Evidence-Based Clinical Practice Guideline

Comprehensive Pediatric Eye and Vision Examination

East West Eye Conference 2016

Developed by the AOA Evidence-Based Optometry Guideline Development Group

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What is a Clinical Practice Guideline:

- Institute of Medicine defines CPGs as:

"Clinical practice guidelines are statements that include recommendations intended to optimize patient care that are informed by a systematic review of the evidence and an assessment of the benefits and harms of alternative care options."

What a Clinical Practice Guideline is NOT:

Recommendations made in this guideline **do not represent a standard of care.**

Instead, the recommendations are intended to assist the clinician in the decision-making process.

Patient care and treatment should always be based on a clinician's independent professional judgment, given the patient's circumstances, and in compliance with state laws and regulations.

Key to Strength of Evidence

Grade	
A	Data derived from well-designed, randomized clinical trials (RCTs); systematic reviews; meta-analyses; or diagnostic studies (Grade A) of relevant populations with a validated reference standard. Grade A diagnostic studies do not have a narrow population or use a poor reference standard and are not case control studies of diseases or conditions.
B	Randomized clinical trials (RCTs) with weaker designs; cohort studies (retrospective or prospective); or diagnostic studies (Grade B). Grade B diagnostic studies have only one of the following: a narrow population, or the sample used does not reflect the population to whom the test would apply, or uses a poor reference standard, or the comparison between the test and reference standard is not blinded, or are case control studies of diseases or conditions.
C	Studies of strong design, but with substantial uncertainty about conclusions or serious doubts about generalizations, bias, research design, or sample size. Nonrandomized trials; case control studies (retrospective or prospective); or diagnostic studies (Grade C). Grade C diagnostic studies have at least 2 or more of the following: a narrow population, or the sample used does not reflect the population to whom the test would apply, or uses a poor reference standard, or the comparison between the test and reference standard is not blinded, or are case control studies of diseases or conditions.
D	Cross sectional studies, case reports/series, reviews, position papers, expert opinion; or reasoning from principal.

Key to Clinical Recommendation Grading

Strong Recommendation: The benefits of the recommendation clearly exceed the harms (or the harms clearly exceed the benefits in the case of a negative recommendation) and the quality of evidence is excellent (Grade A or B). In some clearly identified circumstances, a strong recommendation may be made on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.
This recommendation should be followed unless clear and compelling rationale for an alternative approach is present.

Recommendation: The benefits of the recommendation exceed the harms (or the harms exceed the benefits in the case of a negative recommendation) but the quality of evidence is not as strong (Grade B or C). In some clearly identified circumstances, a recommendation may be made on lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.
This recommendation should generally be followed, but remain alert for new information.

Option: The benefits of the recommendation exceed the harms (or the harms exceed the benefits in the case of a negative recommendation) but the quality of evidence is low (Grade D) or well-done studies (Grade A, B, or C) show little clear advantage of one approach versus another. In some clearly identified circumstances, an option may be elevated to a recommendation even with lesser evidence when high-quality evidence is impossible to obtain and the anticipated benefits strongly outweigh the harms.
There should be an awareness of this recommendation, but a flexibility in clinical decision-making as well as remaining alert for new information.

Example of "Action Box"

EVIDENCE-BASED ACTION STATEMENT: Parents/caregivers and children should be educated about potential risks for eye injuries at home, at school, and during sports and recreational activities and advised them about safety precautions to decrease the risk of ocular injury.[177,143] Prevention of eye injuries in children should focus on the use of protective eyewear, parental supervision, and on education about both the risks of eye injury and the benefits of protective eyewear.[178]

Evidence Quality: Grade B: Retrospective cohort studies
Level of Confidence: Medium
Clinical Recommendation Level: Strong Recommendation. This recommendation should be followed unless clear and compelling rationale for an alternative approach is present.

Evidence Statements. It is important to discuss eye safety issues with children/ parents/ caregivers.[177] (Evidence Grade: B)[143] (Evidence Grade: B)

Prevention strategies should focus on the use of protective eyewear, parental supervision, and on childhood education about both the risks of eye injury and the utility of protective eyewear.[178] (Evidence Grade: B)

Potential Benefits: Reduction in eye injuries in children.

Potential Risks/Harms: None

Benefit and Harm Assessment: Benefits significantly outweigh harms.

