, and I implanted the microshunt in 10 eyes of 10 children by July 2020. I will share preliminary 1-year results and a surgical video with you at the meeting. A prospective multicenter pivotal trial is being planned.

Our pediatrician colleagues constantly remind us that children are not just little adults. The same goes for children’s eyes. It is not surprising that no pivotal trials have yet been attempted in childhood glaucoma—it is neither feasible to do large clinical trials for this rare group of disorders nor to expect clean IOP outcomes when measuring IOP in a child is challenging at best. Nonetheless, those of us treating childhood glaucoma should insist on the same high level of data our adult colleagues expect when evaluating new surgical approaches and implants. It is time to try!

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Don't Forget Me: Strabismus and Glaucoma

Ta Chen Peter Chang MD

- I. Semantics
 - A. Diplopia
 - B. Strabismus
 - C. Motility disturbance
- II. Review of Literature
- III. Clinical Observations
- IV. Treatment Goals
 - A. Single binocular vision
 - B. Elimination of diplopia
 - C. Cosmesis
- V. Surgical Approach

Glaucoma Following Cataract Surgery: What Have We Learned?

Sharon F Freedman MD and the Infant Aphakia Treatment Study Group

See Freedman SF, Beck AD, Nizam A, et al; IATS Group. Glaucoma-related adverse events at 10 years in the Infant Aphakia Treatment Study: a secondary analysis of a randomized clinical trial. *JAMA Ophthalmol.* 2021; 139(2):165-173.

- I. Glaucoma remains a dreaded complication of childhood cataract removal.
 - A. Risk factors have varied, but young age and microcornea are major risk factors. Prospective studies are best to avoid bias (especially given that some retrospective studies find that primary IOL placement is protective against this glaucoma).
 - B. The Infant Aphakic Treatment Study (IATS) randomized infants 1-6 months of age with unilateral cataract to primary IOL or aphakia with contact lens correction (IOL and CL groups).
 - C. The standard definitions of “glaucoma suspect” and “glaucoma” in childhood were inspired by the need for consistency in this study, leading to the formation of the international classification for childhood glaucoma in conjunction with the Childhood Glaucoma Research Network and the World Glaucoma Association (2013).
 - D. At 1 and 5 years after original cataract surgery in IATS, glaucoma suspect and glaucoma following cataract developed, and major risks were young age at surgery and small cornea; IOL and CL groups were similar in terms of risk.
- II. Ten-year follow-up of the original IATS cohort provides a unique group in which to study development of glaucoma suspect and glaucoma following cataract surgery.
 - A. Risk of glaucoma rose from 9% (95% CI, 5%-16%) at 1 year to 17% (95% CI, 11%-25%) at 5 years to 22% (95% CI, 16%-31%) at 10 years following cataract removal.
 - B. Risk of glaucoma plus glaucoma suspect rose from 12% (95% CI, 7%-20%) at 1 year to 31% (95% CI, 24%-41%) at 5 years to 40% (95% CI, 32%-50%) at 10 years and was not significantly different between the IOL and CL groups.
 - C. Eyes with glaucoma (compared with eyes with glaucoma suspect or neither) had longer axial length.
 - D. In eyes with glaucoma, retinal nerve fiber layer (by OCT analysis) was relatively preserved compared with eyes with glaucoma suspect or neither status in the IATS at 10 years after surgery.
- III. Glaucoma following cataract surgery in infants may be successfully treated, but the risk is highest in those eyes having surgery at very young age.
 - A. Desire for optimal vision in unilateral cataract surgery management must be tempered against an increased risk for developing glaucoma or glaucoma suspect at a very young age.
 - B. Data from other prospective (and retrospective) studies of similar cohorts confirm very young age as the strongest risk for development of glaucoma-related adverse events after cataract removal.
 - C. Primary IOL placement does not prevent development of glaucoma-related adverse events after removal of cataracts in infancy.

My Preferred Angle Surgery: Goniotomy

Brenda L Bohnsack MD PhD

Short description: Video describing goniotomy surgery. This will include the preoperative considerations, intraoperative procedure, and postoperative management.

My Preferred Angle Surgery: Circumferential Schlemm Canal Surgery

Ta Chen Peter Chang MD

I. Ab Externo Circumferential Filament Trabeculotomy

A. Useful when:

1. Poor view through the cornea
2. Good view but lens is scarily exposed (aniridia)
3. Good view but angle landmark is indistinct

B. Pros

1. It's the angle procedure that can be done in any situation.
2. Most of the surgery is outside of the eye—safe(ish).

C. Cons

1. Labor intensive
2. Time consuming
3. Violates conjunctiva

D. Pearls

1. Careful, deep dissection is key.
2. When in doubt, transilluminate.

II. Ab Interno Gonioscopy-Assisted Transluminal Trabeculotomy

- ### A. Useful when good view through the cornea with good trabecular landmark

B. Pros

1. Fast (if/when things go well)
2. Spares the conjunctiva

C. Cons

1. Difficult skill to acquire
2. At the mercy of the cornea
 - a. Enlarged/thin cornea can form striae and distort view.
 - b. Edema can worsen intraoperatively and degrade view.
3. Most of the surgery is inside the eye—less safe.

D. Pearls

1. Make sure there is a view by repeating gonioscopy before prepping.
2. Do not overfill the anterior chamber (can distort landmark).
3. When in doubt, go ab externo.

Beyond Angle Surgery: Pearls for Trabeculectomy

Beth Edmunds MD PhD

Pearls to Help Avoid Hypotony and Bleb-Related Infections

Providing that the initial angle surgery was not an ab externo approach involving superior conjunctiva or sclera, a trabeculectomy is a viable approach in appropriate patients.

Goals of Trabeculectomy (After Childhood Angle Surgery, or Indeed, at Any Point in a Person's Life)

The goal of trabeculectomy is to lower IOP in a safe and effective way. While there are many potential pitfalls requiring pearls, this talk will focus on two of the more frequently encountered or feared complications and offer pearls on how to avoid them.

Early hypotony and late bleb-related complications (particularly infections) are both especially of concern when performing trabeculectomies in a pediatric population, who by nature, may not be able to tolerate hypotony or the activity restrictions it imposes, or who have many years of living with a bleb ahead, creating conditions for late bleb-related complications (blebitis, leaks, endophthalmitis).

Early hypotony is more likely in highly myopic and buphthalmic eyes due to the stretched floppy cornea and sclera, as are its consequences (shallow anterior chamber [AC], maculopathy, choroidal detachments, accelerated cataract, suprachoroidal hemorrhage). It is also more likely in uveitic eyes (ciliary body shut-down) and those in whom surgical wounds are inadequately closed (over-draining scleral flap, leaking suture tracks, leaking conjunctival closure, leaking paracentesis wound).

