Update on PEDS Research in Treatment and Prescribing

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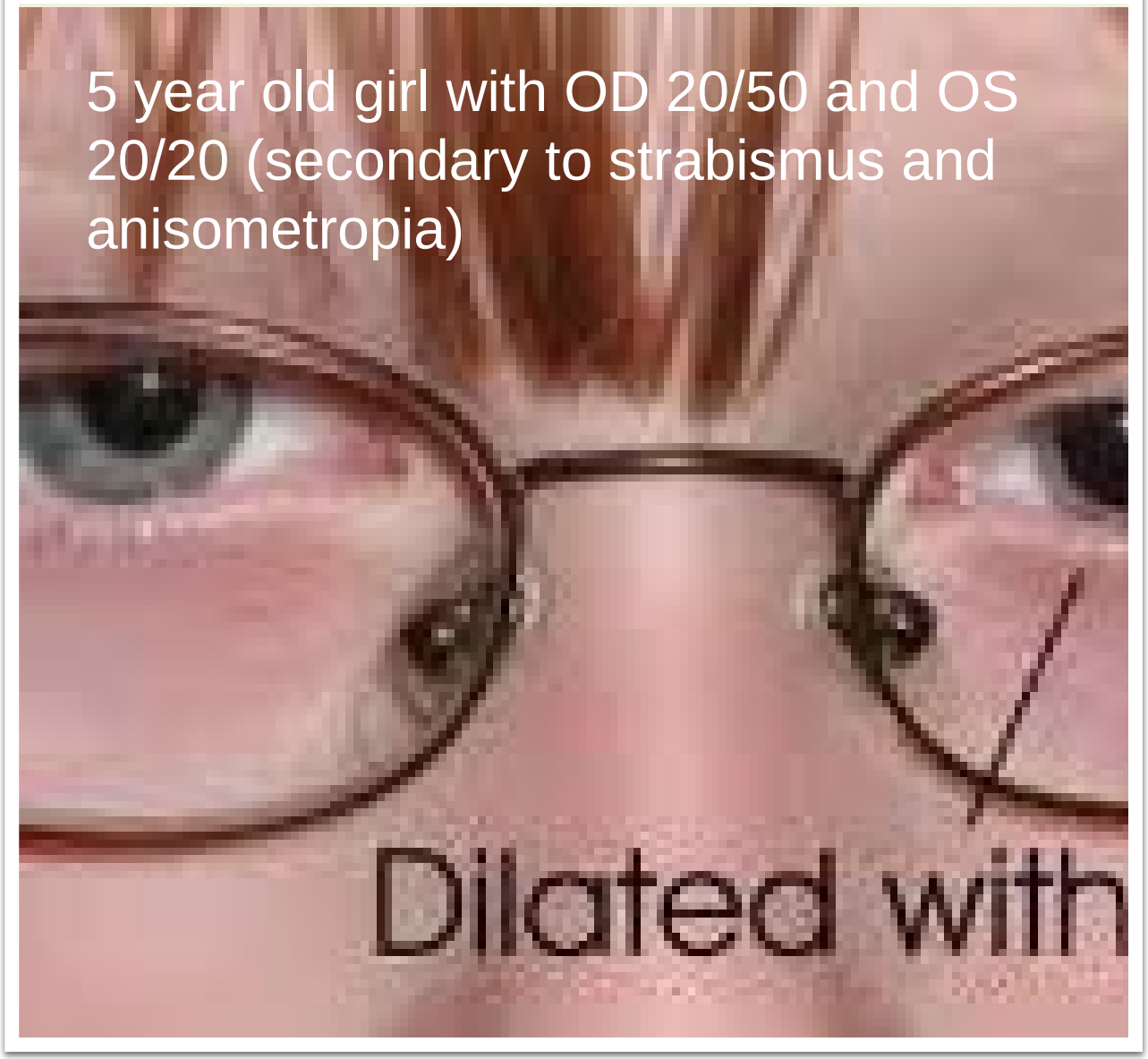
Appropriate treatment is

A. Spectacles alone
B. Spectacles and atropine
C. Spectacles and patching



How much patching?

A. 2 hours per day
B. 6 hours per day
C. Full day

4 year old, VA OD 20/200 (secondary to anisometropia)

How manage amblyopia?

A. Spectacles alone
B. Spectacles and patching
C. Spectacles and atropine

12 year old boy with 20/100 VA (secondary to anisometropia)

How manage amblyopia?

A. Spectacles alone
B. Spectacles and patching
C. Spectacles and atropine

15 year old boy with 20/100 VA

EVIDENCE-BASED?

