

Master Class: Myopia and Amblyopia

Kathryn M. Haider, MD
Indiana University



• I have no financial interests to disclose




Objectives

- Myopia
 - Review of recent Myopia Literature
- Amblyopia
 - Etiology
 - Treatment options
 - New outcome data
- Rare/exotic diagnosis
 - ROP, CVI, RB




Myopia




Myopia / Hyperopia

- Hyperopia
 - Under age 8
 - Amblyopia
- Myopia
 - “Rare” under age 3-5
 - ROP, IRD, MNFL, staphyloma
 - More commonly over age 8



Myopia: Increased Prevalence

- Rise of Myopia
 - Moderate myopia (-2 to -8) increased from 11% in 1971 to 22% in 2004
 - High myopia (> -8) increased 8-fold 0.2% to 1.6% (200 mil people worldwide)¹
- 2050 - Prevalence is predicted to increase to approximately 5 billion people by 2050 (~ half of the global population.)^{2,3}

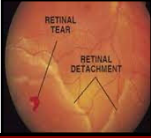
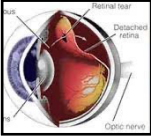


wikipedia


1. Holden et al 2015
2. Holden et al 2014
3. Holden et al 2016

"Pathologic" Myopia

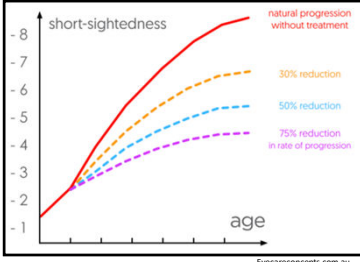
- Affects between 1-12% of patients¹⁻³
- Increased risk for:
 - Myopic maculopathy
 - Retinal detachment
 - Glaucoma
 - Cataract



Endmyopia

 SCHOOL OF MEDICINE

Early Interventions Slow Myopic Progression



short-sightedness

age


natural progression without treatment

30% reduction

50% reduction


75% reduction in rate of progression

Eyecareconcepts.com.au


 SCHOOL OF MEDICINE

Myopia Treatment Center

- Cost
 - 1,000\$ to 3,000\$ per year
- Not Covered by insurance




istockphoto.com

 SCHOOL OF MEDICINE

What Does NOT Work?

- **Undercorrection:**
 - Increases or has no effect on myopia progression¹⁻⁶.
 - It should no longer be advocated.
- **Pin hole glasses:** No Effect.
- **Blue light blocking glasses:** No Effect.
- **Bifocal glasses:**
 - Randomized, clinical trials in the US, Finland, and Denmark showed no significant slowing of myopia with bifocals alone⁷⁻¹⁰.

Wikipedia


AAPOS.org

SCHOOL OF MEDICINE

World Society of Paediatric Ophthalmology & Strabismus
Myopia Consensus Statement 2023

What Does NOT Work?

- **Progressive addition spectacles:**
 - Small benefit - statistically significant but not clinically meaningful¹
- **Peripheral plus/defocus correcting spectacles:**
 - Aspheric spectacle lens did not lead to a decrease in myopia progression or axial elongation²⁻⁴
 - Positively aspherized PALS do appear to work⁵
- **Day time single vision soft contact lenses/rigid gas permeable contact lenses:**
 - There was little or no effect⁶⁻¹³





Timetoshade

SCHOOL OF MEDICINE

World Society of Paediatric Ophthalmology & Strabismus
Myopia Consensus Statement 2023

What Appears to Work: Behavioral Interventions

- **Increased time spent outdoors:**
 - Effective in preventing onset of myopia¹⁻⁴
 - Mixed conclusion of slowing progression^{3,4}
 - 2 hours a day
- **Reduced time on Smartphones/Near Digital Devices/Near Tasks:**
 - The odds of myopia increased by 2% for every one diopter-hour of near work per week⁵.
 - A working distance of <20 cm⁶.
 - Smartphone use⁵.
 - Near task in dim light⁵

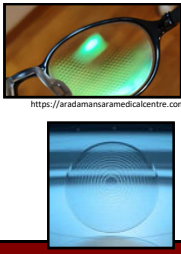



SCHOOL OF MEDICINE

World Society of Paediatric Ophthalmology & Strabismus
Myopia Consensus Statement 2023

What Appears to Work:
Glasses (not yet FDA approved)

