

# Unlocking Visual Neuroplasticity in Pediatric Anisometropic Amblyopia Through Immersive Virtual Reality Therapy

Ragni Kumari<sup>1</sup>

## ABSTRACT

**Purpose:** This pilot study evaluated the effectiveness of immersive virtual reality (VR) therapy in improving visual function in children with anisometropic amblyopia by stimulating residual visual neuroplasticity through dichoptic binocular training. **Methods:** Four paediatric participants aged 6–11 years with diagnosed anisometropic amblyopia underwent 18 supervised VR therapy sessions over six weeks. Inclusion criteria included best-corrected visual acuity (BCVA) in the amblyopic eye between 20/40 and 20/100, stable refractive correction for at least three months, and absence of manifest strabismus. The VR system delivered dichoptic stereoscopic 3D interactive games designed to reduce interocular suppression and promote binocular cooperation by dynamically adjusting contrast and luminance for each eye. Outcome measures included distance and near BCVA (logMAR), stereoacuity assessed using the Randot stereotest, and contrast sensitivity measured at 3 cycles per degree (CPD). Safety, compliance, and participant feedback were also evaluated. **Results:** post-intervention, two younger participants demonstrated improvement in distance BCVA by 0.1–0.2 logMAR units. Three participants showed improvement in near visual acuity by one to two lines. Stereoacuity improved in all participants, with three achieving 60 arcseconds, indicating functional binocular depth perception. Contrast sensitivity improved in three participants by approximately 0.5 log units. The therapy was well tolerated with no reported adverse effects, and compliance was excellent. **Conclusion:** Immersive VR-based dichoptic therapy appears to be a safe, engaging, and promising modality for improving both monocular and binocular visual functions in paediatric anisometropic amblyopia. Larger randomized controlled trials with long-term follow-up are required to confirm clinical efficacy.

**KEY WORDS:** Amblyopia, Anisometropia, Virtual reality, Dichoptic therapy, Neuroplasticity, Paediatric vision therapy, Stereoacuity

## Introduction & Background

### Epidemiology and Clinical Significance of Amblyopia

Amblyopia, often termed “lazy eye,” is a neurodevelopmental disorder characterized by reduced best-corrected visual acuity in one or both eyes, unrelated to any detectable structural abnormalities of the eye or visual pathways. It is the most prevalent cause of monocular visual impairment in children and young adults worldwide, affecting approximately 2% to 4% of the general population, with variability across ethnicities

and geographical regions<sup>[9, 23]</sup>.

The impact of amblyopia extends beyond visual acuity deficits. Affected individuals frequently suffer from impaired depth perception (stereopsis), contrast sensitivity loss, and difficulties with motion perception and eye-hand coordination<sup>[14]</sup>. These deficits can interfere with daily activities such as reading, driving, and sports, thereby influencing educational achievement and quality of life<sup>[19]</sup>. Furthermore, untreated amblyopia significantly increases the risk of permanent vision loss in the amblyopic eye if the better eye becomes injured or diseased, underscoring the critical importance of early diagnosis and effective treatment<sup>[1]</sup>.

### Types of Amblyopia and Anisometropic Amblyopia

Amblyopia arises primarily from abnormal visual experience during a critical period of visual development in childhood, leading to disrupted binocular visual cortical development and impaired visual processing<sup>[13]</sup>.

### Access this article online

Quick Response Code:



Website: [jmsh.ac.in](http://jmsh.ac.in)

Doi:  
10.46347/jmsh.v12.i1.25.236

<sup>1</sup>Assistant Professor & Head, Department of Optometry, Faculty of Paramedical Sciences, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Etawah – 206130, Uttar Pradesh, India.