Amblyopia

Strabismus

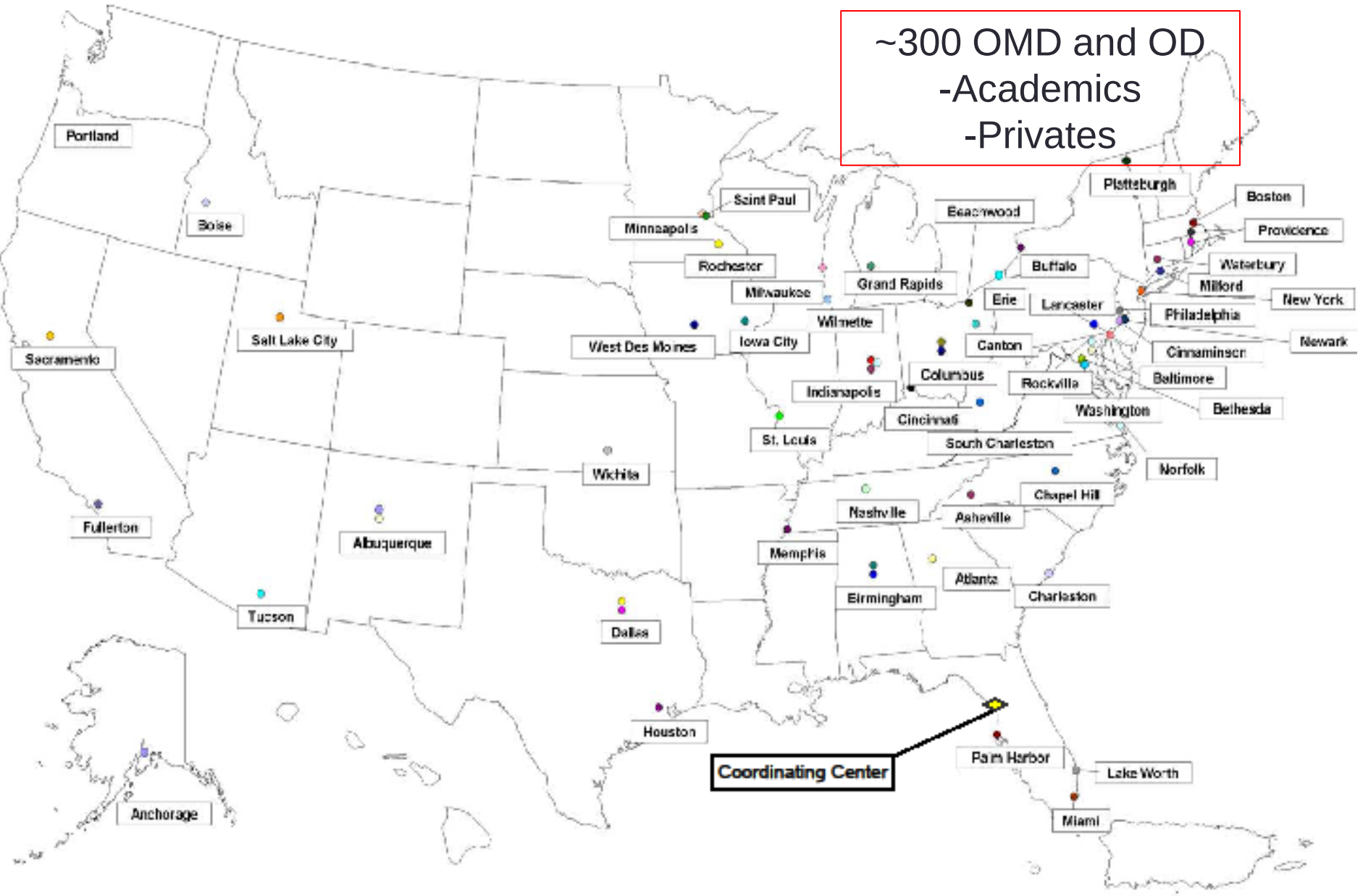
Refractive errors (anisometropia, meridional, high bilateral)

ATS (AMBLYOPIA TREATMENT STUDY) ---ANISOMETROPIA/STRABISMUS

Pediatric Eye Disease Investigator Group (PEDIG)

PEDIG Clinical Sites

~300 OMD and OD
-Academics
-Privates



ATS1

- **A Randomized Trial of Atropine vs Patching for Treatment of Moderate Amblyopia in Children**

