# Article • Case Report: Enhancing Binocular Vision of an Adult with Anisometropic Amblyopia

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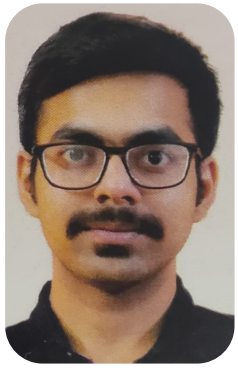

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## ABSTRACT

**Background:** Dichoptic training, anti-suppression, and binocular vision therapy have been shown to be of benefit in adults with anisometropic amblyopia.

**Case report:** A 23-year-old female complained of blurred vision in the left eye. Her unaided vision OD was 20/32 (6/9) for distance and N6 for near, and OS was 20/500 (6/150) for distance and N12 for near. Her best-corrected visual acuity was 20/20 (6/6)/N6 OD with plano-0.75x165 and 20/80 (6/24)/N10 OS with -7.50-2.00x180. She was diagnosed with anisometropic amblyopia as there was no evidence of a squint (strabismus). She completed 15 sessions of vision therapy, followed by a re-assessment, where her vision in the left eye improved to 20/25 (6/7.5), and stereopsis improved from <400 to 200 secs of arc stereopsis. She was then diagnosed with convergence insufficiency, and additional vision therapy was suggested for further treatment. With the assistance of contact lenses and vision therapy, including anti-suppression therapy, her stereopsis greatly improved to 30 secs of arc.

**Conclusion:** Adult amblyopia is manageable if an organized therapy protocol is followed to minimize suppression and to improve binocular single vision by conjointly treating amblyopia and binocular vision anomalies. Visual prognosis can vary depending on the underlying cause of amblyopia and the depth of suppression.

**Keywords:** amblyopia, anisometropia, anti-suppression, binocular vision disorder

## Introduction

Amblyopia, with a prevalence of 2-3%, is a common preventable cause of monocular and occasionally binocular visual impairment.[1] Morphological changes and abnormal visual processing are the leading causes of amblyopia, characterized by reduced visual acuity and contrast sensitivity.[2] Anisometropic amblyopia is the most typical form of amblyopia,[3] which is easily manageable if appropriately diagnosed. As per the American Optometric Association guideline,[4] a difference of 1 diopter of refractive error between two corresponding eyes can cause amblyopia. In addition, amblyopia can cause abnormal development of the visual pathway and visual cortex due to the blurred image formed on the retina.[5] There is a clear association between increasing anisometropia and decreasing stereopsis,[6] which can reflect the binocular sensory status. Park[7] noticed the presence of "monofixation syndrome" for anisometropic amblyopia without strabismus. Helveston and Von Noorden.[8,9] reveal microtropia as a clinical representation of anisometropic amblyopia. Evaluation of binocular parameters is essential for anisometropic amblyopia patients. Re-establishing binocularity by minimizing monocular suppression is the primary goal. Normal binocularity rarely restores during patching treatment; rather, amblyopia can be managed as a binocular disorder.[10] Hess et al.[11] hypothesized that binocular dysfunction is of primary importance, and monocular function is a secondary consequence. This hypothesis reveals a fresh approach to treating adult amblyopia by targeting suppression mechanisms and neuroplasticity within the visual cortex.[12] This case report aims to draw attention to restoring binocular vision using an appropriate protocol in adult amblyopia.

## Case Report

A 23-year-old female complained of blurred vision OS for the past three years. There was no associated history of headache, asthenopia, squinting of the eye, or diplopia. She had been using her glasses for the past three years. Her general health was normal. On examination, the presenting unaided Snellen visual

acuity for distance was 20/32 (6/9) OD and 20/500 (6/150) OS. A final prescription, determined objectively and subjectively, was plano-0.75x165, 20/20 (6/6, N6) OD and -7.50-2.00x180, 20/80 (6/24, N18 ) OS.

Anterior and posterior segment findings were within normal limits, and ocular motility was full, free, and painless in all gazes. On the Hirschberg test, a central corneal reflex was noted OU. She was diagnosed with simple myopic astigmatism OD and compound myopic astigmatism with anisometropic amblyopia OS. Corneal topography and Pentacam were performed to rule out ectasia changes, and the values were within the standard limits. Following the primary workup, she was prescribed a -7.00-1.75x180 contact lens OS and was referred to the specialized amblyopia clinic.

After one week, on detailed evaluation, the uncorrected visual acuity OD was 20/32(6/9), and with a contact lens OS was 20/80 (6/24). On the Worth 4-dot test, OS suppression was present for near and distance. She had <400 seconds of arc stereopsis when checked with random dot stereo acuity. On binocular vision assessment, the near point of convergence (NPC) was 8 cm, and the near points of accommodation (NPA) OD, OS, and OU were 10 cm, 50 cm, and 9 cm, respectively. After analyzing the report, she was advised to start office-based vision therapy and to undergo a reassessment after 15 days of treatment. On reassessment, her vision OS with the contact lens was 20/25 (6/7.5), N6 at 40 cm; OD unaided was 20/32 (6/9), N6 at 40 cm. She was advised to go for a detailed orthoptic evaluation to examine her binocular parameters. On thorough orthoptic evaluation, there was no suppression on the Worth 4-dot test, and her stereopsis, which was <400 sec of arc before treatment, had improved to 200 secs of arc. The full data set can be located in Table 1. Her negative relative accommodation (NRA) was +2.00, and her positive relative accommodation (PRA) was -2.50. Tests that directly assess PFV and the patient's ability to relax accommodation (NRA) will be decreased, which confirmed our diagnosis of convergence insufficiency.16 Her orthoptic management was planned accordingly. After her 9th session, her revaluation showed that stereopsis was 140 secs of arc. NPA, NPC, AF, VF, and PFV improved, and the patient qualitatively felt a 70% improvement in her functional vision assessed with the College of Optometrists in Vision Development Quality of Life Outcomes Assesment (COVD-QOL). She was advised to continue office-based exercises for one more week. After the 17th session, her stereopsis improved to 30 secs of arc. NPA, NPC, AF, VF, and PFV were all improved to the normal ranges (Table 1).