#### Address for correspondence:

Ragni Kumari, Assistant Professor & Head, Department of Optometry, Faculty of Paramedical Sciences, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Etawah – 206130, Uttar Pradesh, India. E-mail: [ragnimishraa@gmail.com](mailto:ragnimishraa@gmail.com)

Clinically, amblyopia is classified into three major types:

- **Strabismic Amblyopia:** Due to ocular misalignment causing suppression of the deviated eye's input.
- **Anisometropic Amblyopia:** Caused by unequal refractive errors between the two eyes, resulting in chronic blur in the eye with greater ametropia.
- **Deprivation Amblyopia:** Resulting from visual deprivation due to opacities such as cataracts or ptosis.

Anisometropic amblyopia is among the most common types and often underdiagnosed because it lacks obvious ocular misalignment. It typically occurs when the difference in spherical equivalent refractive error exceeds 1.00 to 1.50 diopters. This refractive imbalance causes chronic retinal image degradation in the more ametropic eye, leading to cortical suppression and subsequent reduction in visual acuity and binocular function<sup>[6]</sup>.

The visual impairment in anisometropic amblyopia affects not only monocular acuity but also binocular visual functions such as stereopsis and contrast sensitivity, which are crucial for depth perception and spatial orientation<sup>[13]</sup>. Given that anisometropic amblyopia can develop subtly and progressively, it may evade early detection, highlighting the importance of routine vision screening during childhood.

### Pathophysiology and Neuroplasticity in Anisometropic Amblyopia

The visual cortex undergoes extensive experience-dependent plasticity during a critical period in early childhood, typically extending until 7 to 8 years of age but with some residual plasticity into adolescence and adulthood. Normal binocular vision requires synchronous and matched input from both eyes to form coherent binocular neurons within the primary visual cortex (V1) and higher visual processing areas.

In anisometropic amblyopia, the blurred image from the eye with higher refractive error leads to persistent suppression of that eye's cortical representation to avoid visual confusion or diplopia. This suppression causes synaptic weakening and loss of functional connections in binocular neurons. Consequently, there is a reduction in monocular visual acuity, diminished contrast sensitivity, and impaired stereopsis<sup>[8, 13]</sup>.

Functional neuroimaging studies have demonstrated abnormal activation patterns in the visual cortex of amblyopic patients, with decreased responses from the amblyopic eye and altered binocular integration<sup>[16]</sup>. These neural changes are largely reversible if the abnormal visual input is corrected within the critical developmental window through targeted therapies.

## Conventional Treatment Strategies & Their Limitations

### Optical Correction and Refractive Adaptation

Full refractive correction with spectacles or contact lenses is the foundational step in treating anisometropic amblyopia. In many cases, correction alone can improve visual acuity by providing a clearer retinal image, thus reducing cortical suppression<sup>[7]</sup>. However, improvement with refractive correction alone may be incomplete or slow, especially in older children or those with severe amblyopia, necessitating additional treatment modalities.

### Occlusion Therapy (Patching)

Occlusion therapy involves patching the dominant, non-amblyopic eye to force the use of the amblyopic eye, thereby promoting visual cortical development associated with the weaker eye. This method has been the mainstay of amblyopia treatment for over a century and has proven effective in many cases<sup>[20]</sup>.

However, occlusion therapy is associated with several challenges:

- **Poor Compliance:** Children often find patching uncomfortable or socially embarrassing, resulting in inconsistent use and diminished treatment efficacy<sup>[22]</sup>.
- **Incomplete Restoration of Binocular Vision:** While monocular acuity may improve, patching does not adequately address binocular dysfunction, leaving deficits in stereopsis and contrast sensitivity<sup>[10]</sup>.
- **Potential for Reverse Amblyopia:** Excessive patching risks inducing amblyopia in the patched eye if not carefully monitored.

### Pharmacologic Penalization

Atropine penalization blurs the dominant eye pharmacologically, promoting use of the amblyopic eye without occlusion. This approach can be less stigmatizing and easier to comply with than patching<sup>[4]</sup>. Nevertheless, side effects such as light sensitivity and poor near vision can limit tolerability. Moreover, atropine does not directly address binocular vision deficits.

