

BYNOCS Dichoptic Therapy for the management of Amblyopia

Shua Azam¹, Piyar Ali², Zuha Hameed Talpur³, Quratulain⁴, Sarina Malik⁵

¹Isra school of Optometry, Isra University, Karachi ^{2,3,4,5}Al-Ibrahin Eye Hospital, Karachi

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ABSTRACT

Purpose: To evaluate visual acuity and stereopsis after Bynocs dichoptic therapy in amblyopic subjects.

Study Design: Descriptive observational study.

Place and Duration of Study: Laser Sight Eye Clinic, Hyderabad from February 2024 to November 2025.

Methods: Bynocs® AmblyoGo cloud-based software with Dichoptic games was utilized for amblyopia therapy. LogMAR visual acuity chart was used to measure Visual acuity. Stereopsis and binocularity were examined using the Randot Stereotest and the Worth 4-dot test, respectively, to assess depth perception and sensory fusion. The sample consisted of 9 patients who had completed the prescribed therapy regimen and had fully documented pre- and post-treatment records.

Results: Nine patients with amblyopia were included in this pilot study. Distance visual acuity improved significantly following Bynocs dichoptic therapy. Median distance visual acuity improved from 0.68 (IQR: 0.60–0.80) before therapy to 0.50 (IQR: 0.16–0.54) after therapy (Wilcoxon signed-rank test, $p = 0.004$). Near visual acuity also improved significantly from a median of 0.50 (IQR: 0.48–0.64) before therapy to 0.34 (IQR: 0.34–0.46) after therapy ($p = 0.004$). The mean improvement was 0.18 LogMAR. One participant showed measurable stereopsis at baseline, while eight participants did not. Five participants continued to exhibit no measurable stereopsis after therapy, whereas four participants showed measurable stereopsis ranging from 50 to 1200 seconds of arc.

Conclusion: Bynocs dichoptic therapy results in a statistically significant improvement in distance and near visual acuity. While depth perception remains variable and may require extended treatment.

Keywords: Amblyopia, Visual acuity, Stereopsis.

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Correspondence: Shua Azam
Isra school of Optometry, Isra University, Karachi
Email: optomshuaazam@gmail.com

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INTRODUCTION

Amblyopia is a neurodevelopmental condition and one of the major causes of vision impairment in children, affecting roughly 3% of the population.¹ Although the current standard of care treatment is refractive correction, which is supplemented with patching of the

non-amblyopic eye, the approach to treating amblyopia has evolved considerably in recent years.^{2,3,4} With emerging new innovative treatments dichoptic therapy has become a popular alternative to patching therapy for amblyopia over the past decade.^{5,6} In dichoptic stimulation, distinct images are shown to each eye, and a visual task that requires the integration of information from both eyes is presented. By directly targeting binocular dysfunctions and enhancing binocular vision, dichoptic-based binocular therapies offer encouraging advancements in the treatment of amblyopia. By lowering inhibitory interactions in the visual cortex, these methods hope to enhance stereo acuity and lessen the crowding effect.⁷

Visual acuity and depth perception can be improved significantly with the binocular therapies. Many of these therapies are available commercially and have consistently demonstrated noninferiority to routine patching treatments or full-time refractive correction.^{8,9}

Research shows that binocular treatments should be evaluated as a first-line therapy, either alone or as an adjuvant.^{9,10} Nevertheless, more research is required to substantiate some claims of superiority and long-term stability of benefits, as well as to offer particular therapy suggestions based on patient age and the cause of amblyopia.¹¹

Bynocs® Dichoptic Amblyopia Training (DAT) is a comprehensive, specially built cloud-based dichoptic training software program that uses anaglyph to stimulate both eyes simultaneously and independently.¹² The amblyopic eye appears to have a stronger contrast image than the non-amblyopic eye in Bynocs, and visual acuity and binocular vision functions both improve when suppression is reduced.¹³ With the ability to diagnose and treat conditions remotely, Bynocs® serves as a useful telehealth vision therapy tool for managing binocular vision abnormalities and amblyopia as telehealth gains popularity worldwide.¹⁴ The Dichoptic Principle, a contrast-balanced technique employs by BYNOCS-AmblyGo, produces low contrast for the healthy eye and strong contrast for the amblyopic eye.¹⁵ Bynocs DAT successfully enhances stereoacuity and distance best-corrected visual acuity (DBCVA) in adults with anisometropic and meridional amblyopia. Visual gains are sustained for 24 months, validating dichoptic amblyopia therapy for individuals with amblyopia.¹⁶

Although Bynocs (dichoptic therapy) is used globally there is limited local data to evaluate its real-world outcomes, especially in a clinical setting relevant to our patient population. Due to the well-established decline in neural plasticity beyond the critical period, age continues to be a crucial prognostic factor in the management of amblyopia. However, most of the previous research has concentrated on pediatric populations, with little information available on therapeutic responses across various age groups in our local context.^{17,18} This gap is particularly relevant given that our clinical population includes both children and adults, and treatment protocols may require age-specific modifications. This study retrospectively analyzed existing clinical data from Laser Sight Hyderabad where Bynocs therapy had

been used.