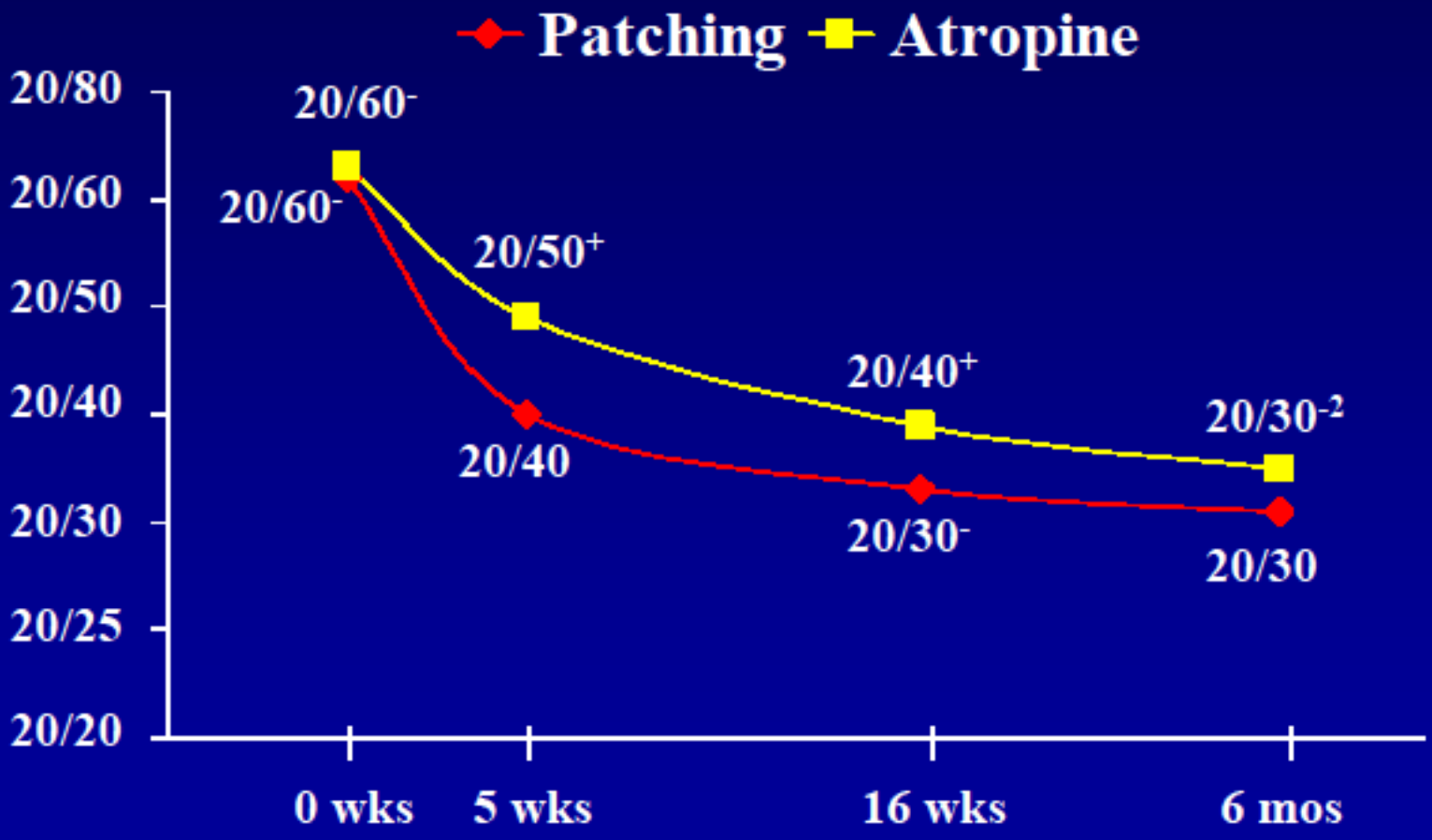
1 drop daily

6 hours daily patching

- 3 - 7 year olds
- Strabismus, Anisometropia, or both
- 20/40 to 20/100
- 3 or more lines difference

PEDIG. Arch Ophthalmol. 2002;120(3):268-278.

ATS1 - Amblyopic Eye Mean Acuity at Each Visit



Daily Atropine vs. Weekend Atropine for Moderate Amblyopia

- 168 3 to < 7 yo
- Daily atropine
- Weekend only
- 4 months
- Outcome
  - At least 20/25
  - At least 3 lines improvement
  - 47% daily
  - 53% weekend

- Weekend atropine improvement in VA similar to daily atropine

WHAT IS THE EFFECTIVENESS OF SPECTACLES ALONE?

When patient presents with anisometropia or strabismus and anisometropia, and requires both spectacle correction and penalization therapy, should I do one first or do both at the same time?

Optical Treatment of Strabismic and Combined Strabismic–Anisometropic Amblyopia

Ophthalmology. January 2012

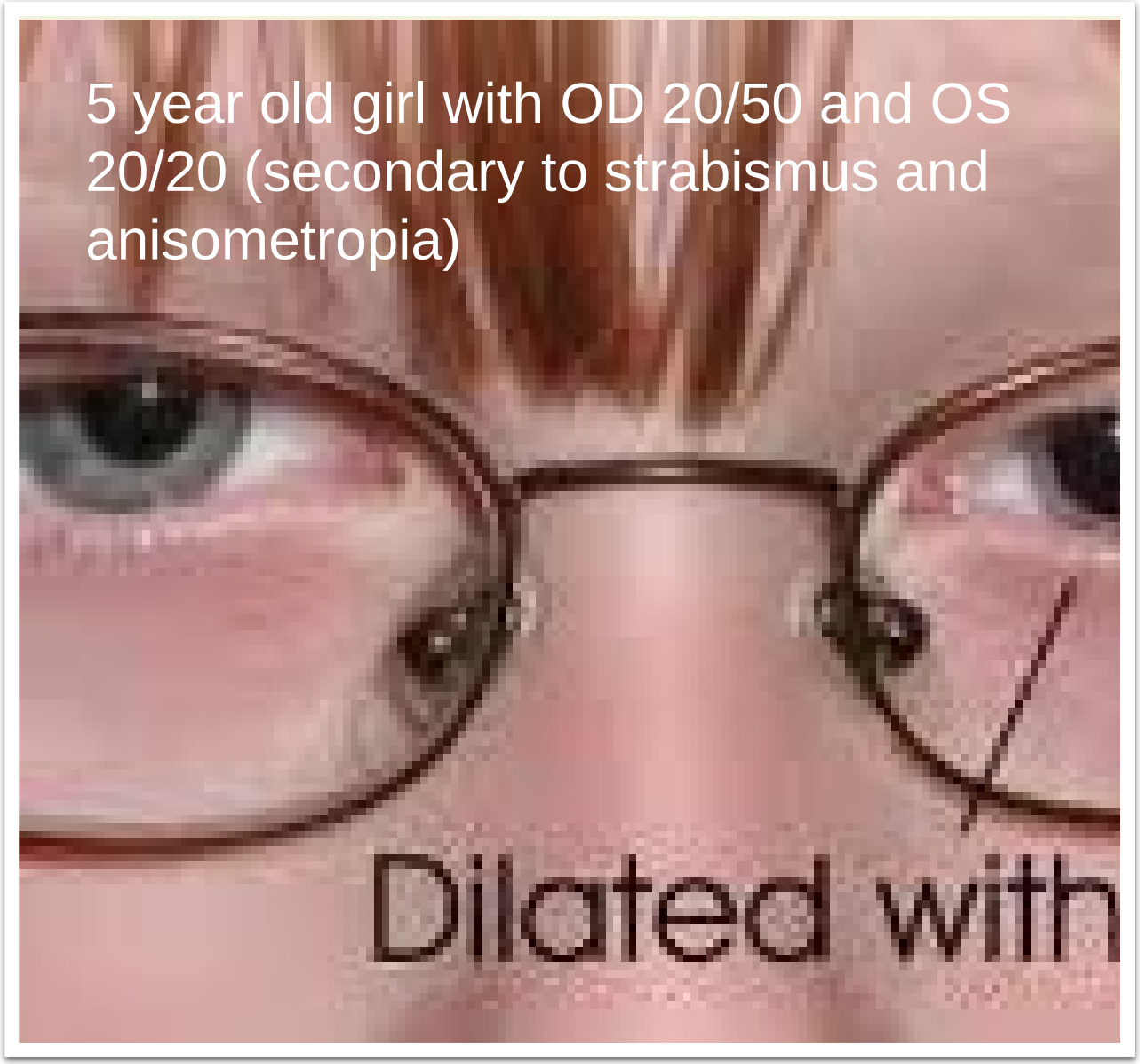
Volume 119, Issue 1 , Pages 150-158.

- To determine VA with spectacles alone
- 146 total, 3 to < 7 years old
- VAs 20/40 to 20/100
- After 18 weeks
  - mean 2.6 lines improvement
- Optical treatment alone
  - >1/4 amblyopia resolved

Appropriate treatment is

A. Spectacles alone
B. Spectacles and atropine
C. Spectacles and patching

A. Spectacles alone



ARE SPECTACLES ALONE A POWERFUL TREATMENT FOR AMBLYOPIA?