## Advances In Binocular & Digital Therapies For Amblyopia

### Perceptual Learning and Neuroplasticity in Amblyopia

Perceptual learning refers to the process by which practice or experience results in a long-lasting

improvement in the ability to perform sensory tasks<sup>[14]</sup>. In the context of amblyopia, perceptual learning exploits residual neural plasticity in the visual cortex beyond the traditional critical period, allowing improvement in visual functions through repeated, task-specific stimulation.

Research has shown that training on tasks such as contrast detection, orientation discrimination, or spatial localization can enhance visual acuity, contrast sensitivity, and sometimes stereopsis in amblyopic patients, including older children and adults previously considered resistant to treatment<sup>[15, 21]</sup>. This suggests that amblyopia treatment need not be confined to early childhood and that targeted visual training can reactivate plastic cortical circuits.

The neural mechanisms underlying perceptual learning involve synaptic strengthening, reorganization of receptive fields, and reduced interocular suppression within binocular cortical neurons<sup>[12]</sup>. Importantly, perceptual learning-based interventions typically engage the amblyopic eye under binocular conditions to facilitate functional recovery of binocular vision rather than monocular compensation alone.

### Dichoptic Therapy and Its Role in Amblyopia Treatment

Dichoptic therapy represents a specialized form of perceptual learning that presents distinct but complementary stimuli to each eye simultaneously, thereby promoting binocular combination and reducing suppression of the amblyopic eye<sup>[8]</sup>. Unlike occlusion, dichoptic therapy aims to rebalance binocular cortical input by adjusting the contrast and luminance of stimuli so that the amblyopic eye is favored, enabling simultaneous stimulation of both eyes.

This approach has been implemented through interactive videogames or apps that require binocular cooperation to complete visual tasks, making therapy engaging and motivating for children<sup>[3]</sup>. Several clinical trials have demonstrated improvements in visual acuity and stereopsis with dichoptic therapy, though the magnitude and consistency of benefits vary<sup>[17]</sup>.

### Digital Technologies in Amblyopia Therapy

The increasing ubiquity of digital devices has catalyzed the development of home-based, gamified visual training platforms for amblyopia treatment. Tablets, smartphones, and computer monitors have been used to deliver monocular or dichoptic exercises, enhancing accessibility and potentially improving compliance<sup>[11]</sup>.

However, these two-dimensional platforms have limitations in terms of stimulus control, immersion, and

depth perception. Specifically, they may inadequately replicate real-world binocular cues, limiting the extent to which they can retrain complex binocular functions such as stereopsis.

### Emergence of Virtual Reality (VR) Systems for Vision Therapy

Virtual reality (VR) technology has recently emerged as a promising platform to overcome these limitations by providing fully immersive, stereoscopic 3D environments where precise control over visual stimuli is possible<sup>[18]</sup>. VR headsets create a realistic sense of depth through stereopsis and motion parallax, critical for stimulating and retraining binocular visual pathways.

Key advantages of VR for amblyopia treatment include:

- **Stereoscopic Presentation:** Delivering distinct images to each eye via separate displays with adjustable parameters such as contrast, spatial frequency, and motion characteristics.
- **Full Immersion:** Enveloping the user's visual field, reducing distractions, and increasing attentional focus.
- **Engagement and Gamification:** Interactive VR games encourage motivation and compliance, vital for paediatric patients.
- **Real-Time Adaptation:** VR software can dynamically adjust stimulus parameters based on user performance, tailoring therapy intensity.
- **Objective Data Collection:** VR platforms can log extensive usage and performance data, allowing clinicians to monitor progress remotely.

Early pilot studies and case reports indicate that immersive VR therapy may yield improvements in visual acuity, stereopsis, and contrast sensitivity in amblyopic children, with excellent tolerability and high patient satisfaction<sup>[5, 18]</sup>.

### Pilot Study: Methods & Detailed Results

#### Study Design

This prospective pilot interventional study evaluated the effect of immersive virtual reality-based dichoptic therapy on visual outcomes in children with anisometropic amblyopia. The study was conducted at Narayan Eye Care and Wellness Institute, Lucknow, Uttar Pradesh, India.