Consensus-Based Action Statements

- Action statements based on consensus by the Guideline Development Reading Group

CONSENSUS-BASED ACTION STATEMENT: At the conclusion of a comprehensive pediatric eye and vision examination, the diagnosis should be explained to the patient/parent/caregiver and related to the patient's symptoms, and treatment plans and prognosis discussed.

Evidence Quality: There is a lack of published research to support or refute the use of this recommendation.

Benefit and Harm Assessment: Implementation of this recommendation is likely to increase patient/parent/caregiver understanding of any diagnosed eye or vision problems and improve compliance with any recommended treatment. The benefits of this recommendation were established by expert consensus opinion.

Is the CPG Needed?

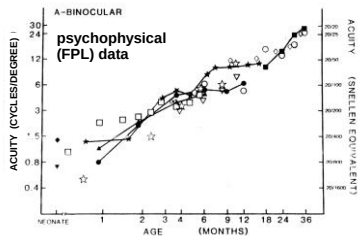
An estimated one in three preschool children[2-5] and one in four school-age children[6] in the United States has a vision problem, and these problems are reported to occur at an even higher rate in children living in poor urban environments.[7,8] Uncorrected eye and vision problems can become worse over time. Early diagnosis and treatment are essential to optimize children's eye health and vision and to prevent vision loss.

Eye and vision disorders can lead to problems in a child's normal development,[9,10] school performance,[8,11-14] social interactions,[15] and self-esteem.[15-17] Vision disorders that occur in childhood may manifest as problems well into adulthood affecting an individual's level of education, employment opportunities, and social interactions.[18]

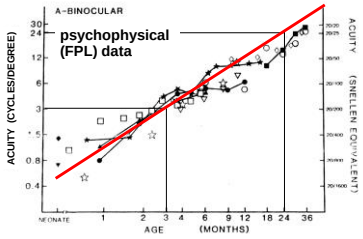
Extremely Important Point….

Development of the visual system is incomplete at birth.[26] Basic visual functions develop rapidly during the first year of life. By 6 months of age, vision has become the dominant sense and forms the basis for perceptual, cognitive, and social development;[27] however, maturation of the visual system continues for several years.

Infant resolution acuity development



Acuity in cyc/deg = Age in months



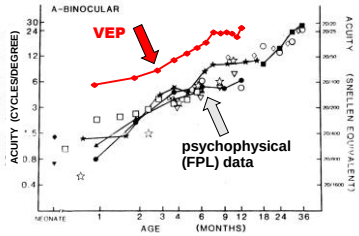
Simple Clinical Pearl
What is Expected Acuity for an Infant?

$$\frac{600}{\text{age in months}} = \text{Snellen denominator}$$

Acuity Development Over First Year

- At 3 month
  - 600/3 → **20/200**
- At 6 months
  - 600/6 → **20/100**
- At 9 months
  - 600/9 → **20/65**
- At 12 months
  - 600/12 → **20/50**
    - **These all based on psychometric acuity determination**

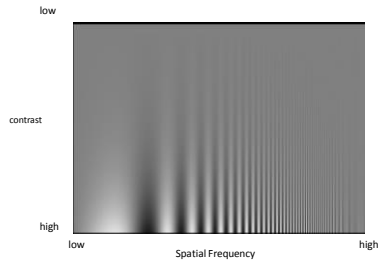
Electrodiagnostically determined VEP is much better
20/20 at end of year 1, versus 20/20 by age 3 years via preferential looking



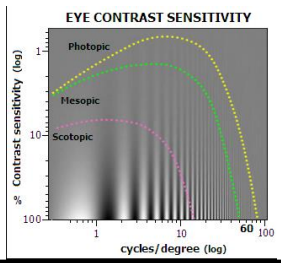
Visual function in infancy.

- Resolution Acuity
- Contrast sensitivity

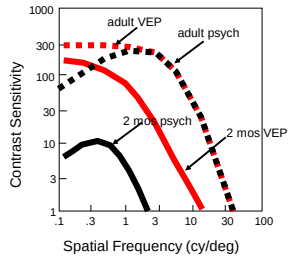
Contrast Sensitivity



Normal Adult Contrast Sensitivity Functions



Contrast Sensitivity in Infants



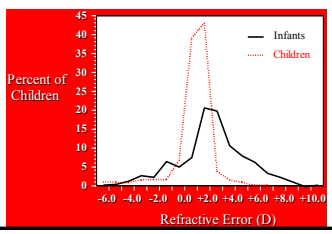
Summary of infant visual development

- Psychophysical resolution acuity in cy/deg is about the baby's age in months, and **reaches adult v.a. at about age 3 yrs.**
- VEP resolution acuity is "better", **reaching near-adult values by age 1 year.**
- Contrast sensitivity very different from adult and major limit to perception.
- Stereopsis can be measured reliably starting by age 6 months, and takes several years to mature fully.
- Color vision can be demonstrated in normal infants by age 3 months. Blue-yellow color vision may come in later than red -green discriminations