- **Defocus-Incorporated Multisegment (D.I.M.S.) Spectacle lenses:**
 - This dual-focus spectacle lens - central distance optical zone, surrounded by an annular mid peripheral zone that includes multiple (396) small round segments with a +3.50¹
 - 50% Effect. Mid-peripheral blurred vision²
- **Highly Aspherical Lenslet (H.A.L.) Spectacle Lenses:**
 - Slightly aspherical lenslets (SAL)^{3,4}
 - Low contrast visual acuity and reading was slightly reduced

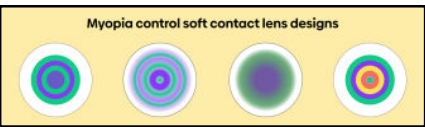


<https://aradamsaramedicalcentre.com>

SCHOOL OF MEDICINE World Society of Paediatric Ophthalmology & Strabismus Myopia Consensus Statement 2023 reviewofoptometry.com

What Appears to Work: Contact Lens

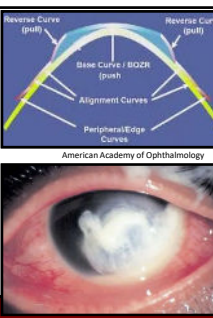
- **Soft Multifocal Contact Lenses:**
 - Center - distance with concentric rings as distinct zones of relative plus power
 - Lenses with a gradient design and increasing plus power toward the lens periphery.
 - 37% effect³⁻⁴. Accumulation Effect⁵.



SCHOOL OF MEDICINE World Society of Paediatric Ophthalmology & Strabismus Myopia Consensus Statement 2023 Mykiddvision.org

What Appears to Work:
Contact Lens

- **Orthokeratology:**
 - Overnight, reverse geometry hard lens.
 - Correction of myopia (up to -6 D sphere and -1.75 astigmatism)
 - Effect 50%. High drop-out rate in some studies.¹⁻²³ Relative decrease efficacy over time⁵ Rebound can occur.
 - Microbial keratitis (1.2 v 13/10,000) pigmented ring formation and altered corneal nerves²⁷⁻²⁸.



SCHOOL OF MEDICINE World Society of Paediatric Ophthalmology & Strabismus American Academy of Ophthalmology Myopia Consensus Statement 2023

What Appears to Work: Atropine Eye Drops

- Exact mechanism is unknown
- 1% atropine - 77% effective¹⁻⁵
- Atropine 0.5% (75%), 0.1% (70%), 0.01% (60%). Rebound greatest with higher doses. 5 year = 0.01% lowest progression = 50% effective
- Atropine 0.01% (27%), 0.025% (43%), and 0.05% (67%)⁶
- 10% may still respond poorly, even at higher doses.



<https://reviewofmm.com/harrows-compounded-atropine-now-available-through-imprimisrx/>



SCHOOL OF MEDICINE

World Society of Paediatric Ophthalmology & Strabismus
Myopia Consensus Statement 2023

Atropine Meta-analysis

- Optimal choice of management of myopia depends on treatment availability, acceptability to child and parents, and specific patient features such as age, baseline myopia, and lifestyle.



SCHOOL OF MEDICINE

Lanica, et al 2021

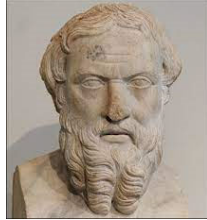
Amblyopia



SCHOOL OF MEDICINE

Definition of Amblyopia

- "Amblyopia" = Dullness of vision¹
 - Greek: 'ambly' – dull
 - Greek: 'ops' - vision
- 480 BC – Amblyopia²



Factsanddetails.com

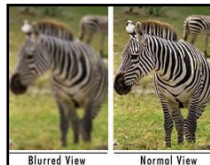


SCHOOL OF MEDICINE

1. Amblyopia
2. Loudon, et al 2005

Neurologic Condition

- Decreased vision in one or both eyes
 - Disruption in the visual experience of a child in the first decade of life
 - Affecting their brain development
- NOT REFRACTIVE



Blurred View Normal View
Aapos.org



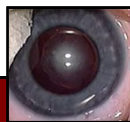
SCHOOL OF MEDICINE

Causes of Amblyopia

- Refractive error ~ 70%¹
 - Hyperopia / Astigmatism / Myopia
- Strabismus
 - Esotropia, Exotropia
- Trauma
- Exotic
 - RB/ ROP/ Cataracts / Glaucoma