#### Ethical Approval and Participant Consent

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Narayan Eye Care and Wellness Institute,

Lucknow, India (Approval Number: 142/2025; Approval Date: 25 January 2025).

Written informed consent was obtained from parents or legal guardians of all participants prior to enrolment. Age-appropriate assent was obtained from children aged seven years and above after explanation of study procedures, potential benefits, and minimal risks. Participation was voluntary, and participants could withdraw at any stage without affecting clinical care. Participant confidentiality was maintained through anonymization and coded data identifiers.

### Participants and Inclusion Criteria

The study enrolled four paediatric participants diagnosed with anisometropic amblyopia (two females and two males; age range: 6–11 years). All participants had stable refractive correction for at least three months before therapy initiation and underwent comprehensive baseline binocular vision assessment.

Inclusion criteria were:

- BCVA in amblyopic eye between 20/40 and 20/100
- Absence of manifest strabismus
- No history of amblyopia treatment within six months prior to enrolment

Participant demographic and clinical characteristics are summarized in [Table. 1].

**Table 1: Participant demographic and clinical characteristics**

Participant	Age	Sex	Amblyopic Eye BCVA (logMAR)	Refractive Error (D)	Baseline Stereoacuity (arcsec)
1	6	F	0.5 (20/63)	+3.00	200
2	8	M	0.3 (20/40)	-4.50	400
3	10	F	0.4 (20/50)	+2.75	800
4	11	M	0.5 (20/63)	-3.00	400

### Intervention Protocol

Participants underwent 18 supervised office-based VR therapy sessions over six weeks (three sessions weekly, approximately 30 minutes each). A head-mounted VR display with stereoscopic visualization and head-tracking technology was used to create an immersive three-dimensional virtual environment.

Dichoptic interactive games required binocular cooperation for tasks such as shape recognition, motion detection, and contrast discrimination. Stimulus contrast and luminance were dynamically adjusted to reduce interocular suppression and enhance binocular fusion. Spatial frequencies ranging from 1 to 6 cycles per degree

were targeted to stimulate acuity and stereopsis pathways. All sessions were supervised by trained therapists to ensure correct headset usage and participant engagement.

### Outcome Measures

Primary and secondary outcome measures included:

- **Visual Acuity:** Distance and near BCVA measured using standardized logMAR charts
- **Stereoacuity:** Evaluated using the Randot stereotest
- **Contrast Sensitivity:** Assessed at 3 cycles per degree
- **Safety and Compliance:** Monitored via session attendance, adverse event recording, and participant feedback.

## Results

### Visual Acuity

Distance best-corrected visual acuity (BCVA) demonstrated improvement in two participants aged 6 and 8 years, with gains ranging from 0.1 to 0.2 logMAR units following completion of the VR therapy program. The remaining two older participants (aged 10 and 11 years) maintained stable distance BCVA throughout the intervention period. Near visual acuity improved in three participants, with improvements corresponding to one to two lines on standardized near vision charts.

### Stereoacuity

Stereoacuity improved in all four participants following therapy. Three participants achieved a final stereoacuity threshold of 60 arcseconds, representing functional binocular depth perception. Baseline stereoacuity ranged from 200 to 800 arcseconds, indicating substantial binocular functional improvement across participants.

### Contrast Sensitivity

Contrast sensitivity measured at 3 cycles per degree demonstrated improvement in three participants, with an average gain of approximately 0.5 log units. These findings suggest enhancement in mid-spatial frequency visual processing, which contributes to improved spatial resolution and depth discrimination.

### Compliance and Safety

All participants completed the prescribed 18 therapy sessions, demonstrating excellent compliance with the intervention protocol. No adverse effects, including motion sickness, headache, visual discomfort, or ocular strain, were reported during or after therapy sessions.