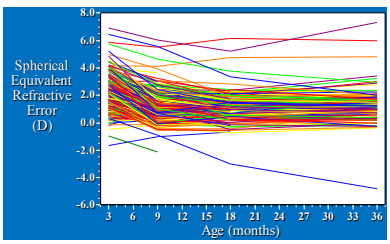
Refractive Error Development

Emmetropization

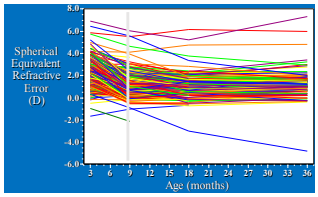
- Reduction in average amount of hyperopia
- Reduction in variance in refractive error



Emmetropization—Time Course

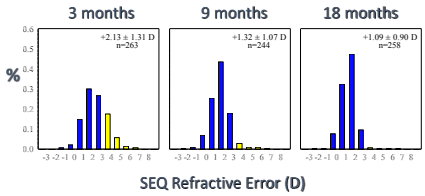


Emmetropization—Time Course

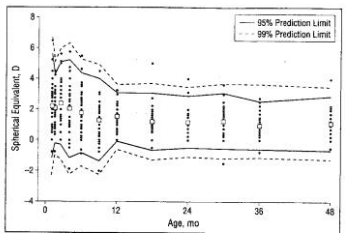


Rapid change in refractive error over birth to nine months
I prefer to do infant exams between 9 and 12 months

Emmetropization—Time Course

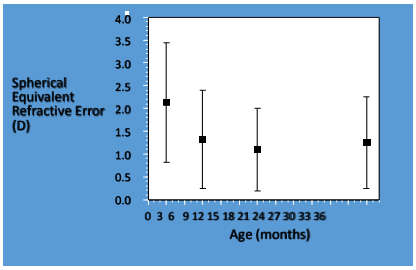


Reduction in Variance of Refractive Error

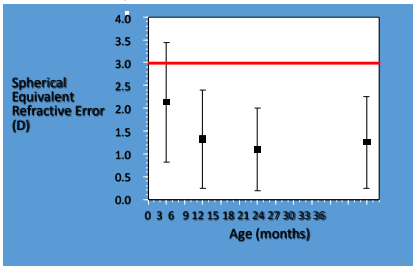


Mayer et al (2001) Arch Opthalmo

Emmetropization—Time Course



If 3 Diopters at 3 Year….
Emmetropization Didn't Work



Astigmatism in Infancy

Non-cycloplegic data

Author	n	Age	% ≥1.00 DC	Orientation
Mohindra et al. (1978)	276 right eyes	<1-50 weeks	45%	40% ATR 40% WTR 20% Oblique
Howland et al. (1978)	93 infants	0-12 months	47%	70% "horizontal and vertical"
Gwiazda et al. (1984)	521 infants	0-11 months	53%	44% ATR 39% WTR 16% Oblique
Howland and Sayles (1984)	117 infants	0-12 months	63%	55% ATR 3% WTR 42% Oblique

Astigmatism in Infancy

Cycloplegic data

Author	n	Age	% ≥1.00 DC	Orientation
Dobson et al. (1984)	46 infants	0-6 months	17%	100% ATR
Fulton et al. (1980)	133 infants	40-50 weeks	20%	71% ATR 21% WTR 8% Oblique
Ingram and Barr (1979)	296 eyes	1 year	29.7%	Not given
Santonastaso (1930)	63 infants	0-12 months	52.4%	15% ATR 85% WTR

Prevalence of Refractive Error in Children 6 months to 72 months

Condition	Non-Hispanic White	Hispanic	African American	Asian
Myopia				
≤1.00D spherical equivalent (SE)	1.20%	3.7%	6.6%	3.98%
>1.00D SE	0.70%		5.5%	
Hyperopia				
>2.00D SE	25.65%	26.9%	20.8%	13.47%
>3.00D SE	8.9%		4.4%	
Astigmatism				
≥1.50D cylindrical refractive error	6.33%	16.8%	12.7%	8.29%
≥3.00D cylindrical refractive error		2.9%	1.0%	
Anisometropia				
>1.00D SE		4.3%	4.2%	

Source: *Multi-Ethnic Pediatric Eye Disease Study*[33, 34, 42, 45] and the *Baltimore Pediatric Eye Disease Study*[46]

With all this going on….

