Binocular Vision Simplified, the role of Microprisms in our digital world

LENS-BASED INTERVENTIONS

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Learning Objectives

- BV's impact on comfort and performance
- Treatments options: lens, prism, and therapy interventions
- Create clinical decision pathway to screen, manage, and refer patients for BV interventions aimed at improving daily productivity.

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Acknowledgement

- I am NOT a binocular vision specialist
- I learned optimal binocular vision is critical in today's environment
- Huge unmet need, solutions are within our arsenal
- It is our responsibility to provide relief to benefit ***our*** patients
- Who would ***not*** want to be more comfortable?

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Normative values vs. Symptomology

TABLE 1. NORMATIVE VALUES[29-29]

NORMS IN BINOCULAR VISION TESTING		
Test	Expected Finding	Standard Deviation
Distance cover test	1 exophoria	±2^
Near cover test	3 esophoria	±3^
Accommodative NPC	5cm to 7cm	±2.5cm to 3cm
Non-accommodative or red lens NPC	7cm to 10cm	±4cm to 5cm
Jump convergence	30cpm	±10cpm
Distance lateral phoria pre-presbyopes	1 esophoria	±1^
Distance lateral phoria presbyopes	1 esophoria	±1^
Near lateral phoria pre-presbyopes	3 esophoria	±3^
Near lateral phoria presbyopes	8 esophoria	±3^
Near AC/A ratio	4:1	±2^
NORMS IN SMOOTH VERGENCE TESTING (BLUR/BREAK/RECOVERY)		
Test	Expected Finding	Standard Deviation
Distance base-out	9/19/10^	±4/6/4^
Distance base-in	x/7/4^	±x/3/2^
Near base-out	17/21/11^	±5/6/7^
Near base-in	13/21/13^	±4/4/5^
NORMS IN STEP VERGENCE TESTING IN SEVEN-TO-12 YEAR OLDS (BREAK/RECOVERY)		
Test	Expected Finding	Standard Deviation
Distance base-out	23/16^	±8/6^
Distance base-in	12/7^	±5/4^
NORMS IN STEP VERGENCE TESTING IN ADULTS (BREAK/RECOVERY)		
Test	Expected Finding	Standard Deviation
Distance base-out	11/7^	±7/2^
Distance base-in	7/4^	±x3/2^
Near base-out	19/14^	±9/7^
Near base-in	13/10^	±6/5^
NORMS IN NEAR VERGENCE FACILITY TESTING		
Test	Expected Finding	Standard Deviation
12 BO/3 BI	15cpm	±3cpm

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Symptomology

Various studies conclude:

- Headaches: Between 15% and 80% of the population complain of headaches.
- Digital Eye Strain (Eyestrain): Approximately 65% of Americans reporting symptoms(some reports up to 80%).
- Neck and Shoulder Pain: An annual prevalence of neck pain affects more than 30% of U.S. adults.
- Light Sensitivity (Photophobia): Estimates range from 5% to 20% of the population.
- Dizziness: Affects about 15% to 20% of adults yearly.
- Symptomatic dry eye: 6.8% to over 20% depending on the population studied.

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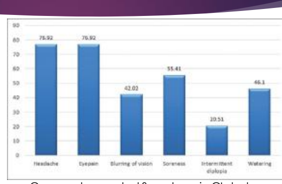
A closer look at CI (convergence insufficiency)

Studies suggest that between 2% and 13% of the U.S. population has convergence insufficiency (CI), ranging from 1.7% to 33%, Study consensus is around 5%



Commonly reported Symptoms in CI study

clinical decision pathway to screen, manage, and refer patients for BV interventions aimed at improving daily productivity. Vaishali, Ramesh Shruthy; Jha, Kirti Nath; Srikanth, Krishnagopal, 2019

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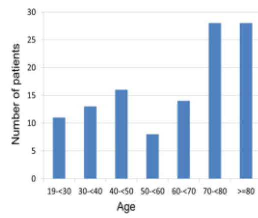
Why Binocular Vision Matters



The Incidence and Clinical Characteristics of Adult-Onset Convergence Insufficiency
Rafif Ghadban 3A, Jennifer M Martinez 1A, Nancy N Diehl 2B, Brian G Mohney 3A

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Too much paper work

Table 3. Customized Binocular Vision Questionnaire

VISION SYMPTOM SURVEY	NEVER	INFREQUENTLY	FREQUENTLY
Blurry vision with reading or doing near work			
Words go in and out of focus when reading			
Headaches with reading or doing near work			
Things far away look blurry after reading			
Vision is worse at the end of the day			
Avoid reading or doing homework			
Hold reading materials close to face			
Eyes feel tired, sore or uncomfortable after reading			
Words run together, move, jump or swim			
Double vision (see two of something when there should be one)			
Close or cover one eye when reading			
Difficulty copying from the board			
Lose your place when reading			
Perform poorly in math, misalign digits or columns			
Difficulty with correct spelling			
Skip words and lines or reread material			
Omit small words when reading or writing			
Reverse letters or numbers when reading or writing			
Write up or downhill			
Feel sleepy or lose concentration when reading			
Trouble understanding or remembering what is read			
Dizziness or nausea with reading			
Homework/schoolwork takes a long time to complete			
Perform below potential at school			
Understand things better when they are verbally explained vs. when you read it yourself			
Attend extra help in school or get therapy (occupational, physical, speech, reading)			
Difficulty with crowded or visually busy pieces			
Difficulty with fine motor tasks, hand-eye coordination and/or sports			