Yes

When there is no further improvement in acuities from spectacle correction, is patching effective?

A Randomized Trial to Evaluate Two Hours of Daily Patching for Amblyopia in Children 3 to <7 years old

Ophthalmology. 2006 June; 113(6): 904–912

- Compare 2 hours daily patching with spectacles alone
- 3 to <7 years, 84 total
- 20/40 – 20/400
- (1) Rx worn at least 16 weeks (up to 30) until acuities stabilized
  - 1/3 resolved
- (2) After 5 weeks
  - 2.2 lines improvement for patch
  - 1.3 lines for control
- Modest improvement in VA
  - More for severe amblyopia (20/125-20/400)

PATCHING IS SUPERIOR TO SPECTACLES ALONE

Yes

Amblyopia resolved in at least 1/3 of anisometropes.

2 hours of patching daily showed improvement (esp. in severe amblyopes)

A randomized trial of patching regimens for treatment of moderate amblyopia in children

PEDIG. Arch Ophthalmol. 2003 May;121(5):603-11

- Compare 2 hours vs 6 hours of daily patching
- 3 to <7 year old
- 20/40 -20/80, 189 total
- After 4 months
  - Avg 2.4 lines improvement in both groups
  - 62% at least 20/32 or improved 3 or more lines
- Conclude: 2 hours produces improvement in VA similar to 6 hours of patching in moderate amblyopia aged 3 to < 7 years

A randomized trial of prescribed patching regimens for treatment of severe amblyopia in children.

Ophthalmology. 2003 Nov;110(11):2075-87

- Compare full-time patching to 6 hours daily
- 3 to < 7 years
- 20/100 – 20/400
- After 4 months
  - Avg 4.8 lines improvement for 6 hrs
  - Avg 4.7 lines improvement for FT
- Conclude: 6 hours daily patching improves VA similar to full-time for severe amblyopia in children aged 3 to < 7 years

How much patching?

A. 2 hours per day
B. 6 hours per day
C. Full day

4 year old, VA OD 20/200

Answer: B

PATCHING TIME DEPENDS ON…

- For moderate amblyopia (20/40-20/100)
  2 hours as effective as 6 hours

- For severe amblyopia (20/125-20/400)
  6 hours as effective as FT

What about age?

IS IT TOO LATE TO TREAT AMBLYOPIA?

Is there an age when a patient presents and the doctor says it is too late to treat the amblyopia?

A prospective, pilot study of treatment of amblyopia in children 10 to <18 years old.

PEDIG. Am J Ophthalmol. 2004 Mar;137(3):581-3

- Can amblyopia be treated successfully in older children?
- 20/40 – 20/160, 66 patients
- Patching 2 hours or more
- After 2 months
  - 27% improved 2 or more lines
    - similar for all ages

Randomized trial of treatment of amblyopia in children aged 7 to 17 years

Arch Ophthalmol 2005 Apr;123(4):437-47

- 507 patients, 20/40 – 20/400
- Indicated whether had previous treatment
- Randomized
  - 2-6 hrs of patching and atropine
  - or spectacles alone
- >1/4 patients improved acuities with optical correction alone
- For all patching and atropine improves VAs if not previously treated
  - 7-12 yo improved even if previously treated
  - 13-17yo little benefit if previously treated

EFFECT OF AGE ON RESPONSE TO AMBLYOPIA TREATMENT IN CHILDREN

Meta-analysis of individual subject data from 4 recently completed randomized amblyopia treatment trials

Arch Ophthalmol. 2011 November; 129(11): 1451–1457.

- 3 to <13 yo
- 20/40 – 20/400
- 3 to < 7 yo more responsive than 7 to <13 yo
- For severe amblyopia
  - 3 to < 5 yo more responsive than 5 to < 7 yo

How manage amblyopia?

A. Spectacles alone
B. Spectacles and patching
C. Spectacles and atropine

Ans B or C

Not dependent on previous treatment

--patch for 6 hrs/day

--atropine weekends only

12 year old boy with 20/100 VA

How manage amblyopia?

A. Spectacles alone
B. Spectacles and patching
C. Spectacles and atropine

Ans B or C
If not previously treated
--patch for 6hrs/day
--atropine weekends only

Ans A and active therapy
If previously treated

15 year old boy with 20/100 VA

IS PERFORMING NEAR ACTIVITIES NECESSARY?

In all studies with patching or atropine, patients were instructed to do at least one hour of near activities.

Near activities

- Arts & crafts
- Blocks/marbles/dominoes
- Board games/ puzzles/card games
- Cars up close
- Computer/video game
- Counting up close
- Dolls/action figures up close
- Homework
- Lite Brite
- Playing with toys up close
- Sorting/stringing beads
- Stacking coins
- Tying shoes
- Writing/reading/activity books

Distance activities

- Active/physical games
- Chores
- Counting at distance
- Dolls/action figures at a distance
- Dressing
- Errands/car rides
- General indoor play
- General outdoor play
- Indoor events / locations
- Make-believe games
- Outdoor events/locations
- Playing
- Playing ball
- Remote control toys
- Riding bike
- Television
- Visiting/playing with friends/family

A randomized trial of near versus distance activities while patching for amblyopia in children aged 3 to less than 7 years

PEDIG. Ophthalmology 2008;115(11):2071-8

- 2 hr patching with near or distance activities
- 20/40 – 20/400 (after spec)
- 3 to < 7yo, 425 total
- After 8 weeks
  - 2.6 lines in distance group
  - 2.5 lines in near groups
- Similar VA outcome
- Severe amblyopes (20/125-20/400)
  - greater improvement with near activities

RECURRENCE?

Patient has been successfully treated for the amblyopia, what is the expected recurrence?