EVIDENCE-BASED ACTION STATEMENT: Infants should receive an in-person comprehensive eye and vision assessment between 6 and 12 months of age for the prevention and/or early diagnosis and treatment of sight-threatening eye conditions and to evaluate visual development.[210-212]

Evidence Quality: Grade B: Prospective cohort studies, Diagnostic study
Level of Confidence: High
Clinical Recommendation Level: Strong Recommendation. This recommendation should be followed unless clear and compelling rationale for an alternative approach is present.

Evidence Statements:
Preterm infants with a history of retinopathy of prematurity should be closely monitored for the development of high myopia, astigmatism and anisometropia.[210] (Evidence Grade: B)

Prevalence of Refractive Errors in children 5 to 17 years of age

Condition	Non-Hispanic White	Hispanic	African American	Asian
Myopia				
≥0.75D in each principal meridian	4.4%	13.2%	6.6%	18.5%
Hyperopia				
≥1.25D in each principal meridian	19.3%	12.7%	6.4%	6.3%
Astigmatism				
≥1.00D difference between two principal meridians	26.4%	36.9%	20.8%	33.6%

What is NEW in area of refractive error

- Impact of uncorrected hyperopia
- Prevention of myopia

Hyperopia

- 18.5 D – (0.3)age = average accommodative amplitude
- This is only for short term measurement…..
- What is impact on long term uncorrection?

Kulp and VIP-HIP Study Group Ophthalmology, 2016

- Uncorrected Hyperopia and Preschool Literacy
  - Results of Vision in Preschoolers - Hyperopia in Preschoolers Study (VIP-HIP) Study

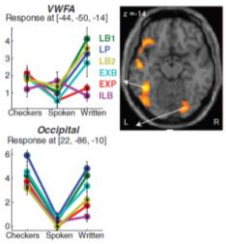
Conclusions: Uncorrected hyperopia ≥4.0 D or hyperopia ≥3.0 to ≤6.0 D associated with reduced binocular near VA (20/40 or worse) or reduced near stereoacuity (240 seconds of arc or worse) in 4- and 5-year-old children enrolled in preschool or kindergarten is associated with significantly worse performance on a test of early literacy. *Ophthalmology 2016;■:1–9 © 2016 by the American Academy of Ophthalmology.*

Science, Vol 330 3 December 2010

How Learning to Read Changes the Cortical Networks for Vision and Language

Stanislas Dehaene,[1,2,3,4]* Felipe Pegado,[1,2,3] Lucia W. Braga,[5] Paulo Ventura,[6] Gilberto Nunes Filho,[5] Antoinette Jobert,[1,2,3] Ghislaine Dehaene-Lambertz,[1,2,3] Régine Kolinsky,[7,8] José Morais,[7] Laurent Cohen[9,10,11]

- For **every** language tested, the acquisition of literacy results in cortical changes in left ventro – occipital cortex (at temporal lobe junction)
- Cells which responded to FACES change to respond to WORDS



Visual Word Form Area

- Mental lexicon of stored words that can process up to 50,000 words instantaneously
- Development requires consistent accurate visual image!!

Kulp and VIP-HIP Study Group Ophthalmology, 2016

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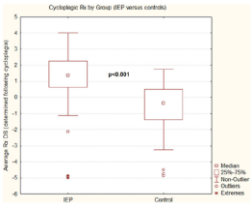
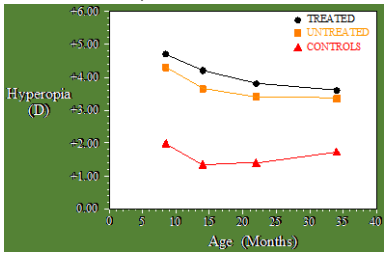
Quaid and Simpson, Arch Clin Exp Ophthalmology 2013



Does Early Correction of Hyperopia Affect Emmetropization?



Atkinson et al. (*Eye*, 1996)

So, not surprising….