Bleb-related complications are more likely over time as blebs “mature” if they do so in a way that leads to a thin avascular anterior bleb, the “bleb-at-risk” for blebitis and late leaks, which may then progress to endophthalmitis. Children have many years ahead of them, increasing the lifetime exposure to trauma and infection. Understanding the evolution of the bleb-at-risk morphology helps us understand the rationale behind some of the following pearls.

Understanding Wound Healing and Bleb Maturation

This is an enormous topic, and what follows is a brief description of the relevant clinical features. The blebs that develop problems are those that become thin and avascular, especially when located anteriorly at the limbus. This occurs when there is “anterior” drainage from the underlying scleral flap (eg, due to small flap construction or due to aqueous leakage from sides of the scleral flaps or through anterior suture tracks in thin flaps). Anterior drainage allows the more posterior conjunctiva and Tenon capsule to approximate to sclera, scar down and set up the conditions for a progressively contracting “ring of steel,” which is the advancing edge of healed/scarred conjunctiva and Tenon. This scarring marches forward, welding down the potential posterior bleb space and instead directing aqueous into a smaller anterior conjunctival bleb area, which thins with

chronic focal aqueous pressure (providing there is still scleral flow of aqueous into the bleb; if the site of scleral aqueous drainage seals, then the bleb scars down and “fails”). Ironically, these trabeculectomies may be considered “successful” in the narrow sense that the IOP is “controlled,” but they are morphologically risky. Mitomycin C (MMC) inadvertently applied to the anterior conjunctiva/Tenon exaggerates this thinning effect produced by focal aqueous drainage under MMC-treated conjunctiva; however, if applied posteriorly (while protecting the anterior conjunctiva/Tenon from exposure), MMC helps inhibit posterior healing/scarring to maintain posterior flow from the posterior aspect of the scleral flap, creating a desirable *posteriorly directed, diffuse, low healthy* bleb. The “ring of steel” effect is also more likely when limbal-based blebs are created, as the posteriorly placed conjunctival incision (which is often closed with a running Vicryl suture) provokes an inflammatory response in the area where scarring/healing is undesirable, setting up the potential for progressive, anteriorly directed scarring as described above, resulting in a “bleb-at-risk.”

Pearls for Avoiding Trabeculectomy Complications

Patient factors

- Careful patient selection: Consider the whole patient, their family and their social circumstances, with thought about how well they might cope with postop instructions, restrictions, frequent visits (and EUs in young children), and frequent postop drop instillation.
- IOP goal: If advanced glaucomatous cupping, may require as low an IOP as possible; trabeculectomy may be more likely to achieve this than a tube.
- Underlying condition: Some conditions fare less well with trabeculectomy than others. For example, glaucoma following cataract surgery (GFCS) cases achieve better results with tube than trabeculectomy, which also allows contact lens wear (contraindicated after trabeculectomy).
- Previous surgeries: Those involving superior incisions increase difficulty of surgery and risk of complications and lower success rate.

Surgeon factors

- Meticulous safe technique: Surgeon and team perform best when familiar with trabeculectomy and postop management, performing trabeculectomy frequently enough to keep surgeon and staff (surgical staff and clinic support staff) at the top of their game.
- Safe anesthesia

Surgical approach: *Go big.*

- Adequate exposure and large treatment area; generous limbal conjunctival opening (ie, “fornix-based trab”), keeping Tenon intact with wide, deep, extensive posterior dissection exposing clean sclera.

- Large scleral flap with radial incisions just short of the limbus to direct aqueous posteriorly rather than seeping out the sides.
- Large posterior treatment area with MMC: Area treated is posterior to the scleral flap (and can include the edge of the flap) to inhibit fibroblast activity in this area and set up conditions for a posterior bleb and a low, smooth, diffuse bleb profile. MMC is needed in children because of their more vibrant scarring response; when used carefully with a technique that is designed to avoid the factors that lead to bleb thinning, it is less likely to be implicated in bleb complications.

Surgical approach: Go small.

- A single bite of a Kelly punch is sufficient to achieve gushing flow (in infants, the pediatric Kelly punch is helpful). Making sclerostomy any bigger with multiple bites only invites hypotony. The point at which flow will be regulated is at the posterior scleral flap border, so making larger sclerostomies to achieve more flow is not necessarily going to achieve this but does risk hypotony and leakage from sides of the scleral flap.

Surgical approach: Go tight.

- Scleral flap flow titration with adjustable sutures can err on the side of tight closure with opportunity to relax/release them later (in cooperative older children); buphthalmic eyes may require multiple sutures to achieve flap closure. Use lamellar passes to avoid leakage around needle tracks.
- Conjunctival closure: Avoid postoperative leaks that would deflate the bleb and set up the architecture for adhesion and scarring. Meticulous closure of conjunctiva at the limbus using interrupted 10/0 nylon (maintains tension longer than Vicryl and is also inert) with all sutures cut on the knot, and knots well buried. (Suture tail exposure is to be avoided as it invites mucus, inflammation, and infection, as well as being uncomfortable, which makes a child more likely to rub the eye.)
- Close all potential points of inadvertent or undesirable leakage (lateral sides of scleral flap if not self-sealing, all paracentesis wounds) with 10/0 nylon. If the sclera is very thin, a BV needle can be helpful to avoid seepage around the suture track, though the knot cannot be turned and so must be cut flush. Lowering IOP (by turning AC

maintainer off) while tightening knots also allows tight closure without cheesewiring. Raising IOP (by turning AC maintainer back on) makes it easier to pass sutures and assess leakage, which is vital to discover if wanting to avoid hypotony.

- Promoting posterior flow while bleb is maturing requires close postop monitoring with subconjunctival 5-fluorouracil, as well as suture adjustment to loosen posterior scleral flap tension if more drainage is required or needed if further out postop (requires more frequent EUAs in small children), and adequate steroid cover with slow taper.

Surgical approach: Go slow.

- AC maintainer and meticulous technique: An AC maintainer has multiple uses during surgery. Most importantly it stabilizes the AC and protects against intraoperative hypotony (which is a risk factor for suprachoroidal hemorrhage, choroidal effusions, lens trauma, etc.). By having a continuous infusion maintain the eye, the surgeon does not have to rush the flap suturing; and by adjusting the height of the infusion bottle, can compensate for degree of flow from a particular eye at different points in surgery. A continuous flow of BSS (rather than using viscoelastic to maintain the AC) helps gauge scleral flap flow and detect points of undesirable leakage and their adequate closure (to avoid postop hypotony). The dynamic nature of the AC maintainer setup also allows tight tying of sutures without cheesewiring, which is especially helpful in buphthalmic eyes (turning infusion off and on allows eye to soften while tying, and firm up for passing sutures).