Risk of amblyopia recurrence after cessation of treatment

J AAPOS. 2004 Oct;8(5):420-8

- 2 hr patching or atropine
- 3 - < 8 years, 156 total
- Followed for 52 weeks
  - reduction of 2 or more lines
- Overall 24% recurrence both groups
  - Patching (25%)
  - Atropine (21%)
- Higher recurrence (42%) for severe amblyopia group
  - if not reduced (for 6-8hr patch)
  - 14% only if reduced to 2 hr prior to cessation

TAPER AND F/U

About ¼ of 3-7 yo regress in one year (patching and atropine)

--7-12 yo 7% after 1 year

Taper patching (4x less likely) especially for severe amblyopes

Continue to monitor patients

Your 5 year-old patient's vision improved from 20/200 to 20/60 after 3 months of patching, 6 hours daily. What should you do next?

A. Stop treatment

B. Reduce patching to 2 hours per day

C. Continue patching of 6 hours per day

D. Continue patching of 6 hours per day and add daily atropine

IT IS NOT TOO LATE TO TREAT AMBLYOPIA, BUT AGE DOES MATTER

- Older children(10-17yo) can still be treated and improve in visual acuity with optical correction alone
- Younger patients (3–7 yo) are more responsive to treatment
- Patching and atropine is effective in older children particularly if they have not previously been treated

How manage?

A. Prescribe full Rx
B. Prescribe partial Rx
C. Return in 3 months

6 month old, InfantSEE exam
Mohindra Retinoscopy +6.00-0.75x180 OU
No strabismus
+Alternation on vertical prism

REFRACTIVE ERRORS

Hyperopia

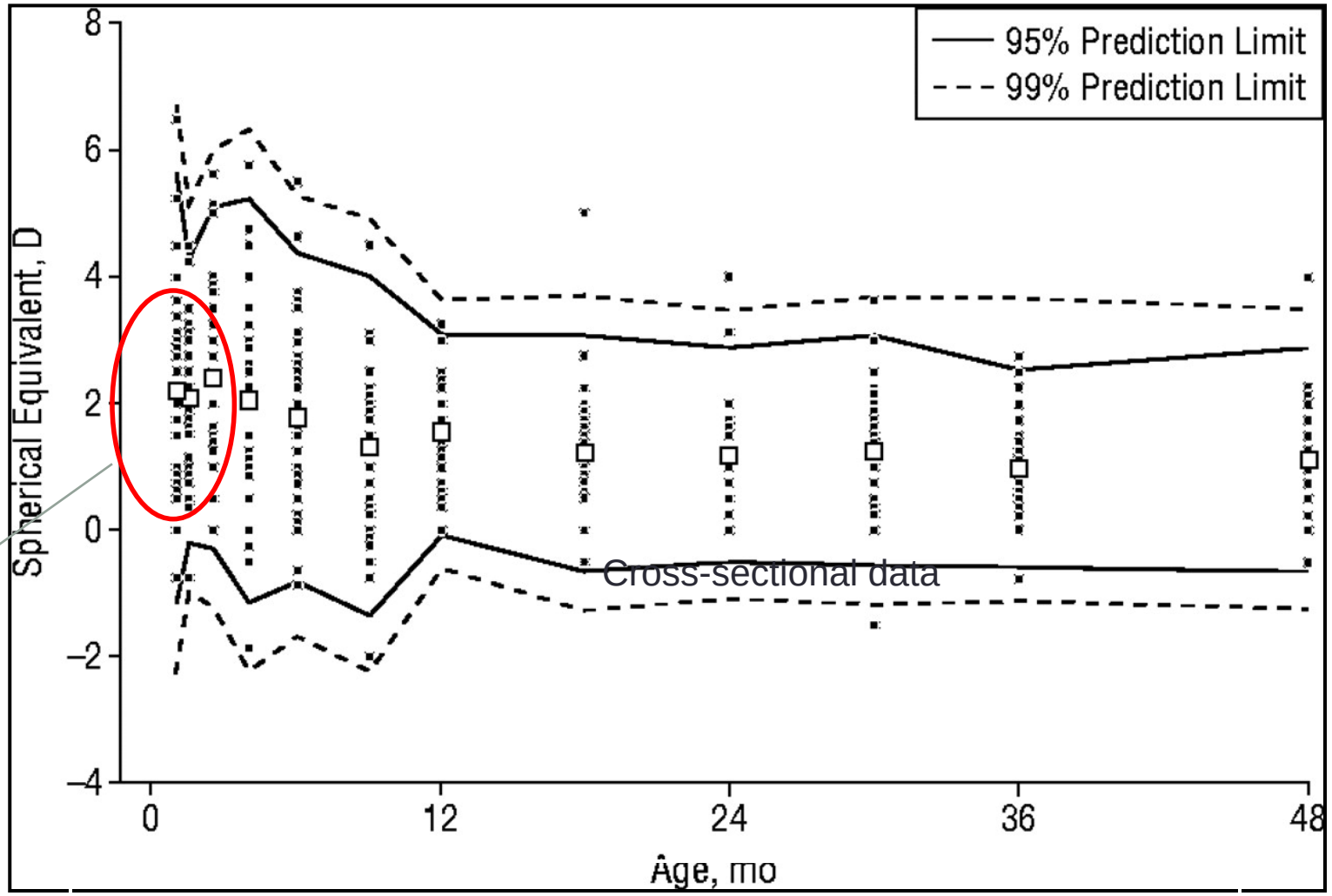
Astigmatism

Myopia

Refractive Normal Limits: Birth to 48 mo

Spherical equivalent of the right eye in 514 subjects in 12 age groups

Mean RE +2.00 at birth



Mayer, DL et al. *Arch Ophthalmol* 2001;119:1625-1628

Normal Limits of Refractive Error in Children

- Upper normal limits for hyperopia
  - 12 mo-4 yrs: <+3.00 D
  - Child: <+2.00 D
  - Adolescent: ≤+1.50 D

Marsh-Tootle in Benjamin WJ. Borish's Clinical Refraction 2009
Chapter 30: Infants, Toddlers, & Children