EVIDENCE-BASED ACTION STATEMENT: Preschool age children should receive an in-person comprehensive eye and vision examination at least once between the ages of 3 and 5 to prevent and/or diagnose and treat any eye or vision conditions that may affect visual development.[43, 51, 58, 212,216]

Evidence Quality: Grade B: Systematic Review, Case series, Cross-sectional study
Level of Confidence: Medium
Clinical Recommendation Level: Strong Recommendation. This recommendation should be followed, unless clear and compelling rationale for an alternative approach is present.

Evidence Statements: Amblyopia is a treatable condition in children and adults.[40] (Evidence Grade: A),[51] (Evidence Grade: A) however, delayed treatment may reduce treatment outcomes.

Uncorrected hyperopia in 4 and 5 year old children has been associated with delays in the development of early literacy.[217] (Evidence Grade: C)

Spectacle correction of astigmatism during the preschool years can result in significantly improved best-corrected visual acuity by kindergarten age.[218] (Evidence Grade: C)

The U.S. Preventive Services Task Force recommends that children have their vision screened at least once between the ages of 3 and 5 years of age;[58] (Evidence Grade: B) however, gaps exist in the delivery of preschool vision screening and rates of screening are low, particularly in 3 year old children.[212] (Evidence Grade: C)

What About the Myopes?

Condition	Non-Hispanic White	Hispanic	African American	Asian
Myopia				
≥0.75D in each principal meridian	4.4%	13.2%	6.6%	18.5%
Hyperopia				
≥1.25D in each principal meridian	19.3%	12.7%	6.4%	6.3%
Astigmatism				
≥1.00D difference between two principal meridians	26.4%	36.9%	20.8%	33.6%

Prevention or reduced progression of myopia

- Lots of evidence showing impact of bifocal contact lenses on reducing progression of myopia
- Are there any less expensive options?

GO OUTSIDE!!

EVIDENCE-BASED ACTION STATEMENT: Patients/parents/caregivers should be counseled about the benefits to children's vision of spending more time outdoors.[58, 59]

Evidence Quality: Grade B: Randomized clinical trial; prospective cohort studies, cross-sectional study
Level of Confidence: Medium
Clinical Recommendation Level: Recommendation. This recommendation should generally be followed, but remain alert for new information

Evidence Statements:
More time spent outdoors and less time indoors doing near work may slow axial elongation and prevent high myopia thereby reducing the risk of developing sight-threatening conditions such as retinal detachment and myopic retinopathy.[59] (Evidence Grade: A)

More time outside may decrease myopia progression. Less outdoor/sports activity before myopia onset may exert a stronger influence on the development of myopia than near work.[181] (Evidence Grade: B)

Outdoor time and near work do not have a major effect on myopia progression.[184] (Evidence Grade: B)

Higher levels of outdoor activity were associated with lower amounts of myopia in primary school students.[185] (Evidence Grade: D)

Potential Benefits:
Implementation of this recommendation is likely to help reduce the development and progression of myopia in children.

Benefit and Harm Assessment: Benefits significantly outweigh harms.

Potential Risks/Harms: None

Cost of Eye and Vision Disorders in Children

- Eye and vision disorders impose a significant burden on patients, parents and the public.
- The total economic cost of vision loss and eye disorders among children younger than 18 years of age in 2012 was estimated to be 5.9 billion dollars
- This does NOT include educational costs that could be avoided
- This does not capture the LOSS in POTENTIAL for each child untreated.

Need for Comprehensive Examinations

EVIDENCE-BASED ACTION STATEMENT: Vision screenings have not been found to be an optimal means of identifying which children need eye and vision care and which do not. A comprehensive eye and vision examination can determine if a child does or does not have an eye or vision problem requiring treatment. Therefore, vision screenings should not be considered as a substitute for an in-person comprehensive eye and vision examination.[33,34]

Evidence Quality: Grade B. Systematic reviews, Diagnostic studies, Reviews
Level of Confidence: Medium
Clinical Recommendation Level: Strong Recommendation. This recommendation should be followed unless clear and compelling rationale for an alternative approach is present.

Evidence Statements: Low screening rates and inadequate referral and follow through with a comprehensive eye examination indicate that screening children in a pediatric or other primary care setting does not result in optimal detection and treatment of vision problems.[32] (Evidence Grade: C)

Screening for vision problems in preschool children can be problematic and may lead to the under detection of strabismus, amblyopia, and significant refractive error.[34] (Evidence Grade: A),[35] (Evidence Grade: A),[36] (Evidence Grade: B).

Preschool children, who are unable to perform a screening test, are often not referred for a comprehensive eye and vision examination, but instead are managed as a child who passed the screening.[37] (Evidence Grade: B).