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Beyond Angle Surgery: The Role for Cycloablation

David A Plager MD

The videos will focus on endocyclophotocoagulation (ECP) as this modality gives us views of the eye that ophthalmologists aren't usually otherwise privy to, at least not in vivo.

The technique of ECP will be presented, including the appearance of normal ciliary processes (CPs), abnormal CPs, immediate and long-term post-treatment CPs, and some other interesting observations made with the endoscope.

Selected Readings

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NEI Goals and Pediatric Ophthalmology

Michael F Chiang MD

What is the National Eye Institute?

The National Eye Institute (NEI) has been a world leader in directing and funding eye and vision research since 1968, when Congress and President Lyndon Johnson established it as an independent entity within the National Institutes of Health (NIH) to manage national efforts in vision science. The current annual NEI budget is \$835 million. Now in 2021, the NEI is releasing a new Strategic Plan, which outlines our directions and priorities over the next 5 years and is the first NEI Strategic Plan since 2012.

What are key recent NEI-funded accomplishments in retina?

- Ocular gene therapy: inherited retinal degenerations
- ROP: early treatment, anti-VEGF treatment, artificial intelligence
- Low vision: FDA approval of first retinal prosthesis (Argus II)
- Imaging: development and/or FDA 510(k) clearance for pediatric devices, eg, OCT (Bioptigen), AO (Physical Sciences), amblyopia detection (Rebiscan), low-cost autorefractor (PlenOptika)
- Visual neuroscience: discovery of MHC Class I proteins in neurons, with potential to regulate juvenile forms of plasticity in visual cortex → possible target for amblyopia treatment

Why do we need a new NEI Strategic Plan and mission statement?

- Unprecedented advances in science and computing have occurred during the past several decades, creating unique opportunities to improve understanding of disease mechanisms, which in turn lead to novel diagnostic and therapeutic tools.
- The COVID-19 pandemic demonstrated the value of investment in research, yet exposed many underlying health disparities, making more evident the importance of making advances accessible to entire population.
- The revised NEI mission statement (first revision since 1968) begins: “The mission of the National Eye Institute is to eliminate vision loss and improve quality of life through vision research.”

How is the new NEI Strategic Plan organized to promote collaboration across fields?

- NEI core research programs are currently organized by anatomy and disease (retina; cornea; lens; glaucoma & optic neuropathy; strabismus, amblyopia, visual processing; low vision).
- NEI strategic plan is organized around 7 cross-cutting areas of emphasis: genetics, neuroscience, immunology, regenerative medicine, data science, quality of life, and public health & disparities.
- Examples of potential innovations in each area of emphasis

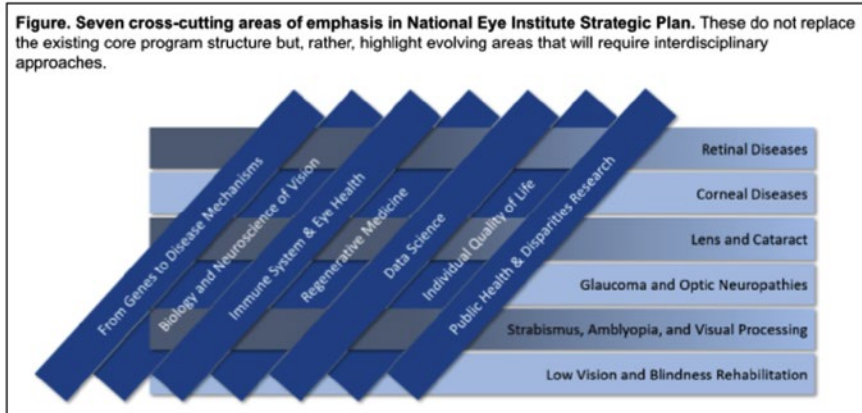


Figure 1

Intermittent Exotropia Overminus Therapy and Myopia Progression

Justin Marsh MD for the Pediatric Eye Disease Investigator Group

I. Study Design

A. Randomized control trial with eligibility including:

1. Age 3 to <11 years
2. Distance exotropia control ≥ 2 (mean of 3 measures)
3. Near exotropia control <5 (mean of 3 measures)
4. Prism + alternate cover test ≥ 15 PD of exotropia in distance
5. No previous strabismus surgery
6. Spherical equivalent refractive error between -6.00 and +1.00 (inclusive)

B. Twelve months of randomized treatment (1:1) to overminus lenses (-2.50 D over full correction) vs. non-overminus lenses with 12-month on-treatment analysis

C. Three months of reduced overminus lenses (-1.25 D over full correction) given to overminus group at 12 months

D. Three months of non-overminus lenses given to overminus group at 15 months

E. Eighteen month off-treatment analysis of control of distance exotropia for overminus and non-overminus treatment

II. Control of Intermittent Exotropia On and Off Treatment

A. Children 3 to 10 years of age had improved distance exotropia control scores when assessed at 12 months in overminus treatment.

1. Overminus ($n = 189$) distance exotropia control = 1.8
2. Non-overminus ($n = 169$) distance exotropia control = 2.8
3. Adjusted group difference: -0.8 in favor of overminus group (95% CI, -1.0 to -0.5 points; $P < .001$)

B. Improved control of distance exotropia was not maintained after discontinuing overminus treatment.

1. Overminus ($n = 176$) distance exotropia control = 2.4

2. Non-overminus ($n = 155$) distance exotropia control = 2.7

3. Adjusted group difference: -0.2 (95% CI, -0.5 to 0.04 points; $P = 0.09$)

III. Myopia Progression During Overminus Therapy

A. At 12 months, patients treated with overminus lenses had a greater myopic shift (in most myopic eye) when compared with those treated with non-overminus lenses.

1. Overminus: -0.42 D myopic shift
2. Non-overminus: -0.04 D myopic shift
3. Adjusted group difference: -0.37 D more myopic shift in overminus group (95% CI, -0.49 to -0.26; $P < 0.001$)

B. More than 1.0 D of myopic shift occurred in 17% of patients in the overminus group compared with 1% of non-overminus group, with a risk ratio of 14.8 (95% CI, 4.0 to 182.6).

C. At 12 months, patients who entered the study myopic (-0.50 D to -6.00 D) had a greater myopic shift if treated with overminus lenses when compared with those treated with non-overminus lenses.