By assessing outcomes such as visual acuity improvement and binocular vision enhancement, we aim to determine the clinical effectiveness of this emerging therapy in a real-world setting and to evaluate whether age-related differences in treatment response observed globally are reflected in our patient population. Additionally, the cloud-based nature of Bynocs offers practical advantages in amblyopia management, enabling home-based therapy with remote monitoring.

METHODS

This was a retrospective pilot observational study conducted at the Isra School of Optometry, Karachi, utilizing data retrieved from patient records maintained at Laser Sight Eye Clinic, Hyderabad. Patients' records from February 2024 to November 2025 were reviewed. Data extraction and analysis were conducted over a period of six months. All eligible patients were included using a convenience sampling technique based on the availability of complete records. The study was approved by the Institutional review board/Ethical review board (REC/IPIO/2026/107). A formal sample size estimate was not performed prior to data collection due to the retrospective nature of the study. The final sample comprised 9 patients who had completed the prescribed therapy regimen and had fully documented pre- and post-treatment records.

Data was transcribed onto a self-designed proforma. Patients' records were included if they were over the age of six, had unilateral amblyopia (anisometropic or mixed), and had bi-foveal fixation in the amblyopic eye. A strict visual acuity cut-off was used: the amblyopic eye had a minimum best-corrected visual acuity (BCVA) of 6/60 (20/200) or 1.0 LogMAR, while the fellow eye had a minimum BCVA of 6/9 (20/30) or higher. Records were excluded if the patient had a history of previous ocular pathologies, any ocular pathology, or did not complete the entire 6-week course of therapy. Patients who had previously undergone strabismus surgery or had been treated for amblyopia were also excluded. The pre-therapy clinical data included visual acuity, which was evaluated with a standard Snellen chart or LogMAR chart for distance vision and a modified Snellen chart for near vision. Objective refraction data obtained through retinoscopy were recorded with subjective

Table 1: Comparison of Visual Acuity Before and After Bynocs Dichoptic Therapy.

Parameter	Before Therapy Median (IQR)	After Therapy Median (IQR)	p-value*
Distance VA (LogMAR)	0.68 (0.60–0.80)	0.50 (0.16–0.54)	0.008
Near VA (LogMAR)	0.50 (0.48–0.64)	0.34 (0.34–0.46)	0.007
Stereopsis	0 (0–0)	50 (0–800)	0.068

refraction information. Stereopsis and binocularity were examined using the Randot Stereotest and the Worth 4-dot test, respectively, to assess depth perception and sensory fusion. Additionally, ocular alignment was assessed by measuring heterophoria using the prism cover test. All pre- and post-therapy measurements were taken with the patient's optimal refractive correction in place, as assessed by subjective refraction.

All subjects completed a 6-week home-based binocular therapy regimen using the Bynocs® AmblyoGo software (Kanohe Eye Private Limited, Mumbai, India).¹ This platform uses binocular training to increase stereopsis and dichoptic training to improve visual acuity in the amblyopic eye. To decrease the non-amblyopic eye's cortical dominance and encourage the brain to use input from the weaker eye to promote neuroplasticity and rebalance binocular cortical interactions, the contrast of the images shown to it was constantly altered dependent on patient performance. According to the patient records, therapy consisted of 30 sessions structured as a daily routine of three distinct games played for 10 minutes each, totaling 30 minutes of therapy per session. Patients attended five sessions a week in addition to two days off. After the first ten sessions, a documented mid-protocol assessment was conducted to reevaluate near and distant visual acuity. This allowed the supervising optometrist to modify in-game contrast parameters and maintain a suitable therapeutic challenge. Final post-therapy data for visual acuity, stereopsis, and binocularity were taken from the records at the conclusion of the 6-week period after all 30 sessions were completed.

The non-parametric Wilcoxon Signed-Rank Test was used to compare the pre- and post-therapy visual acuity and stereopsis outcomes. A p-value of <0.05 was considered statistically significant. All data were anonymized to ensure patient confidentiality.

RESULTS

Records of nine patients (three males and six females) with amblyopia were included in this pilot study. The

median age was 21 years (IQR: 17–24 years). Distance visual acuity improved significantly following Bynocs dichoptic therapy. Median distance visual acuity improved from 0.68 (IQR: 0.60–0.80) before therapy to 0.50 (IQR: 0.16–0.54) after therapy (Wilcoxon signed-rank test, $p = 0.004$). The mean improvement was 0.27 LogMAR, corresponding to approximately 2.7 lines of visual acuity gain. Near visual acuity also improved significantly from a median of 0.50 (IQR: 0.48–0.64) before therapy to 0.34 (IQR: 0.34–0.46) after therapy ($p = 0.004$). The mean improvement was 0.18 LogMAR as shown in Table-1.