## Discussion

## Interpretation of Findings and Neuroplasticity Considerations

The results of this pilot study support the hypothesis that immersive virtual reality (VR)-based perceptual learning can induce measurable improvements in visual function in children with anisometropic amblyopia. The observed improvements in visual acuity, stereopsis, and contrast sensitivity particularly among younger participants highlight the presence of residual cortical plasticity beyond the traditionally defined critical period.

The ability of VR to present distinct and controlled visual stimuli to each eye while maintaining binocular fusion likely underlies its therapeutic effectiveness. By modulating contrast and luminance to favour the amblyopic eye, the VR environment reduces interocular suppression, a fundamental pathophysiological mechanism in anisometropic amblyopia<sup>[8]</sup>. This controlled binocular stimulation may facilitate synaptic strengthening and functional reorganization within primary and extrastriate visual cortical regions, thereby promoting binocular integration and improving monocular acuity<sup>[16]</sup>.

As this is a pilot study, further investigations are planned to expand subject cohorts and explore neuroimaging correlates and real-world visual performance outcomes. The improvements in stereopsis are particularly noteworthy, as traditional monocular therapies, such as patching, frequently fail to restore binocular depth perception<sup>[10]</sup>. The enhancement in contrast sensitivity additionally suggests that VR therapy may target neural processing channels beyond simple acuity, improving the precision of spatial detail processing.

## Comparison with Existing Treatments

Conventional amblyopia treatments, including patching and atropine penalization, primarily focus on promoting use of the amblyopic eye by occluding or pharmacologically blurring the dominant eye, often overlooking underlying binocular dysfunction<sup>[2]</sup>. Although this monocular approach can improve visual acuity in many cases, it does not consistently restore stereopsis or eliminate suppression<sup>[9]</sup>.

Recent developments in binocular treatment modalities, such as dichoptic training delivered through computer or tablet-based platforms, have demonstrated promising outcomes. However, these approaches are limited by the two-dimensional nature of stimulus presentation and reduced immersion<sup>[17]</sup>. Non-immersive dichoptic therapies may also experience reduced patient engagement and limited stimulation of naturalistic binocular cues.

Immersive VR therapy addresses these limitations by providing stereoscopic, interactive three-dimensional environments that closely simulate natural viewing conditions. This improves the ecological validity of visual training and may accelerate cortical plasticity. Furthermore, real-time adaptation of stimulus parameters allows individualized therapy based on suppression levels and performance, a feature that is largely absent in conventional treatment methods.

## Clinical and Technological Implications

The findings support the potential integration of VR-based therapies as an adjunct or alternative to traditional amblyopia treatments, particularly for children with anisometropic amblyopia who continue to demonstrate visual deficits despite optimal optical correction. The interactive and engaging nature of VR-based therapy may enhance compliance, which remains a critical determinant of treatment success.

Additionally, the objective data recording capabilities of VR systems enable remote monitoring of therapy adherence and visual progress, facilitating telemedicine-based amblyopia management. This approach may be particularly beneficial in underserved or rural regions where access to paediatric ophthalmology services is limited.

From a technological standpoint, continuous advancements in VR hardware, including lighter and more ergonomic headsets with improved resolution and wider fields of view, are expected to enhance therapy comfort and effectiveness. The integration of eye-tracking and augmented reality technologies may further allow personalized stimulus delivery and enable therapy within naturalistic environments.

## Limitations and Challenges

Despite encouraging preliminary findings, this study has several limitations. The small sample size ( $n=4$ ) limits generalizability, and the absence of a control group prevents definitive conclusions regarding treatment efficacy compared with placebo or conventional therapies.

The relatively short follow-up duration restricts assessment of the long-term sustainability of visual improvements and potential regression. Furthermore, office-based therapy sessions may not fully reflect real-world compliance levels achievable through home-based treatment systems.

As this is a pilot study, future research is planned to address these limitations and improve scalability. Although no adverse symptoms were reported in this cohort, the possibility of motion sickness or visual

discomfort remains a consideration in larger populations.