1. Overminus: -1.07 D myopic shift
2. Non-overminus: -0.16 D myopic shift
3. Adjusted group difference: -0.84 D more myopic shift in overminus group (95% CI, -1.13 to -0.54)

Selected Readings

1. Chen AM, Erzurum SA, Chandler DL, et al; Pediatric Eye Disease Investigator Group. Overminus lens therapy for children 3 to 10 years of age with intermittent exotropia: a randomized clinical trial. *JAMA Ophthalmol.* 2021; 139(4):464-476.
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Intermittent Exotropia Prism Therapy

Veeral Shah MD

- I. Review of the History Data for the Consideration and Effectiveness of Prism Therapy for Intermittent Exotropia (IXT)
- II. Randomized Trial, Prism Therapy in IXT 6: Design and Study Results
- III. Future Directions: Studies of Combined Therapy With Prisms

How Intermittent Exotropia Studies Will Change My Practice in 2021

Katherine A Lee MD PhD

Introduction

In the past decade there have been several randomized trials regarding the surgical and nonsurgical management of pediatric intermittent exotropia (IXT). As an investigator in the Pediatric Eye Disease Investigator Group (PEDIG), I have good familiarity with the conclusions of these studies.

How has my practice as a community pediatric ophthalmologist been influenced by this exposure? How has study design affected the application of study conclusions to my practice? What are my main “take away” messages, and what am I doing or not doing differently in 2021 based on PEDIG study results?

1. Conservative Treatment of IXT

Patching

The design of the PEDIG studies that evaluated the effect of patching in pediatric IXT affected the applicability of the study conclusions to the management of IXT with patching in my practice.

Observation

PEDIG 3-year observation of untreated IXT has strengthened my inclination to recommend observation only for well-controlled IXT. This option looks better as the years go by, but it continues to be a hard sell to the family that wants to take action.

Prism management of IXT

A more recent PEDIG pilot protocol investigated whether the use of partially relieving prism correction improved control of IXT. This pilot was a bit of a “head scratcher” idea for me, and I did not participate in it. I have not employed partially relieving prisms for IXT.

Overcorrecting myopic spectacle correction of IXT: For years I have observed my overminused myopes with IXT “grow” into their overcorrection. The recent PEDIG trial of overminus correction demonstrated that it works well to improve IXT control while it is employed (for 1 year) but does not have any lasting effect once weaned (over 6 months). Furthermore, the treatment causes increased myopic progression, primarily in children who are already myopic. There is lots of information to take away from this study, particularly in light of a worldwide epidemic in myopia. This PEDIG study has most profoundly influenced my treatment in intermittent exotropia in children.

2. Surgical Management of IXT

Bilateral rectus recession (BLRc) vs. recess/ resect for basic IXT

The PEDIG trial comparing these operative approaches did not detect a statistically significant difference between them. I have gravitated from BLRc to recess/ resect over my time in practice (22 years), and I am less likely to strongly recommend surgery.

Selected Readings

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Atropine Usage in Myopia

Low-concentration Atropine for Myopia Progression: LAMP Study

Jason C S Yam FRCS(Ed) MBBS

I. First-Year Results

- A. Concentration-dependent response along 0.05%, 0.025%, 0.01%, and placebo group
- B. 0.05% atropine reduced myopia progression by 67% over 1 year.
- C. All low-concentration atropine (0.05%, 0.025%, and 0.01%) are well tolerated.

II. Second-Year Results

- A. The efficacy of 0.05% atropine observed was double that observed with 0.01% atropine in SE progression over 2 years.
- B. 0.01% atropine was mildly more effective in the second year than the first year, but not 0.05% or 0.025% atropine.

III. Effect on Cornea

- A. Low-concentration atropine has no effect on corneal power and lens power.
- B. Its antimyopic effect acts via retarding axial elongation, and thus can reduce risk of myopia complications.

IV. Effect on Choroid

- A. Concentration-dependent effect on choroidal thickness
- B. Potential biomarker effect

V. Age-Dependent Effect

- A. A poorer treatment response in younger children
- B. Younger children required the highest (0.05%) concentration to achieve reduction in myopic progression similar to that of older children on lower concentrations.
- C. Therefore, a higher concentration (ie, 0.05%) should be administered as a starting dosage for younger children.

VI. Third-Year Results

- A. Efficacy of 3-year continued treatment
- B. Rebound effect after cessation of treatment

Multifocal Contact Lens Use in Myopia and DIMS Lenses

Michael X Repka MD MBA

Introduction

Progressive add spectacle lenses have been shown to modestly slow myopia development in children.¹ Additional optical approaches are being sought, possibly through blocking peripheral hyperopic defocus.² Recently, contact lenses and defocus incorporated multiple segments (DIMS) spectacle lenses designed to reduce peripheral hyperopic defocus have both been shown to slow myopia progression, although the results remain modest.

Multifocal Contact Lenses

MiSight 1 day is a daily wear, single use contact lens (Cooper-Vision), FDA-approved (late 2019) to slow the progression of myopia (nearsightedness) when initially prescribed for children 8-12 years old with -0.75 to -4.00 D (spherical equivalent) or myopia with 0.75 D or less of astigmatism. MiSight 1 day reduced the progression of myopia spherical equivalent by 59% (-0.51 vs. -1.24 D) and axial length by 52% over 3 years when compared to a group of children wearing a single-vision 1-day lens.³ Eligibility criteria matched the subsequent labeling (spherical equivalent -0.75 to -4.00 D; astigmatism, <1.00 D; aged 8 to 12 years).

The BLINK (Bifocal Lenses in Nearsighted Kids) study—NCT02255474—tested 3 types of Biofinity contact lenses, all FDA-approved for refractive correction.⁴ These were disposable monthly lenses worn daytime only: (1) spherical lens (“regular contact lens”) and (2) two bifocal contact lenses with different reading powers ($+1.50$ and $+2.50$). Children 7-11 years of age were enrolled for 3 years; 3-year myopia progression = -0.60 D for high add power, -0.89 D for medium add power, and -1.05 D for single-vision contact lenses. Statistically significant result. Eye growth was consistent with these changes. Additional products are being studied.

DIMS and Other Novel Lenses

DIMS lenses are designed to correct peripheral hyperopic defocus. In a randomized trial, 183 children were enrolled: aged 8 to 13 years, with myopia between -1.00 and -5.00 D and astigmatism ≤ 1.50 D. At the primary 2-year outcome, refractive error progression was reduced by 52% (-0.41 D vs. -0.85 D), and axial length elongation was reduced by 62%.⁵ Additional follow-up in Year 3 found the slowing persisted, but there is no randomized comparison group.⁶ These lenses are not available in United States. Based on this technology, Hoya has been marketing the MiYoSmart lens in Canada. Zeiss has MyoVision lenses in its myopia prevention portfolio.