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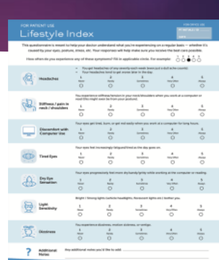
Simplified questionnaire for discovery

- 7 simple questions, rated by severity



FOR PATIENT USE

Lifestyle Index

Headaches

Stiffness / pain in neck / shoulders

Discomfort with Computer Use

Tired Eyes

Dry Eye Sensation

Light Sensitivity

Dizziness

Additional Notes

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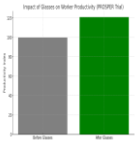
Economic & Productivity Impact

- 2025, VSP finds nearly 3 out of 4 of employees struggle with digital eye strain, 59% say it affects their productivity
- PROSPER trial: 21% output gain with glasses
- Workplace efficiency tied to binocular stability
- Better BV will improve patient comfort and efficiency



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Binocular Test Issues

- Isue#1: time restraints
- Issue #2: Inaccuracy of testing and recording
- Issue #3: Prism calculations
- Issue #4: Confidence in the actual prescription
- Paradym shift: Does "normal" mean doing nothing?

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Low-Add Boost Lenses

- Concept Overview: Eases accommodative effort at near
- Power boost range: +0.40 to +0.75 D add
- Examples: Essilor Eyezen, Zeiss Digital, Hoy Sync III, Shamir Relax, VSP Unity Via/TechShield
- Best use for Pre-presbyopic patients with long hours of close work
- Mixed evidence in peer-reviewed trials
- Ignores: convergence influence AC/A ratio

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Blue Light Filtering Lenses

- Commonly prescribed to reduce symptoms of DVS
- Does not address any issues with BV
- More contradictory study conclusions versus positive conclusions.
- Provides little or no benefit for cataract or retinal prevention issues
- Intended to reduce digital strain and aid circadian rhythm.
- Current evidence suggest Bluel light filtering lenses not to be superior over standard lenses in reducing digital eye strain

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Micro-Prisms

- Microprisms (typically less than 1–2 prism diopters)
- Subtly shifts images to reduce the effort required for binocular fusion during near tasks.
- Shifts demand toward comfort zone, improving reading speed and comprehension by easing vergence demand.
- **Issue**: How do you determine the adequate amount of prism to prescribe to get improvement in comfort or a therapeutic benefit?

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New category: Contoured Prism + Accommodative Boost

- The benefit of convergence relief with the addition of BI prism at intermediate and near, plus, accommodative relief.
- Contoured or variable prism: progressively more BI prism at near vs distance
- Evidence: Reduced Symptomology and increasing reading speed

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Reviewing AC/A ratio

- AC/A ratio (Accommodative Convergence to Accommodation ratio) quantifies how much convergence (in prism diopters) occurs per diopter of accommodation.
- Formula:
  AC/A=IPD (cm)+Near phoria (Δ)−Distance phoria (Δ)Near s timulus (D)\text{AC/A} = \text{IPD (cm)} + \frac{\text{Near phoria (Δ)} - \text{Distance phoria (Δ)}}{\text{Near stimulus
  - Clinical Interpretation:
  - Normal AC/A: ~4:1 to 5:1
  - High AC/A: >6:1 (often in convergence excess)
  - Low AC/A: <3:1 (often in convergence insufficiency)

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Vision Therapy + lens Therapy

- Critically important for those patients that can benefit from it.
- Develop a referral network
- Standard Boost lenses and Boost lenses with contoured or variable prism can be an adjunct or place holder for VT.
- Prism reduces vergence stress
- Boost lenses stabilize accommodation
- Therapy increases convergence dynamics

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Clinical Decision Pathway

- Step 1: Screen/Testing
- Step 2: Trial prism or boost lenses
- Step 3: Escalate to contoured prism or OBVAT(Office Based Vergence/ Accommodative Therapy)
- Step 4: Re-assess

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Case Study: *"I seem to see 4 headlights in cars when I know there are only 2!"*

- "Routine exam"
- 4 PD vertical phoria and significant exophoria.
  - Treat vertical first then address the horizontal component
- Part 2, same patient: "I get headaches and neck strain when I am working at the computer after 2 hrs"
  - Micro-prism testing results: 2 BI contoured prism, 6.5 PD exophoria at distance, 14.2 PD Exophoria at near with an AC/A 1.90 (Low AC/A: <3:1, convergence insufficiency)

Gave up contact lenses in exchange for glasses with contoured prism.

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Case Study #2: My kid is putting in " A" level effort at school but only getting "C" level results

- "I hate school. I'm a terrible student. But, I try really hard."
- 20/20 sc OD and OS, 16 yo male in for first eye exam
- Rx: Plano OU, Phorias 8 BI D/15 BI N, AC/A <3:1, NRA/PRA decreased and variable
- Plan: Contoured Prism glasses for study and initial treatment and Urgent referral for VT.

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Case Study #3 the Non-Adapt

- Progressive Lens Non-Adapts: Presbyopes have less ability to converge when they start to lose accommodation. Leads to discomfort or non-adapt issues with additional plus pushing the AC/A ratio into convergence insufficiency.
- 46 yo female CC: tried progressives and hated them. Just started to need glasses for reading about 5-6 years ago. Was prescribed her first PAL and hasn't been back to the eye doctor since.
- Low hyperope with AC/A 4:1
- 12+ hours on the computer or phone and travels for work on a monthly basis.

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Key Take-Home Messages

- Small BV gains → large productivity benefits
- Evidence strongest for prism & VT
- Boost lenses with variable/contoured prism is very promising. BUt, more research needed

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Thank You!

Any Questions?

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