## Future Directions

### Future Research and Clinical Trials

The encouraging outcomes observed in this preliminary investigation highlight the need for larger, well-designed randomized controlled trials (RCTs) to rigorously evaluate the efficacy, optimal therapeutic dosage, and long-term benefits of immersive VR therapy in anisometropic amblyopia. Future research should focus on:

- Larger sample sizes to improve generalizability across different age groups, amblyopia severities, and refractive profiles
- Inclusion of control groups receiving standard or placebo interventions to determine treatment-specific effects
- Longitudinal follow-up to evaluate durability of visual improvements and functional visual outcomes
- Development and evaluation of home-based VR therapy systems to improve accessibility and compliance
- Integration of neuroimaging and electrophysiological biomarkers to better understand cortical changes associated with VR therapy
- Development of artificial intelligence–driven adaptive algorithms to individualize therapy based on suppression patterns and treatment response

### Clinical Implementation Considerations

VR therapy may be considered as a complementary modality within a multimodal amblyopia treatment strategy. Early initiation of therapy, particularly in younger children, may maximize neuroplastic potential. Educating patients and caregivers regarding the importance of consistent therapy and setting realistic expectations remains essential for achieving optimal outcomes.

Healthcare systems and policymakers should also consider frameworks for incorporating VR-based therapies into pediatric ophthalmology services, including therapist training and evaluation of device accessibility and cost coverage.

## Conclusion

Immersive virtual reality represents a novel, engaging, and technologically advanced approach to the management of anisometropic amblyopia. By utilizing perceptual learning principles and dichoptic stimulation within a fully immersive three-dimensional environment, VR therapy has the potential to improve visual acuity, stereopsis, and contrast sensitivity, which are essential components of functional vision.

Although preliminary findings are promising, larger clinical trials and continued technological innovation are required to fully establish the therapeutic role of VR in amblyopia management. Ongoing research may further optimize treatment protocols and facilitate clinical implementation, potentially transforming the management paradigm of amblyopia and improving visual outcomes and quality of life in affected children.

## Disclosure

**Conflict of Interest Statement:** The authors declare no conflicts of interest.

**Funding:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## References

1. American Academy of Ophthalmology. (2017). *Preferred Practice Pattern® Guidelines: Amblyopia*.
2. Birch EE. Amblyopia and binocular vision. *Progress in Retinal and Eye Research*. 2013; 33:67-84. Available from: <https://doi.org/10.1016/j.preteyeres.2012.11.001>
3. Birch EE, Li SL, Jost RM, Morale SE, De La Cruz A, Stager DR, et al. Binocular iPad treatment for amblyopia in preschool children. *Journal of American Association for Pediatric Ophthalmology and Strabismus*. 2015; 19(1):6-11. Available from: <https://doi.org/10.1016/j.jaapos.2014.09.009>
4. Chua BL, Mitchell P, Saw SM. (2006). Amblyopia treatment in children: atropine penalization versus patching. *Ophthalmology*, 113(6), 787–792.
5. Chung STL, Li RW, Levi DM. Improving vision in adult amblyopia by perceptual learning. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2017; 372(1717). Available from: <https://doi.org/10.1098/rstb/372/1717>
6. Cotter SA, Edwards AR, Wallace DK, Beck RW, Arnold RW, Birch EE, et al. Treatment of anisometropic amblyopia in children with refractive correction. *Ophthalmology*. 2006; 113(6):895-903. Available from: <https://doi.org/10.1016/j.opthta.2006.01.068>
7. Cotter SA, Chu R, Chandler D, Beck RW, Arnold RW, Birch EE, et al. (2007). Treatment of moderate amblyopia with refractive correction alone. *Ophthalmology*, 114(8), 1515–1520.
8. Hess RF, Thompson B, Baker DH. Binocular vision in amblyopia: structure, suppression and plasticity. *Ophthalmic and Physiological Optics*. 2014; 34(2):146-162. Available from: <https://doi.org/10.1111/opo.12123>
9. Holmes JM, Clarke MP. Amblyopia. *The Lancet*. 2006; 367(9519):1343-1351. Available from: [https://doi.org/10.1016/s0140-6736\(06\)68581-4](https://doi.org/10.1016/s0140-6736(06)68581-4)
10. Holmes JM, Repka MX. (2009). Management of amblyopia: Diagnosis and treatment. *American Academy of Ophthalmology*.
11. Kelly KR, Jost RM, De La Cruz A, Dao L, Birch EE. Binocular iPad Game vs Patching for Treatment of Amblyopia in Children: A Randomized Clinical Trial. *JAMA Ophthalmology*. 2016; 134(12):1402-1408. Available from: <https://doi.org/10.1001/jamaophthalmol.2016.4224>