Control of Myopia Using Novel Spectacle Lens Designs (CYPRESS) (Clinicaltrials.gov NCT03623074) is evaluating 2 novel lens designs compared to single-vision lenses. They are using SightGlass Vision’s DOT lenses, which modulate peripheral contrast with no impact to on-axis vision. They recruited 266 patients, with study completion in 2022. Planned 12-month interim data analysis showed a reduction in myopia progression of up to 74%.⁷

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How I Am Treating Myopia in 2021

Laura B Enyedi MD

- I. Myopia Basics and Epidemiology
- II. Prevention of Myopia: Increased Time Outdoors
- III. Slowing Myopia Progression
 - A. Pharmacologic measures
 - B. Optical treatments
 - 1. Multifocal spectacle lenses
 - 2. Dual-focus and multifocal contact lenses
 - 3. Orthokeratology
 - C. Future directions
- IV. General Considerations

Selected Readings

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Lois E H Smith MD PhD

NOTES

ROP Treatment Studies

Primary Treatment Modality for Retinopathy of Prematurity (ROP)

Kathryn M Haider MD

- I. There are multiple options for the primary treatment of ROP.

While it is mostly clear *when* we should treat ROP (type I ROP), it is less clear *what* the best treatment modality is and the exact technique/dose for that treatment. Currently, our choices include:

- A. Cryotherapy
- B. Confluent laser, near confluent laser, spaced laser treatment
- C. Bevacizumab, ranibizumab, aflibercept, or conbercept
- D. Variable dose of anti-VEGF agents
- E. Synchronous or asynchronous combination of laser and anti-VEGF agents

I plan to briefly discuss the pros and cons of the different treatment modalities.

- II. CRYO-ROP has provided the foundation for our current understanding of ROP.

- A. Cryotherapy reduced poor outcomes from roughly 50% to about 30%.
- B. We learned that zone I disease has a worse prognosis than zone II disease.

- III. Laser therapy has better outcomes when compared to cryotherapy.

- A. At 10 years post-treatment in 66 patients, visual acuity was better in the laser group (20/66) than in the cryotherapy group (20/182) ($P = .015$).¹
- B. The laser group was 5.2 times more likely to see better than 20/50.¹
- C. The cryotherapy group was 7.2 times more likely to develop retinal dragging.¹
- D. Cryotherapy induced more myopia (-7.65 D vs. -4.48 D; $P = .019$).²
- E. Conclusions: The improved outcomes with laser therapy currently make cryotherapy treatment nearly obsolete.

- IV. The Early Treatment of Retinopathy of Prematurity (ETROP) study defined the optimal treatment time-frame; when type I ROP is identified.

- A. Type I ROP is defined as
 - 1. Zone I any stage ROP with plus disease
 - 2. Zone I stage 3 without plus disease
 - 3. Zone II stage 2 or 3 with plus disease

- B. Early treatment reduced poor visual outcomes at 9 months (19.5% to 14.5%) and poor structural outcomes (15.6% to 9.1%).³

- C. Future consideration: Are there indications for treatment outside strict type I criteria?

- V. General Tips for Performing Laser Treatment

- A. Diode laser is preferable to argon green laser because of the lower risk of burns to the tunica vasculosa lentis and cataract development. Acute complications of laser include corneal edema, intraocular hemorrhage, cataract formation, intraocular inflammation, and exudative retinal detachments.

- B. A general rule is to start laser settings at 150-250 mW for 100-300 msec.

- 1. Aim for a whitish/gray spot color with a $\frac{1}{4}$ to $\frac{1}{2}$ spot width separation; titrate settings accordingly.

- 2. One to 1.5 burn width had a greater risk of progression to stage 4 or 5 ROP when compared to near confluent $\frac{1}{4}$ burn width.⁴

- C. Increased laser spots are associated with increased myopia.

- D. Laser may lead to decreased peripheral vision.

- VI. The introduction of anti-VEGF injections changed the therapeutic game.

- A. Bevacizumab (IVB) was found to be effective for ROP, with less recurrence at 54 weeks: IVB 6/140 eyes (4%) vs. Laser 19/146 eyes (22%); BEAT-ROP.⁵

- B. Optimum dosing is still to be determined.

- 1. De-escalation dosing study of IVB revealed successful outcomes at 4 weeks with 13/13 eyes receiving 0.016 mg, 9/9 eyes receiving 0.008 mg, and 9/10 eyes receiving 0.004 mg of IVB. Only 17/23 (74%) were successful at 0.002 mg of IVB.⁶

- 2. Ranibizumab (IVR) 0.2 mg appears to have better success (no active ROP, no poor structural outcomes, no need for additional treatment at 24 weeks) when compared to IVR 0.1 mg and laser.⁷

- C. There is increasing evidence that anti-VEGF agents may have benefit over laser treatment in certain situations

- 1. Injection of an anti-VEGF agent may be less stressful to the baby than laser treatment.

2. Anti-VEGF agents induce less myopia and may have a greater chance of binocularity when compared to laser.
3. Anti-VEGF agents may be a better option if there is a media opacity or a contraindication to the anesthesia that is required for adequate laser treatment.
4. Anti-VEGF medications allow regression of neovascularization and development of peripheral/ anterior retina.
5. There is increasing evidence that anti-VEGF agents may be preferable to laser in cases of zone I disease.
6. There may be a benefit of anti-VEGF injection over laser in patients with aggressive posterior ROP (APROP).
 - a. The rates of tractional retinal detachments (TRDs) despite adequate laser treatment in patients with APROP range from 20% to 50%.
 - b. TRDs are less common with bevacizumab treatment (1/22 eyes).⁸
- D. Potential negative considerations when using an anti-VEGF agent
 1. There are mixed reviews on long-term neurodevelopmental outcomes. To date there is no clear consensus that anti-VEGF medications definitively lead to worse neurodevelopmental outcomes.
 2. There are case reports of long-term reactivation and retinal detachment after the primary injection of an anti-VEGF agent. Some hypothesize this is due to persistent avascular retina.
 3. Using anti-VEGF agents can increase the total number of exams for the infant.
 4. Using anti-VEGF agent as a primary treatment modality may increase the risk of needing a secondary treatment (initial lack of response, reactivation of ROP, or persistent avascular retina).
 5. We are still defining the structural changes in the retina/eye after anti-VEGF therapy. Secondly, we are defining the visual sequelae from this modality.
 6. There may be unknown long-term side effects or systemic side effects that have not yet been identified.
 7. Reactivation rates may be higher with ranibizumab than with bevacizumab in APROP.⁹

VII. Future Considerations

We need to answer questions to determine if the following variables change the optimal treatment strategy:

- A. Age of the patient at treatment
- B. Rate of ROP progression
- C. Associated comorbidities
- D. Location/zone of the ROP
- E. Level of plus disease
- F. Reasons to treat outside type I ROP criteria
- G. Secondary treatment options and outcomes