One participant (11.1%) showed measurable stereopsis at baseline, while eight participants (88.9%) did not. Five participants (55.6%) continued to exhibit no measurable stereopsis after therapy, whereas four participants (44.4%) showed measurable stereopsis ranging from 50 to 1200 seconds of arc. These results imply that after dichoptic therapy, a subset of patients may regain their ability to perceive binocular depth.

DISCUSSION

This study showed that Bynocs dichoptic therapy resulted in a statistically significant improvement in distance and near visual acuity. While depth perception remained variable and may require extended treatment. Our results are consistent with a study by Ansari et al, who described binocular vision therapy as an effective method to improve control of intermittent exotropia with improvement near stereopsis, and convergence amplitudes.¹⁹

A study conducted in South India enrolled 59 patients aged 11–30 years with amblyopia and evaluated the effects of dichoptic therapy on visual acuity, binocularity, and stereopsis.²⁰ The results demonstrated that patients without binocular single vision for near and distance prior to therapy attained normal binocular single vision post-therapy, except for one patient who continued to suppress at distance. Additionally, 21 patients showed improved near stereopsis and 21 showed improved distance stereopsis. The study concluded that dichoptic therapy enhanced visual acuity, binocularity, and stereoacuity,

even in patients older than 8 years, particularly in cases of partial deprivation, ametropic, and anisometropic amblyopia. Similarly, near and distance visual acuity showed a statistically significant increase in the current pilot trial.

A retrospective study involving 161 participants aged 4–13 years assessed the outcomes of a dichoptic training program using the Bynocs online platform in patients with refractive amblyopia.²¹ The therapeutic protocol, identical to that employed in our study, comprised 30-minute sessions conducted five times weekly for six weeks. The results revealed a significant improvement in the non-dominant eye's BCVA, with a mean change of 0.39 LogMAR ($p < 0.001$), and a significant enhancement in the Binocular Function (BF) score, with a mean change of 1.55 ($p < 0.001$). The age distribution of the recruited cohort varied, even though the same therapeutic platform and protocol were used in our study. Our results showed a statistically significant improvement only in near and distance visual acuity, while a subset of patients may regain their ability to perceive binocular depth. Furthermore, our study did not evaluate the BF score, a crucial binocularity criterion, which further restricted direct comparability.

A quasi-experimental study enrolled 23 participants aged 5–15 years with both microtropia and anisometropic amblyopia.²² Thirty 30-minute at-home training sessions utilizing the Bynocs platform were recommended over a period of six weeks. The percentage of patients with VA of 0.20 LogMAR or worse decreased from 60.9% at baseline to 21.7% after treatment, and the amblyopic eye's visual acuity dramatically improved from 0.28–0.24 to 0.13–0.20 LogMAR ($p < 0.001$). With compliance rates of 92%, 87%, and 93% at two, four, and six weeks, respectively, the BF score was significantly improved from 2.82–1.11 to 2.32–0.94 ($p < 0.001$).

A prospective, non-comparative study of 41 subjects aged 6–60 years, divided into children (6–16 years; $n = 24$) and adults (>17 years; $n = 17$), evaluated the impact of dichoptic training on anisometropic amblyopia using the identical Bynocs protocol.²³ The results showed a considerable increase in both the BF score (mean change of 1.14 log units, $p < 0.001$) and corrected distance visual acuity (CDVA) in amblyopic eyes (mean change of 0.30 LogMAR, $p < 0.001$). Baseline CDVA and the change in CDVA were linked. According to the study's findings, dichoptic training successfully enhanced

binocular function and visual acuity in both age groups.

The limitations of the current study must be taken into consideration when interpreting its results. The primary drawback is the remarkably small sample size ($N = 9$), which significantly decreased the statistical power to identify meaningful improvements in stereopsis. Furthermore, this study's retrospective methodology presents inherent biases, such as reliance on pre-existing medical records and lack of randomization, which could have affected the findings. The absence of a control group further limits the ability to attribute improvements solely to the therapeutic intervention.

Importantly, our study did not evaluate the BF score, a comprehensive measure of binocular function, which limited comparability with previous studies that reported significant increases in BF and prevented a full assessment of binocular recovery. Larger, prospective, randomized controlled trials with sufficient statistical power are necessary to confirm the clinical utility of dichoptic therapy and identify the patient subgroups most likely to benefit from this intervention.

CONCLUSION

Bynocs dichoptic therapy results in a statistically significant improvement in distance and near visual acuity. While depth perception remains variable and may require extended treatment.

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Dr. Abdul Hameed Talpur

*Director Isra School of optometry
Karachi*

Prof. Dr. Syed Jamil Ahmed

*Ophthalmologist
Laser Eye clinic, Hyderabad*

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Piyar Ali; Optometrist: *Literature Search, Data Acquisition, Data Analysis, Statistical Analysis.*

Zuha Hameed Talpur: Resident: *Literature Search, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

Quratulain; Optometrist: *Design, Literature Search, Manuscript Preparation.*

Sarina Malik; Optometrist: *Design, Literature Search, Manuscript Preparation.*

Authors Designation and Contribution

Shua Azam: Assistant Professor: *Concepts, Design, Literature Search, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