12. Kiorpes L. Visual Processing in Amblyopia: Animal Studies. *Strabismus*. 2006; 14(1):3-10. Available from: <https://doi.org/10.1080/09273970500536193>
13. Levi DM. Linking assumptions in amblyopia. *Visual Neuroscience*. 2013; 30(5-6):277-287. Available from: <https://doi.org/10.1016/s0952523813000023>
14. Levi DM, Li RW. Perceptual learning as a potential treatment for amblyopia: A mini-review. *Vision Research*. 2009; 49(21):2535-2549. Available from: <https://doi.org/10.1016/j.visres.2009.02.010>
15. Levi DM, Polat U, Spierer A. (2015). *Perceptual learning in amblyopia*. Springer.
16. Li J, Thompson B, Deng D, Chan LYL, Yu M, Hess RF, *et al*. Dichoptic training improves contrast sensitivity in adults with amblyopia. *Vision Research*. 2015; 114:161-172. Available from: <https://doi.org/10.1016/j.visres.2015.01.017>
17. Li J, Jost RM, Morale SE, Stager DR, Dao L, Birch EE. (2019). Binocular treatment of amblyopia using videogames (BRAVO): A randomized controlled trial. *Investigative Ophthalmology & Visual Science*, 60(4), 1415–1425.
18. Li S, Ashraf M, Solanki A. (2020). Virtual reality and amblyopia: a review of new therapeutic strategies. *Current Opinion in Ophthalmology*, 31(5), 327–332.
19. Mendola JD, Conner IP, Sharma A, Baer J. (2005). Altered neural processing in amblyopia: an fMRI study. *Investigative Ophthalmology & Visual Science*, 46(6), 2075–2081.
20. Pediatric Eye Disease Investigator Group. A Randomized Trial of Patching Regimens for Treatment of Moderate Amblyopia in Children. *Archives of Ophthalmology*. 2003; 121(5):603-611. Available from: <https://doi.org/10.1001/archophth.121.5.603>
21. Polat U, Ma-Naim T, Belkin M, Sagi D. Improving vision in adult amblyopia by perceptual learning. *Proceedings of the National Academy of Sciences*. 2004; 101(17):6692-6697. Available from: <https://doi.org/10.1073/pnas.0401200101>
22. Webber AL, Wood J. (2005). The effect of spectacle wear on visual acuity in anisometropic amblyopia. *Optometry and Vision Science*, 82(2), 96–103.
23. Williams C, Northstone K, Harrad R, Sparrow J, Harvey I, Harvey L. Prevalence and risk factors for common vision problems in children: data from the ALSPAC study. *British Journal of Ophthalmology*. 2008; 92(7):959-964. Available from: <https://doi.org/10.1136/bjo.2007.134700>

**How to cite this article:** Kumari R. Unlocking Visual Neuroplasticity in Pediatric Anisometropic Amblyopia Through Immersive Virtual Reality Therapy. *Journal of Medical Sciences and Health* 2026; 12(1):75-81

Date of submission: 27.06.2025

Date of review: 15.07.2025

Date of acceptance: 25.02.2026

Date of publication: 06.05.2026