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Recurrent ROP Treatment Studies

G Baker Hubbard MD

- I. Recurrent ROP has received increased attention since introduction of anti-VEGF treatment.
 - A. Multiple reports of severe recurrent ROP with poor outcomes after anti-VEGF
 1. Recurrence can occur after seemingly successful initial response.
 2. Late recurrence can occur months or years after initial good response to injection.¹
 - B. How does recurrence rate after anti-VEGF compare to laser for ROP?
 1. Early Treatment for ROP (ETROP; laser): Retreatment rate was 11% and 13.9% for conventionally managed and early treated eyes, respectively.
 2. BEAT-ROP (bevacizumab): Recurrence rate was 4% (6/140 eyes).
 - a. Dose: 0.625 mg bevacizumab
 - b. Follow-up was only to 54 weeks PMA.
 3. Pediatric Eye Disease Investigator Group (PEDIG) Dose De-escalation Study (bevacizumab): Retreatment rate was 23% (early failure or late recurrence).²
 - a. Analyzed doses down to 0.031 mg bevacizumab
 - b. Follow-up was to 6 months corrected age.
 4. RAINBOW (ranibizumab): Infants allowed 2 additional injections at 28-day intervals³
 - a. Treatment switch (proxy for recurrent ROP) occurred in:
 - i. 15.7% of eyes (11/70) with 0.2-mg ranibizumab
 - ii. 17.1% of eyes with 0.1-mg ranibizumab (13/76)
 - iii. 26.5% of eyes with laser (18/68)
 - b. Follow-up was for 24 weeks after injection.
 5. Recurrence rate after anti-VEGF may increase with longer follow-up.
 6. Other retrospective studies have reported recurrence and retreatment rates after various doses of bevacizumab and ranibizumab for ROP in patients followed for varying lengths of time.
 - a. Reported recurrence/retreatment rates range from 0% to 64%.^{4,5}
 - b. Some studies have found a higher recurrence rate for ranibizumab than for bevacizumab.⁵
 - c. One study reported a comparison of 0.625 mg to 0.0625 mg of bevacizumab with 45 patients in each group. The plus resolved more quickly in the high-dose group, but progression of vascularization into the peripheral retina was better in the low-dose group. Two patients (4.4%) in each group required retreatment.⁶
- II. Given late recurrences, appropriate endpoint for ROP monitoring after anti-VEGF remains unknown.
 - A. Prophylactic laser treatment to persistent avascular retina after 60 weeks PMA has been recommended to prevent late recurrence.
 - B. Refractive benefits seem to be maintained with prophylactic laser after 60 weeks.⁷
- III. Manifestations of Recurrent ROP After Anti-VEGF
 - A. Plus disease
 1. Some tortuosity may persist with successful treatment and, by itself, does not imply recurrence.⁸
 2. Worsening tortuosity and dilation of vessels warrant retreatment.
 - B. Neovascularization (NV)
 1. Recurrent NV may manifest at the vascular-avascular junction.
 2. Or, it may manifest at the location of original ridge from the time of the first injection. If retinal vessels progress into periphery before the recurrence, the recurrent NV may now be in a location proximal to the present vascular-avascular junction.⁹
 - C. Traction retinal detachment (TRD)
 1. Occurs at location of recurrent NV when the NV becomes fibrotic
 2. Look for traction in one of the two places noted above.¹⁰
 - a. Conventional location at vascular-avascular junction
 - b. Proximal location at the site of the original ridge (now proximal to the new vascular-avascular junction)

IV. Management of Recurrent ROP After Anti-VEGF

A. For recurrent plus or NV

1. Laser
2. Repeat anti-VEGF may be effective in the short term, but normal vessels do not seem to progress into periphery after recurrence is retreated with anti-VEGF.⁹
3. Both laser and repeat anti-VEGF

B. For TRD

1. When TRD develops, it often occurs after retreatment for recurrence.
2. A combination of modalities can be utilized, including vitrectomy, laser, and repeat anti-VEGF.

V. Outcomes of Recurrent ROP

- A. Aggressive treatment of recurrent ROP after anti-VEGF usually avoids unfavorable structural outcome.²
- B. Recurrent ROP is more common with anti-VEGF compared to laser, but outcomes after recurrence are better with anti-VEGF than with laser.
- C. Management of ROP with anti-VEGF therapy necessitates close follow-up with the expectation of recurrence in a substantial proportion of cases.

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How ROP Studies Have Changed My Practice

William V Good MD

Introduction

There have been many significant clinical trials to study ROP, and they have all affected the way I manage ROP. Most of the excellent studies have emanated from the National Eye Institute. The significant management issues are described in this outline.

1. The Cryotherapy for Retinopathy of Prematurity (CRYO-ROP) Study

CRYO-ROP proved that ablation of the peripheral retina in infants with threshold ROP reduced the rate of blindness by about 50%. Threshold disease was defined as dilation and tortuosity of posterior retinal vessels, and 5 contiguous or 8 total clock hours of stage 3 disease in zone I and zone II. Based on this study, I began using cryotherapy, and then laser therapy to treat threshold ROP.

2. The Supplemental Therapeutic Oxygen for Prethreshold Retinopathy of Prematurity (STOP-ROP) Study

STOP-ROP evaluated whether supplemental oxygen at a certain point in the development of ROP would help eliminate the disease. There was no effect. However, of great significance, supplemental oxygen probably caused no harm. I am asked all the time if a child can receive extra oxygen once the child is older (eg, 36 weeks gestational age or higher). The answer is Yes. So infants who need the oxygen to help their pulmonary status or to help them grow can benefit from extra oxygen.

3. The Light Reduction in ROP (LIGHT-ROP) Study

LIGHT-ROP proved that light does not increase the metabolic rate to any degree that would aggravate ROP. Therefore, I no longer worry about the child's ambient environment, or even using the bright light that emanates from the indirect ophthalmoscope.

4. The Early Treatment for Retinopathy of Prematurity (ETROP) Study

ETROP also changed my clinical practice in significant ways. Infants with so-called type I disease (zone I with plus disease, or stage 3, or both; zone II with plus disease) are treated promptly (within 48 hours or so if stable). So-called type II eyes are those without plus or stage 3 in zone I, and those without plus disease in zone II. These eyes can be safely observed, often eliminating the need for treatment. I still use laser ablation in most cases,

but other data from the study are worth mentioning. The study confirmed that most cases that need treatment occur in the 35-week gestational age range. With infants who are at especially high risk for type I disease, I watch them more closely (at least 1/week) after they reach 32-33 weeks gestational age. The risk of myopia and strabismus is about the same with early treatment, so in my practice I follow these children regularly. The frequency of office visits varies according to the child's status. The rate at which ROP progresses from type I to "threshold" is less than a week. This indicates that the opportunity to get a benefit from early treatment is in the first few days after diagnosis.