Abckidseyes.com






SCHOOL OF MEDICINE


1. Repka 2020


Amblyopia Diagnosis

- Best glasses Rx are used
- High contrast letter/picture opto-type
 - Allen/HOTV/LEA
 - Snellen
- Young kids?
 - Forced preferential looking/ object to occlusion

	
ALLEN	HOTV

 SCHOOL OF MEDICINE



 SCHOOL OF MEDICINE

How to Treat Amblyopia

1. Glasses
2. Occlusion (1742 - Occlusion therapy¹)
 1. Patching
 2. Bangerter foil
3. Atropine 1%
4. Dichoptic/binocular
5. Acupuncture



Wikipedia.com

 SCHOOL OF MEDICINE 1. Loudon 2005

American Academy of Ophthalmology Preferred Practice Patterns

TABLE 3. GUIDELINES FOR REFRACTIVE CORRECTION IN INFANTS AND YOUNG CHILDREN

Condition	Refractive Errors (diopters)			
	Age <1 year	Age 1 to <2 years	Age 2 to <3 years	Age 3 to <4 years
Isoametropia (similar refractive error in both eyes)				
Myopia	5.00 or more	4.00 or more	3.00 or more	2.50 or more
Hyperopia (no manifest deviation)	6.00 or more	5.00 or more	4.50 or more	3.50 or more
Hyperopia with esotropia	2.00 or more	2.00 or more	1.50 or more	1.50 or more
Astigmatism	3.00 or more	2.50 or more	2.00 or more	1.50 or more
Anisometropia (without strabismus)*				
Myopia	4.00 or more	3.00 or more	3.00 or more	2.50 or more
Hyperopia	2.50 or more	2.00 or more	1.50 or more	1.50 or more
Astigmatism	2.50 or more	2.00 or more	2.00 or more	1.50 or more


NOTE: These values were generated by consensus and are based solely on professional experience and clinical impressions because there are no scientifically rigorous published data for guidance. The exact values are unknown and may differ among age groups; they are presented as general guidelines that should be tailored to the individual child. Specific guidelines for older children are not provided because refractive correction is determined by the severity of the refractive error, visual acuity, and visual symptoms.


Wallace et al 2018

Glasses: Common Sense Guidelines

IMHO: kids need an “ah-ha” moment to wear glasses

Ideally, they should help



 **SCHOOL OF MEDICINE**

Occlusion Therapy

- Patching
 - Part time patching
 - Mild amblyopia: 2-4 hours a day
 - Severe amblyopia: 6-8 hours a day
 - Full-time patching (1 week/year of age)
- Bangerter foil
 - Different filters for different severity
- Remember: KID WILL CHEAT!!




 **SCHOOL OF MEDICINE**

Atropine 1%

- Equal Efficacy to Patching in National Studies
- 2-7 days a week
- Atropine 2 days a week is roughly equivalent to patching 2 hours a day
- Toddlers
- Aggressive: Plano/Atropine



New Kid on the Block – Dichoptic therapy



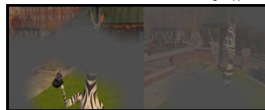
People.com

Dichoptic therapy

- Simultaneous and separate stimulation of both eyes
- Contrast for the good eye is reduced
- Video game tasks can only be solved binocularly
- Movies can be completely viewed binocularly



Digitalispy.com



Sciencedirect.com


2010 - Dichoptic game improves vision and binocularity¹
BORING!!!




 SCHOOL OF MEDICINE CBC.ca 1. Hess 2010


Movies! Movies! Movies!

- 2015 – 2020 Positive results both in-lab and at-home
 - In lab: 1-2 lines of improvement in 2 weeks^{1,2}
 - At home: 1-2 lines of improvement in 12 weeks^{3,4}
- Limitations:
 - Size, weight make head-mounted display awkward
 - Visual isolation
 - Hard to check compliance
 - No access to the public!



EurekaAlert.org



 SCHOOL OF MEDICINE 1. Li et al 2015
2. Birch et al 2019
3. Xiao et al 2021
4. Xiao et al 2022

**Dichoptic therapy –
FDA Approval 2023**



- Equivalent to Patching!
- Expense?




 SCHOOL OF MEDICINE Lumanopia

Unanswered Questions?

- Device without glasses?
- Sub-population of kids this is more/less effective?
- Does more time = faster improvement?
- More months = more improvement?
- Cons? (3 movies/week)
- Is there regression after stopping the movies?
- Do we change to treating strabismus before amblyopia?