- Until recently, no population-based studies; now have MEPEDS/BPEDS in US

MEPEDS/BPEDS

Multi-Ethnic Pediatric Eye Disease Study

Baltimore Pediatric Eye Disease Study

Cross-sectional population-based study

- 12,000, 6-72 months old

Mean Refractive Error: MEPEDS

African-American Age (n)	Spherical Equivalent Mean diopters (SD)	
	Right Eye	Left Eye
6 to 11 mo (277)	0.6 (1.4)	0.7 (1.5)
12 to 23 mo (549)	0.7 (1.3)	0.8 (1.4)
24 to 35 mo (542)	0.9 (1.3)	1.0 (1.3)
36 to 47 mo (532)	1.1 (1.4)	1.1 (1.6)
48 to 59 mo (549)	1.2 (1.6)	1.2 (1.7)
60 to 72 mo (543)	1.1 (1.3)	1.1 (1.4)
Total (2992)	**1.0 (1.4)**	**1.0 (1.5)**

Hispanic Age (n)	Spherical Equivalent Mean diopters (SD)	
	Right Eye	Left Eye
6 to 11 mo (293)	1.3 (1.4)	1.3 (1.5)
12 to 23 mo (536)	1.0 (1.5)	1.1 (1.5)
24 to 35 mo (565)	1.1 (1.4)	1.1 (1.5)
36 to 47 mo (527)	1.3 (1.4)	1.4 (1.4)
48 to 59 mo (539)	1.4 (1.3)	1.4 (1.4)
60 to 72 mo (540)	1.3 (1.2)	1.4 (1.3)
Total (3000)	**1.2 (1.4)**	**1.3 (1.4)**

MEPEDS. *Ophthalmology* 2011 Aug

What Magnitude of SE Hyperopia Increases Odds of Having ET?

a. +1.00 D
b. +2.00 D
c. +3.00 D
d. +4.00 D

Risk of Esotropia Associated with Bilateral Hyperopia

MEPEDS/BPEDS: 9970 AA, Hispanic, White Children 6-72 months		
Bilateral SE Hyperopia	**Odds Ratio***	**95% CI**
0.0 to <+1.00 D	reference	------
<0.00 (myopia)	2.48	0.89 – 6.91
+1.00 to <+2.00 D	1.81	0.71 – 4.62
+2.00 to <+3.00 D	**6.38**	**2.56 – 15.93**
+3.00 to <+4.00 D	**23.06**	**9.65 – 55.61**
+4.00 to <+5.00 D	**59.81**	**23.61 – 151.52**
≥ +5.00 D	**122.24**	**49.86 – 299.70**

†Based on multivariate stepwise logistic regression model; adjusted for age, anisometropia, maternal smoking, gestational age.
*Significant Odds Ratio's (OR) in bold. * Level of hyperopia defined by less hyperopic eye.

Cotter et al. Ophthalmology 2011

What Magnitude of Bilateral SE Hyperopia Increases Odds of Isoametropic Amblyopia?

a. +2.00 D
b. +3.00 D
c. +4.00 D
d. +5.00 D

Risk of Bilateral Decreased VA Associated with Hyperopia

MEPEDS/BPEDS: 5704 AA, Hispanic, White Children 30-72 months		
Bilateral SE Hyperopia	**Odds Ratio***	**95% CI**
<0.0 D	1.37	0.63 – 2.99
0.0 to <+1.0 D (reference)	1.0	---------
+1.0 to <+2.0 D	0.37	0.13 – 1.02
+2.0 to <+3.0 D	1.02	0.36 – 2.85
+3.0 to <+4.0 D	1.64	0.51 – 5.24
≥+4.0 D	**11.45**	**5.01 – 26.18**

Adjusted for age, astigmatism, gestational age.
*Significant Odds Ratio's in bold. Level of hyperopia defined by least hyperopic eye.

Cotter, MEPEDS/BPEDS 2010

Risk of Decreased Unilateral VA* Associated with Anisometropia

MEPEDS/BPEDS 5704 AA, Hispanic, & White Children 30-72 months		
Risk factor: SE Anisometropia	**Odds Ratio****	**95% CI**
<0.5 D (reference)	1.0	---------
0.5 to <1.0 D	**1.45**	**1.03 – 2.05**
1.0 to <2.0 D	**4.51**	**2.76 – 7.36**
≥2.0 D	**39.04**	**19.24 – 79.21**

**** IOD of ≥2 lines with 20/32 or worse in worse eye***

**Odds ratios that are bolded are significant.

•Adjusted for strabismus, age, and school attendance

•Unilateral decreased VA = 2-line IOD in best-corrected VA

Cotter, MEPEDS/BPEDS 2010

MPEDS APPLICATIONS

- Low amounts of hyperopia puts patients at risk for esotropia (+2 D OU)
- Small amounts of anisometropia (1 D) is a risk for amblyopia, as is moderate hyperopia (>4 D)

OTHER PERTINENT CLINICAL FINDINGS FOR HYPEROPIC CHILDREN

Other tests

- History
  - Signs & symptoms, academic performance
    - Tired eyes, blinking, blurred vision, aversion to near work
  - Family history, patient ocular/medical hx, meds
    - CP or Down Syndrome, medications affecting accommodation

Nonstrabismic

- Visual acuity

- Accommodation
- Phoria direction & magnitude
- Compensating vergence ability

- Potential behavioral & performance effects at near if not corrected

Effect of Spectacle Correction on Preschoolers' Cognitive Abilities

- Low-income children 3-5 yrs
- Previously uncorrected ametropia (n=35)
  - Bilateral hyperopia of ≥ +4.00D
  - Astigmatism ≥2D if 3yrs, ≥1.50 if 4-5 yrs
- Emmetropia (n=35):
  - <2D of bilateral hyperopia; <1D cyl OU
- VMI & WPPSI-R: Assessed at baseline & 6 wks after wearing SRx of full astigmatism & hyperopia undercorrection of 1.50-2.00D (3D if >7.00 D)

Roch-Levecq et al. Archives of Ophthalmology 2008;126;252-8

Effect of Spectacle Correction on Preschoolers' Cognitive Abilities

- **Baseline**: VMI scores significantly reduced in hyperopic kids (vs. emmetropic kids)
  - VMI and most performance subtests of WPPSI-R requiring H-E coordination
  - Comparable to children with nutritional deficiencies, high blood lead concentration, LBW, prematurity