5. The Pediatric Eye Disease Investigator Group (PEDIG) and Bevacizumab

PEDIG studied the effect of intravitreal Avastin (bevacizumab) on ROP. This study found an excellent result using bevacizumab, especially in posterior ROP disease. A Phase 1 trial, the study showed that lower concentrations of bevacizumab are effective, and that an adult dose, as might be used for macular degeneration, is not necessary.

6. Helen Hittner's Work on Bevacizumab

Dr. Hittner deserves credit for her seminal work on bevacizumab for the management of type I ROP. She showed definitively the effectiveness of this form of intervention. I now use bevacizumab for severe cases of posterior ROP, or for cases where laser has not worked. I am careful not to use the drug late in the course of the disease. Many eyes, in my experience, eventually require laser even though they have responded to bevacizumab. For that reason, I follow infants with regressed ROP post-bevacizumab at weekly intervals. This practice pattern also is the product of smaller individual center studies.

7. Other VEGF-Inhibitors

A number of small trials have shown that other VEGF-inhibitors are also effective in eliminating ROP. This has taught me that, in the event the pharmacy has a shortage of bevacizumab, other drugs will work.

8. Need for Further Study

Lastly, the absence of a clinical trial on the long-term effects of bevacizumab on the developing body of infants poses a problem. This is a time when such a study needs to be conducted.

How to Diagnose and Treat Optic Neuritis in 2021

Evidence-Based Workup and Treatment

Stacy L Pineles MD

- I. Newest Evidence to Support the Workup in a Child With Optic Neuritis
 - A. Pediatric Optic Neuritis Prospective Study
 - B. New information about biomarkers
 1. Neuromyelitis optica (NMO)
 2. Myelin oligodendrocyte glycoprotein (MOG)
- II. Pediatric Optic Neuritis Prospective Study (PON1)
 - A. Multicenter prospective data collection study run by the Pediatric Eye Disease Investigator Group (PEDIG) as a collaboration with the Neuro-Ophthalmology Research Disease Investigator Consortium (NORDIC)
 - B. 44 children enrolled over 22 months
 1. Followed for 2 years
 2. Visual acuity (VA) primary outcome
 3. Also analyzed lab results, MRIs, recurrences/relapses and new neurological diagnoses
 - C. First prospective study of VA outcomes in pediatric optic neuritis
 - D. Revealed that pediatric optic neuritis is commonly associated with neurologic syndromes
 - E. Revealed that MOG+ ON is very common in this cohort (54%)
 - F. Demonstrated marked improvement in distance VA in large majority of patients without much change between 6 months and 2 years. Twenty-four of 30 (80%) and 22 of 30 (73%) were in the normal range for high-contrast VA at 6 months and 2 years, respectively.
 - G. Loss to follow-up too large to comment on MRI predictability
 - H. Enrollment did not meet goal; a randomized trial with these inclusion criteria unlikely to be feasible

Table 1. Visual Acuity Results of Patients Enrolled in PON1

N = 30 Eyes	Enrollment	6 Months	2 Years
N (%) eyes within age-normal VA range	8 (27%)	24 (80%)	22 (73%)
Median (25th, 75th percentile)	20/100 (20/32 to 20/800)	20/20 (20/16 to 20/32)	20/20 (20/16 to 20/32)
N (%) eyes with <20/200 VA	13 (43%)	2 (7%)	2 (7%)
N (%) eyes with <20/800 VA	7 (23%)	1 (3%)	1 (3%)

Table 2. Final Neurologic Diagnosis at 2 Years for Patients in PON1

Neurologic Diagnosis at 2 Years	N
Isolated unilateral optic neuritis	9 (35%)
Isolated bilateral optic neuritis	3 (12%)
Acute disseminated encephalomyelitis (ADEM)	2 (8%)
Myelin oligodendrocyte glycoprotein (MOG)	6 (23%)
Multiple sclerosis	3 (12%)
Neuromyelitis optica spectrum disorder (NMOSD)	3 (12%)

III. MOG Findings in the PON1 Cohort

- A. MOG is a myelin protein on the outer surface of myelin sheaths.
- B. MOG+ disorder is thought to be a biomarker for CNS demyelinating disease that overlaps but is distinct from MS and neuromyelitis optica spectrum disorder (NMOSD).
- C. Patients in the PON1 study were asked to participate in a sub-study evaluating MOG antibodies sent to Mayo Clinic.
 - 1. 13 patients consented to have their serum tested.
 - 2. 54% positive (7/13)

Table 3. Results From MOG Antibody Testing in PON1

	MOG+	MOG-
Female	6/7 (86%)	3/6 (50%)
Bilateral	4/7 (57%)	2/6 (33%)
Presenting VA (median)	1.7 logMAR (~20/1000)	0.4 logMAR (20/50)
6 month VA (median)	0.1 logMAR (20/25)	0 logMAR (20/20)

IV. MOG+ Disease Recent Evidence From Other Studies

- A. Often found in patients diagnosed with ADEM, NMOSD, myelitis, optic neuritis
- B. Prospective study of 239 children with demyelinating syndrome (Armangue et al. *Lancet Neurology* 2020)
 - 1. MOG+ in ~50% of the children (only 5% of adult ON)
 - 2. 68% ADEM, 17% optic neuritis, 11% myelitis, 5% NMOSD
- C. Optic neuritis is a very common presentation (either isolated or as part of ADEM).
 - 1. Bilateral, ON edema
 - 2. MRI enhancement of optic nerve sheath and surrounding fat ("perineural enhancement") is fairly common and specific.
- D. Respond well to steroids generally
- E. Overall very good prognosis and visual recovery
- F. Relapsing cases may require immunotherapies (no RCTs yet). Intravenous immunoglobulin very frequently used, also azathioprine, mycophenolate mofetil, rituximab

V. NMOSD Recent Evidence

- A. Inflammatory CNS disorder characterized by severe immune-mediated demyelination and axonal damage predominately targeting the ON and spinal cord
- B. Disease-specific antibodies (anti-aquaporin-4, AQP4)
- C. Characteristic symptoms include acute bilateral optic neuritis and transverse myelitis (limb weakness, bladder dysfunction).
- D. Rarely can present similarly to MS with brain lesions too
- E. Suspect in cases of severe, unremitting, or relapsing optic neuritis
- F. Visual outcome typically worse
- G. Diagnosis matters because treatment is different! And MS treatment can worsen NMO!