## Discussion

The most prevalent form of amblyopia is anisometropic amblyopia. The approach followed in this case was supported by principles from Hess et al.[13] to restore binocularity after initially working monocularly in the specialized amblyopia clinic. Tracing, tracking training, eye-hand coordination with variable stimulus size, and contrast with the Sanet Vision Integrator (SVI) software were introduced.[14] Monocular fixation in a binocular field (MFBF) therapy with the HTS Inet[15] and saccadic therapy were employed. She was advised to perform red/green bar reader with red/green anaglyphic eyeglasses 1 hour/day to allow dichoptic presentation for home-based support (Table 2).

**Table 1. Binocular Vision Parameters from the Various Assessments**

| Binocular vision parameters | | 1st assessment | 2nd assessment | 3rd assessment |
|---|---|---|---|---|
| Stereopsis (secs of arc) | | 200 | 140 | 30 |
| NPC (cm) | | 6 | 5 | 5 |
| NPA | Both eyes (cm) | 9 | 9 | 9 |
| | Right eye (cm) | 10 | 10 | 10 |
| | Left eye (cm) | 13 | 12 | 12 |
| PFV | Distance (B/R) | 8/6 | 25/20 | 25/20 |
| | Near (B/R) | 14/12 | 25/20 | 35/30 |
| NFV | Distance (B/R) | 12/10 | 12/10 | 14/12 |
| | Near (B/R) | 16/14 | 20/18 | 14/10 |
| AF | Both eyes (cpm) | 4 | 12 | 20 |
| | AF | 10 | 17 | 20.5 |
| | Left eye (cpm) | 0 | 10.5 | 13 |
| VF (cpm) | | 3.5 | 13.5 | 20 |

**Table 2. Therapy Procedures for 15 Days**

| Therapy Days 1 to 5 |
|---|
| 1. Amblyopia Inet according to her vision –Find the target (MFBF) |
| 2. SVI eye-hand: proactive, rotator 1 and 2 (under 100% contrast) |
| 3. Marsden ball with sound-eye patching |
| 4. Tracing on the whiteboard: pursuit therapy |
| Therapy Days 6 to 10 |
| 1. SVI Rotator 3, eye-hand: under 60% contrast |
| 2. Amblyopia Inet: letter jump, laser ball, follow the letter |
| 3. Pegboard for eye-hand coordination with balance board |
| 4. Saccades therapy with the saccadic fixator |
| Therapy Days 11 to 15 |
| 1. Pursuit with tracing, saccades with SVI |
| 2. Amblyopia Inet: increased difficulty, focused on traffic jams and capturing target |
| 3. Cheiroscope |
| 4. Anti-suppression therapy bar reader with red and green filter |

The goal was to increase visual concentration and improve visual searching with target segregation. The principle was based on the minimum discriminable property, improving pursuit and saccades by tracing and tracking training. Dorsal and ventral pathways were trained by stimulating what and where mechanisms with variable contrast and stimulus size under MFBF .

Using guidelines from Scheiman and Wick,16 the first phase's goal was to normalize the patient's positive fusional vergence, amplitude of accommodation, and accommodative facilities. Then, the second phase focused on normalizing NFV, PFV, and facilities. The last stage included jump duction (shifting convergence to divergence) with saccade and pursuit training. On the final reassessment, her stereopsis improved to 30 secs of arc with normal binocular parameters (NPC, NPA, AF, VF, PFV, NFV). She was advised to continue the exercise at home with an accommodative flipper (±2.00) and a transparent lifesaver card.

## Conclusion

This case widens our view on managing adult amblyopia and the possibility of restoring vision. We learned that dichoptic therapy with anti-suppression therapy, pursuit and saccades training, followed by binocular vision therapy to maintain and to manage the amplitude of accommodation and convergence is effective in achieving precise, comfortable, and sustainable binocular vision. Further research is required to study amblyopia with a greater sample size to determine predictable visual prognoses in different types of amblyopia.

Acknowledgments

We acknowledge the sincere efforts and valuable time given by Mr. Prithwis Manna, Ms. Kavya S, Ms. Prabriti Thapa, Mr. Pradeep, Ms. Sometnaro A Chang, Ms. Hajira, and Mr. Joel Titung. Their constant concern and guidance with precious feedback helped us complete this report.

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Chakraborty S, Sarbajna P, Vinekar A, Shetty B. Case report: Enhancing binocular vision of an adult with anisometropic amblyopia. Optom Vis Perf 2023;11(3):158-160.