- **Post-spectacle wear**:
  - VMI scores improved = to emmetropic controls
  - WPPSI-R also improved but not stat significant

Roch-Levecq et al. Archives of Ophthalmology 2008;126;252-8

TREATMENT & MANAGEMENT

Amblyopia and Hyperopia Considerations

Goals of Refractive Correction

1. Improve visual acuity
2. Treat amblyopia or strabismus
3. Improve binocular function
4. Manage accommodative or vergence demands
5. Reduce signs and symptoms
6. Does not interfere with emmetropization
7. Prevent amblyopia/strabismus

4 year old

Referred by occupational therapist for tracking problems

+developmental delays

Visual processing at 3 yo level

Repeating kindergarten

VAsc D 20/60 OD, OS

Vasc N 20/60 OD, OS

Ret dry +2.00 OU

SR +2.00 20/60

DLPcc 0rtho

NLPcc 2 XP

MEMcc +1.50 OU

NPC TTN

Stereopsis + Lang 200”

Ret cyclo +5.00 OU

Normal VAs? Amblyopia?	20/60 BCVA
Normal amount of hyperopia for age?	Dry +2.00 Wet +5.00
Normal development?	Delayed dev
Normal accommodation?	Reduced accm
Risk of strabismus?	ET risk 122x

Normal VAs? Amblyopia?	20/60 BCVA	• Rx now or wait? • +2.00 OU /+2.00 add? • SV +3.00? • RTC 6 weeks
Normal amount of hyperopia for age?	Dry +2.00 Wet +5.00	
Normal development?	Delayed dev	
Normal accommodation?	Reduced accm	
Risk of strabismus?	ET risk 122x	

Current PEDIG study

- HTS1
- Hyperopia treatment study 1

- 1 to 5 years of age
- +3.00 to +6.00D
- No strabismus
- No amblyopia
- Normal stereoacuities
- Randomize Rx or observe

How manage?

A. Prescribe full Rx
B. Prescribe partial Rx
C. Return in 3 months

6 month old, InfantSEE exam
Mohindra Retinoscopy +6.00-0.75x180 OU
No strabismus
+Alternation on vertical prism

How manage?

A. Prescribe full Rx
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6 month old, InfantSEE exam
Mohindra Retinoscopy +6.00-0.75x180 OU
No strabismus
+Alternation on vertical prism