 SCHOOL OF MEDICINE

Outcomes

Review of Clinical Trials

- 1,760,066 Amblyopic patients identified¹
- Prevalence 2.5%. Clinical Success 83%
- Mean amblyopic eye visual acuity improved
 - 1.8 lines for kid 3-6 years of age
 - 0.8 lines for kids 7-12 years
 - Residual amblyopia >2 lines
- Reducing hours of patching/frequency of atropine
- There is no appreciable age effect if treatment is started before 5 years of age




 SCHOOL OF MEDICINE 1. Repka 2020


Outcomes

Iris Registry


- New patients 3 to 12 years of age. 2013-2019
- “Treatment success” at 3-12 months:
 - Corrected interocular visual acuity difference of less than 2 lines
 - Improvement in the visual acuity of 3 + lines
 - Final visual acuity in the amblyopic eye of 20/30 or better




HealthyChildrens.org

 SCHOOL OF MEDICINE Repka and Li 2023


**Treatment Success:
Gender and Race
Age 3-7**




- 18,841 kids - 77.3% successful treatment
 - Girls: Boys - OR for success was 1.01 (95% CI, 0.94 - 1.08) Aapost.org
 - **Black: White - OR for success was 0.71 (95% CI, 0.62- 0.83; P = 0.01)**
 - Hispanic/Latino: White - OR was 0.93 (95% CI, 0.83-1.04)
 - Asian: White - OR was 0.97 (95% CI, 0.77-1.23)

 SCHOOL OF MEDICINE Repka and Li 2023

**Treatment Success:
Gender and Race
Age 8-12**




- 9,762 kids - 55.5% successful treatment
 - Girls: Boys - OR for success was 1.05 (95% CI, 0.97 - 1.14)
 - **Black: White - OR for success was 0.81 (95% CI, 0.68 0- 0.96; P = 0.01)**
 - Hispanic/Latino - OR was 1.16 (95% CI, 1.03 - 1.31; P = 0.01)
 - Asian children - OR was 1.28 (95% CI, 0.97 - 1.67)


 SCHOOL OF MEDICINE Repka and Li 2023

**Treatment Success:
Insurance**

Age 3-7	Age 8-12
---------	----------




<ul style="list-style-type: none"> • Medicaid: OR was 0.65 – (95% CI, 0.60 - 0.71; P < 0.01) • Medicare was 0.74 – (95% CI, 0.53 - 1.02) • Military coverage was 0.91 – (95% CI, 0.68 - 1.23) 	<ul style="list-style-type: none"> • Medicaid was 0.84 – (95% CI, 0.77 - 0.93; P < 0.01) • Medicare was 0.80 – (95% CI, 0.56 - 1.14) • Military coverage was 1.02 – (95% CI, 0.75 - 1.40)
--	--

 SCHOOL OF MEDICINE Repka and Li 2023

Why are Outcomes so Important?

- Reduced vision one or both eyes
- Slowed binocular reading speed
- Decreased motion detection
- Reduced self-perception
 - Peer acceptance
 - Physical competence
 - Persist AFTER “corrected”




Healthline.com

Ψ SCHOOL OF MEDICINE

Repka and Li 2023

Screening Efforts Have Decreased

- Vision Screening steadily declined from 2016 -2020 (70% to 60% $P < 0.001$)³
- Of those screened, there was a decrease in % screened by a specialist (56% to 50%. $P < 0.001$)¹



Welch Allen Plus Optix Chauhan et al 2023

Ψ

Discrepancy in Health Care = Problem!


- Poorer outcomes for Black children and those with Medicaid
- Need to develop and test strategies to improve treatment outcomes
 - Socioeconomic factors
 - Cultural factors
 - Access to eyeglasses/eyeglasses replacements/Treatment
 - Unconscious physician bias
 - Education




Ψ SCHOOL OF MEDICINE

Repka and Li 2023

Questions about amblyopia?