Table 4. Possible Treatments for NMOSD

Immunotherapy	Acute Treatment	Chronic Treatment
Steroids	X	
Plasmapheresis	X	
Intravenous immunoglobulin	X (especially when plasmapheresis is not available)	
Azathioprine		X
Mycophenolate mofetil		X
Rituximab		X
Emerging treatments	Mechanism	
Eculizumab	<ul style="list-style-type: none"> • Anti-CD5 prevents complement cascade. • First FDA-approved treatment specifically for NMOSD. 	
Satralizumab	IL6 receptor antagonist blocks inflammation and blood–brain barrier permeability.	
Tocilizumab	IL6 receptor antagonist blocks inflammation and blood–brain barrier permeability.	
Aquaporin (preclinical)	Anti-AQP4 monoclonal antibody competes with AQP4.	

VI. Suggested Workup and Management in a Child Suspected of Having Optic Neuritis

A. MRI brain and orbits

1. Look for enhancement of the optic nerve(s)
 - a. Longer lesions more likely with NMO or MOG
 - b. Perineural enhancement more specific for MOG
2. Look for associated lesions (ADEM, MS, NMO)

B. Lumbar puncture

1. Evaluate for biomarkers of MS
2. Evaluate for evidence of infection

C. If suspicious at all for NMO, admit for steroids and plasmapheresis (or intravenous immunoglobulin if plex not available).

D. If not suspicious for NMO, most practitioners in PON1 still treated with IV steroids, although there is no definite consensus.

VII. My Personal Opinions, Not Universally Done

- A. I suggest sending MOG antibody in all cases of pediatric optic neuritis.
- B. I also send NMO in all cases given the importance of the diagnosis and ease of testing.
- C. I follow all patients approximately every 3 months after treatment with OCT and visual field.
- D. I repeat the MRI at 2 years (if not before).

Suggested Readings

1. Pineles SL, Repka MX, Liu GT, et al.; Writing Committee for the PEDIG. Assessment of pediatric optic neuritis visual acuity outcomes at 6 months. *JAMA Ophthalmol.* 2020; 138(12):1253-1261.
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4. Wingerchuk DM, Banwell B, Bennett JL, et al. International consensus diagnostic criteria for neuromyelitis optica spectrum disorders. *Neurology* 2015; 85(2):177-189.
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Section VI: Innovations in the OR— Surgical Pearls for Complex Strabismus

Moderators: Jeffrey S Hunter MD, David G Morrison MD

**Cynthia L Beauchamp MD, Natalie C Kerr MD, Federico G Velez MD,
David K Wallace MD, Mary C Whitman MD**

NOTES

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Faculty Financial Disclosures

Cynthia L Beauchamp MD

None

Gil Binenbaum MD

Luminopia: C,O
National Eye Institute: S
x Biomedical: O,P

Brenda L Bohnsack MD PhD

None

Erick D Bothun MD

None

James D Brandt MD

Adverum: C
Apple Computer, Inc.: O
Genentech: L
Glaukos Corp.: O
National Eye Institute: S
Santen, Inc.: S
THEA: C

Ta Chen Chang MD

None

Michael F Chiang MD

Genentech: S
Intelereitina: O
National Eye Institute: S
National Science Foundation: S
Novartis Pharmaceuticals Corp.: C

Linda R Dagi MD

None

Alejandra G de Alba Campomanes MD

ForesightVision6 (spouse): E,O
Longbridge (spouse): P,O

Beth Edmunds MD PhD

None

Mays A El-Dairi MD

None

Laura B Enyedi MD

Novartis: C

Sergul A Erzurum MD

None

Alexis M Flowers MD

Vanderbilt University Medical Center: P

Sharon F Freedman MD

Qlaris Bio: C

William V Good MD

None

Kathryn M Haider MD

None

Gena Heidary MD

National Eye Institute: S

Jonathan M Holmes MD

National Institutes of Health: S

G Baker Hubbard MD

National Eye Institute: S

Jeffrey S Hunter MD

None

Anne K Jensen MD

None

Natalie C Kerr MD

None

Eric Joseph Kim MD

None

Scott R Lambert MD

None

Katherine A Lee MD PhD

None

Phoebe D Lenhart MD

None

Irene H Ludwig MD

Thieme Medical Publishers: P

Justin D Marsh MD

None

Scott K McClatchey MD

None

David G Morrison MD

Regeneron Pharmaceuticals, Inc.: S

Christie L Morse MD

AAPOS EVP: S
OMIC: C

Stacy L Pineles MD

None

David A Plager MD

Ocular Therapeutix: S,O

Bibiana J Reiser MD

Bausch + Lomb: C,S
Ophtec: S

Michael X Repka MD MBA

Alcon Laboratories, Inc.: C
American Academy of Ophthalmology: S
Luminopia: C
National Eye Institute: S
Objective Acuity, Ltd: S

Veeral Shah MD

None

Evan Silverstein MD

Amblyopia Home, LLC: O
See Vision, LLC: O

Lois E H Smith MD PhD

None

Deborah K VanderVeen MD

National Eye Institute: S
Ocular Therapeutix: S
Ophtec: C,S
Traverse Therapeutics: S

Federico G Velez MD

Luminopia: S
Nevakar: C
Novartis: C

David K Wallace MD MPH

National Eye Institute: S

Mary C Whitman MD

None

M Edward Wilson Jr MD

Alcon Laboratories, Inc.: C

Kala Pharmaceuticals: C

Ocular Therapeutix: S

Traverse Therapeutics: S

Wolters Kluwer Health: P

Jason Yam FRCS(Ed) MBBS

None

Presenter Index

Beauchamp, Cynthia 47
Bohnsack, Brenda L 26
Bothun, Erick D 10
Brandt*, James D 22
Chang, Ta Chen 24, 27
Chiang*, Michael F 31
Dagi, Linda R 1
de Alba Campomanes*, Alejandra G 1, 6
Edmunds, Beth 28
El-Dairi, Mays A 21
Enyedi, Laura B 37
Flowers*, Alexis M 4
Freedman*, Sharon F 25
Good, William V 43
Haider, Kathryn M 39
Holmes*, Jonathan M
Hubbard*, G Baker 41
Jensen, Anne K 8
Kerr, Natalie 47
Kim, Eric Joseph 16
Lambert, Scott R 19
Lee, Katherine A 34
Lenhart, Phoebe D 15
Ludwig*, Irene H 1
Marsh, Justin D 32
McClatchey, Scott K 12
Morse*, Christie L 2
Pineles, Stacy L 44
Plager*, David A 30
Reiser*, Bibiana J 18
Repka*, Michael X 36
Shah, Veeral 33
Silverstein*, Evan 5
Smith, Lois E H 38
VanderVeen*, Deborah K 14, 20
Velez*, Federico G 47
Whitman, Mary C 47
Wilson*, M Edward, Jr. 11, 17
Yam, Jason 35