Ans C.
Return in 3 months
Non strabismic
Delays?
Emmetropization

5 year old

Referred for vision therapy for RET onset 3 months ago

Patient symptomatic: squinting, eye rubbing, head turn

VAsc D 20/50 OD,20/30 OS

Vasc N 20/40 OD,20/30 OS

Ret(dry) OD+2.50, OS+1.50

SR OD+2.50 20/50
OS+1.50 20/30

CT sc IRET 10% troped

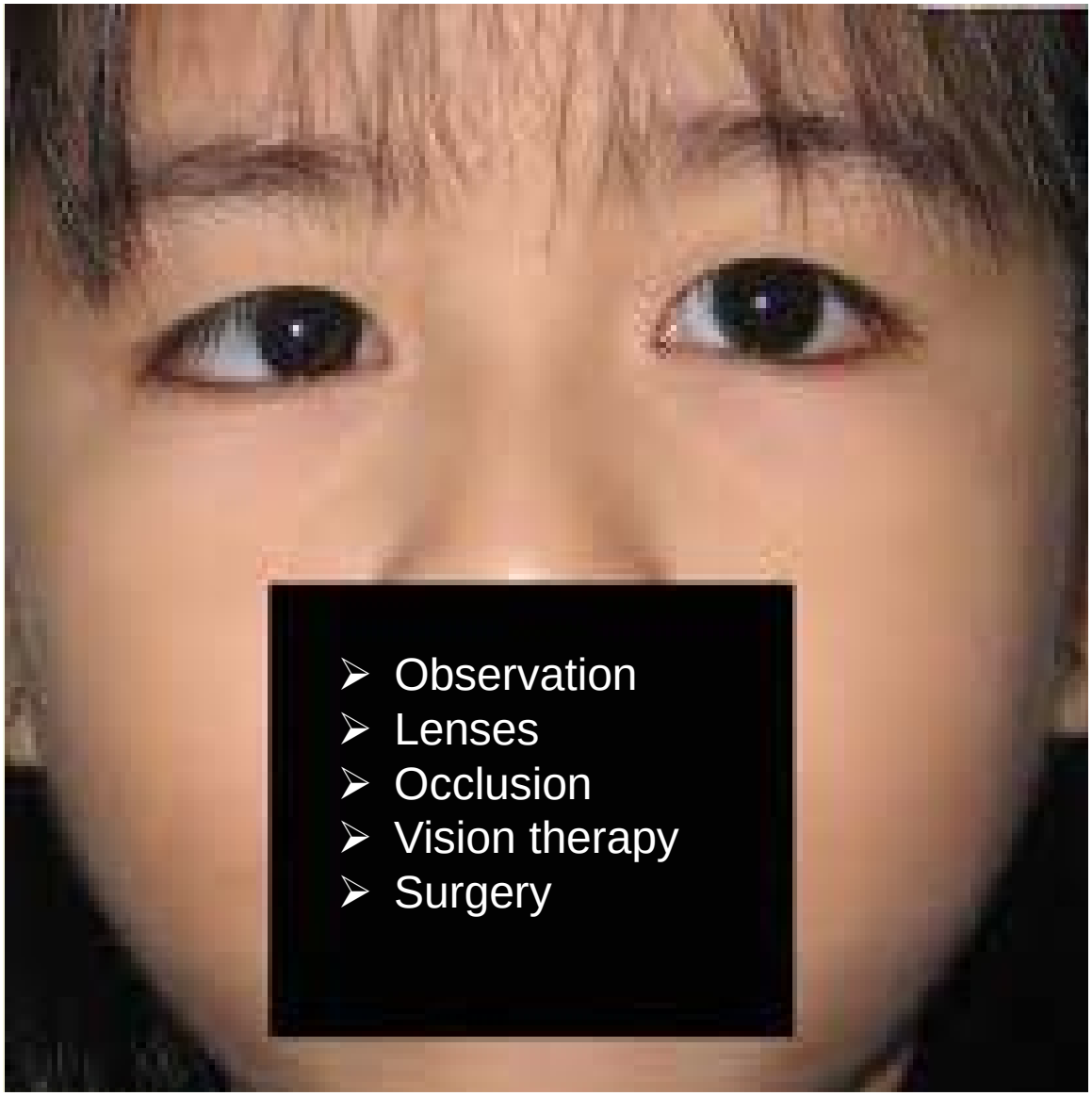
CT cc D 5EP, N 12EP

AC/A: 1/3.5

Stereo: OD suppression

Ret cyclo

OD +3.25 OS +2.75



5 year old

Referred for vision therapy for RET onset 3 months ago

Patient symptomatic: squinting, eye rubbing, head turn

VAsc D 20/50 OD,20/30 OS

Vasc N 20/40 OD,20/30 OS

Ret(dry) OD+2.50, OS+1.50

SR OD+2.50 20/50
OS+1.50 20/30

CT sc IRET 10% troped

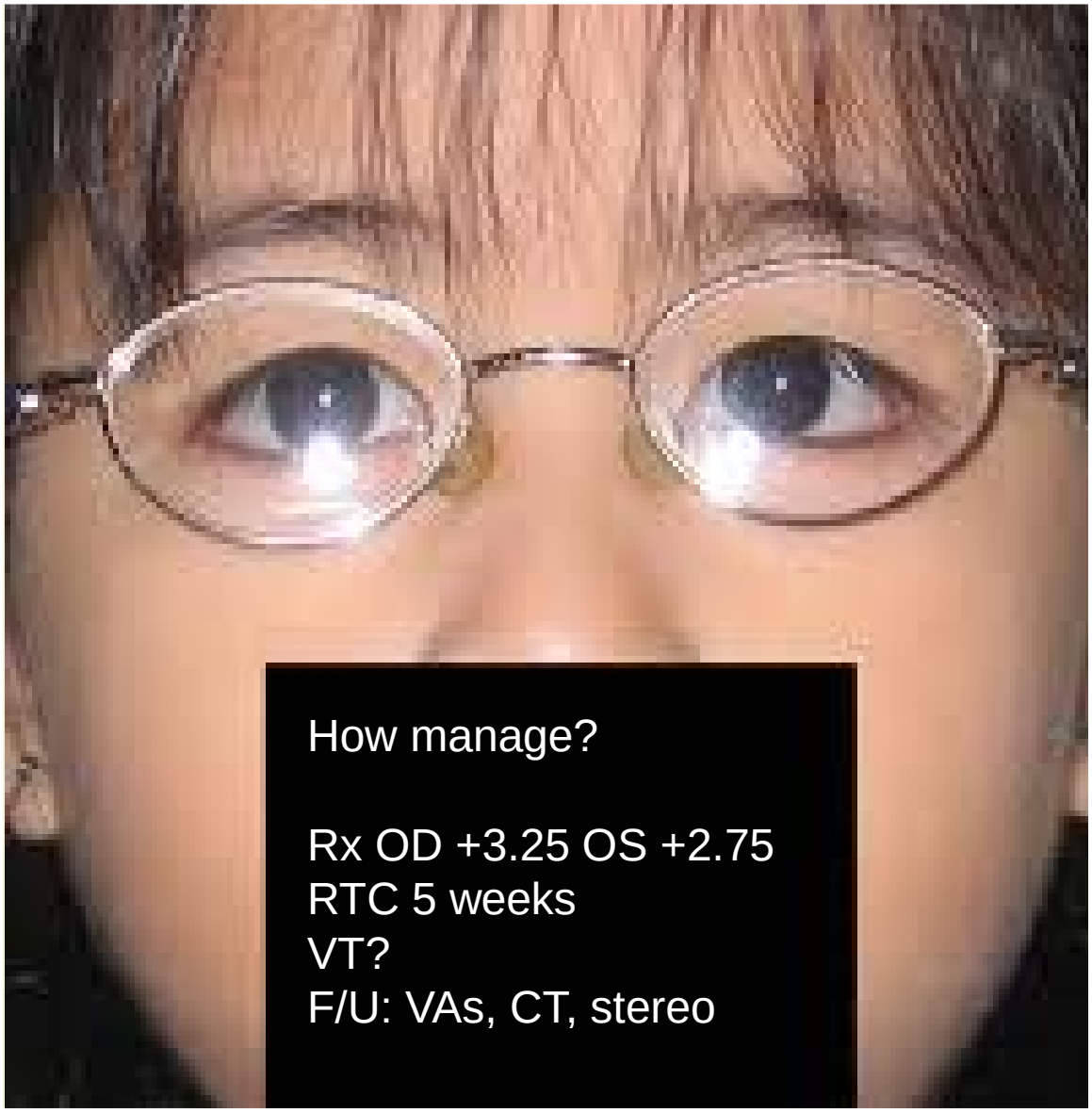
CT cc D 5EP, N 12EP

AC/A: 1/3.5

Stereo: OD suppression

Ret cyclo

OD +3.25 OS +2.75



FOLLOW-UP: WHEN TO RTC

Spectacle correction (specs, 6 weeks, penalization)

Penalization therapy tapering

Vision therapy office-based (tapering)

Current PEDIG study

- ATS18
- Study of Binocular Computer Activities for Treatment of Amblyopia

- 5 to <17 yo
- Amblyopia anisometropia and/or strabismus
- 2 hr daily patching
- 1 hr iPad® biocular activity

Summary

✓Amblyopia

Spectacles first

Penalization therapy

Office-based therapy

Taper

✓Hyperopia

Age norms

Normal development/ Academic performance

Binocular function/ Accm function


THANK YOU!
Email: ichung@westernu.edu