Women's Health

 SCHOOL OF MEDICINE

Rapid Fire Segment



Retinopathy of Prematurity

 SCHOOL OF MEDICINE

ROP - ICROP 3

- International Classification of ROP (1984, 2005, 2021)
- Reasons:
 - Subjective elements of classification
 - Innovations in imaging
 - Novel pharmacologic therapies
 - Recognition of pattern in other regions of the world

SCHOOL OF MEDICINE

Subjective Classification

- Posterior zone II
 - Begins at the margin between zone I and zone II and extends into zone II for 2 disc diameters

SCHOOL OF MEDICINE
ICROP 3


Notch


- An incursion by the ROP lesion of 1–2 clock hours into a more posterior zone.
- e.g., “zone I secondary to notch”

SCHOOL OF MEDICINE
ICROP 3

Aggressive ROP

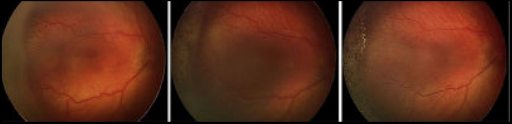
- Previously
 - Aggressive-Posterior ROP (AP-ROP)
- NOW
 - Changes to include areas beyond the posterior retina
 - Larger preterm infants
 - Regions of the world with limited resources (Third Epidemic)




 SCHOOL OF MEDICINE ICROP 3

Regression

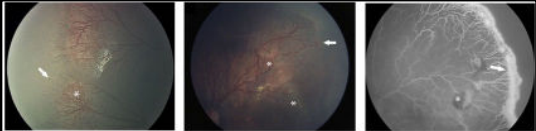
- Regression can be complete or incomplete.
- Location and extent of peripheral avascular retina (PAR) should be documented.




 SCHOOL OF MEDICINE ICROP 3

Reactivation

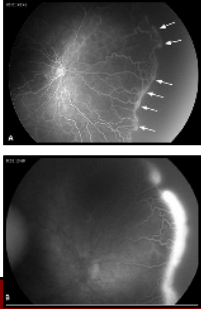
- ROP reactivation after treatment
 - New ROP lesions and vascular changes.
 - The modifier reactivated (e.g., "reactivated stage 2") is recommended




 SCHOOL OF MEDICINE ICROP 3


Long-Term Sequelae

- Long-Term Sequelae.
 - Late retinal detachments
 - PAR
 - Macular anomalies
 - Retinal vascular changes
 - Glaucoma




 SCHOOL OF MEDICINE Atlas 2011

CVI – Cortical Visual Impairment

 SCHOOL OF MEDICINE


CVI – Cortical Visual Impairment

- CVI is a leading cause of vision loss in US Children
 - NOT from problems with the EYE
- Associated co-morbidities
 - HIE, Prematurity, IVH, Genetic/neurologic conditions
- Can get better with time
 - Early intervention/therapy = Key
 - Educational support


 SCHOOL OF MEDICINE

Retinoblastoma

- Incidence on the rise
 - From 1/15,000 to 1/14,000 (Europe)
- Success rates increasing
 - Survival rate of 90%

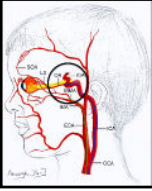


Ejwrl.Laao.org


 SCHOOL OF MEDICINE AAO.org

IAC: Intra-arterial Chemotherapy

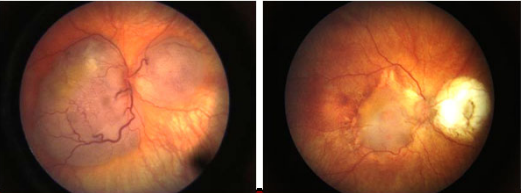
- Started 1998
- More effective with Group D/E eyes compared to systemic chemo
- Reduced overall treatment duration and less side effects compared with systemic chemo




Fairouz et al 2019

 SCHOOL OF MEDICINE

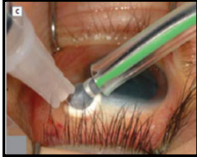
Before IAC..... and After




 SCHOOL OF MEDICINE

Intravitreal Chemotherapy

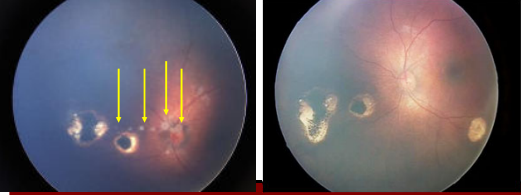
- Topotecan/Melphalan
- Extreme care
 - Avoid touching tumor
 - Freeze-thaw treatment




AAO.org

 SCHOOL OF MEDICINE

Vitreous seeds before and after intravitreal injections of topotecan



 SCHOOL OF MEDICINE

Any Questions from the Audience?

