

COMMENTARY

Unleashing the power of Virtual Reality to manage LAZY EYE-A silent public health problem: A case study from India

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Amblyopia, also known as "lazy eye," is a childhood vision disorder characterized by impaired coordination between the brain and the eye, resulting in decreased vision in one eye. It is not caused by any structural abnormalities in the eye but rather by a lack of effective coordination between the eye and brain during the crucial period of visual development in early childhood.(1) Amblyopia is a significant global public health issue, with an estimated prevalence of 1-5% of the global population according to the World Health Organization (WHO). Developing countries face a higher burden of amblyopia due to limited access to early diagnosis and treatment. If left untreated, amblyopia can result in permanent vision loss and impairment, negatively impacting an individual's quality of life, educational achievements, and career prospects.(1) A 2017 study explored the prevalence and impact of amblyopia and strabismus in Indian children. The study found a prevalence rate of 1.67% for

amblyopia among children aged 5-15 years, with a higher occurrence in rural areas compared to urban areas.(2) In another study conducted by Gupta et al. found the percentage of amblyopia was 8.6% (n=31) among 5-15 years children in uttrakhand.(3) Another study conducted by Ganekal et al. revealed the prevalence of amblyopia was 1.1% (n = 44) among 5-15 years of students.(4) The research emphasized the importance of enhanced awareness, early detection, and improved access to suitable treatment options to alleviate the burden of amblyopia in India. Furthermore, the All India Ophthalmological Society (AIOS) conducted a study in 2019 titled "AIOS Guidelines for Amblyopia Management." This study aimed to provide evidence-based guidelines for managing amblyopia in India. It highlighted the lack of awareness and limited availability of eye care services in certain regions, leading to delayed diagnosis and treatment of amblyopia. The guidelines emphasized the significance of early

screening, timely intervention, and appropriate treatment approaches to prevent long-term visual impairment in children.(5)

Conventional treatment options

Although amblyopia is a diagnosis of exclusion hence, ophthalmologists need to go through detailed eye examination including fundus evaluation. The treatment of amblyopia typically entails a combination of interventions that aim to enhance vision in the affected eye and promote binocular vision (the ability of both eyes to work together). Here are some commonly employed treatment methods(6):

Corrective eyewear: Prescription glasses or contact lenses may be recommended to correct refractive errors that could contribute to the development of amblyopia.

Patching therapy: This involves covering the stronger eye with an eye patch for a designated period each day. By doing so, the brain is compelled to rely on the weaker eye, which stimulates vision in the amblyopic eye and promotes its development. Patching therapy mean at least 6 hours of patching of the stronger eye mainly in the day time while child is busy with their study hours, mainly in the school from Monday to Saturday, 6 days in a week.(6)

Atropine eye drops: In certain cases where patching therapy is not suitable or feasible, atropine eye drops may be prescribed. These drops temporarily blur the vision in the stronger eye, enabling the weaker eye to strengthen.

Vision therapy: Vision therapy comprises a series of exercises and activities specifically designed to improve visual skills, eye coordination, and depth perception.

Pharmacologic penalization: This treatment involves the application of eye drops or ointments containing penalization agents like levodopa or Bangerter filters. These agents temporarily blur the vision in the stronger eye, encouraging the utilization and development of the weaker eye.

Limitations of the current management

While the current treatment options for amblyopia have demonstrated effectiveness, they do pose certain challenges. Some of these challenges associated with amblyopia treatment include(6):

Compliance: Treating amblyopia requires consistent and prolonged effort from both the patient and their caregivers. This can be particularly challenging for young children who may struggle with consistently wearing patches or adhering to vision exercises.

Limited effectiveness in older children and adults: Amblyopia treatment tends to be most successful when initiated at an early age during the critical period of visual development. However, treatment outcomes may be less favourable for older children and adults whose visual system has already matured.

Side effects and discomfort: Patching therapy, while effective, can cause discomfort and may be accompanied by social stigma. Eye drops or ointments used in penalization or atropine therapy may also lead to temporary blurring or other side effects.

Relapse: Even after successful treatment, there is a risk of relapse, and the visual improvements achieved may not always be maintained in the long term. Continued monitoring and follow-up care are necessary to ensure sustained progress.

Access to care: Access to accurate diagnosis, appropriate treatment, and follow-up care for amblyopia can be limited, particularly in resource-limited settings and underserved populations. Factors such as lack of awareness, limited healthcare infrastructure, and financial constraints can hinder timely and suitable treatment

The case study

Virtual Reality (VR) refers to computer-based technology that enables users to immerse themselves in a multimodal virtual environment and interact with it. VR can be used for vision therapy, where patients receive real-time feedback on their activities and exercises. Vision therapy games, based on the principles of neuroplasticity, aim to improve coordination between the brain and eyes by facilitating the brain's acceptance of external stimuli. Through recommended exercises, vision therapy trains the eyes and brain to work together more effectively, enhancing brain-eye synchronization. This multisensory approach helps improve various visual functions and prevent the progression of visual problems.

Unlike traditional therapy, VR therapies utilize engaging and immersive video games. Patients with a VR headset and the necessary technology can complete vision treatment exercises in the comfort and privacy of their own homes. **Cognihab's** Vision Therapy Suite is an alternative to traditional vision treatment exercises that has shown effectiveness in treating Amblyopia in kids & adults.(7) In Cognihab's mobile & VR application, patients practice their strong & amblyopic eye's coordination skills in a simulated environment where each eye sees a different image in the same background. The suite offers a range of games with varying levels of complexity, allowing for individualized treatment based on patient needs and goals.

Cognihab's approach to treating amblyopia using VR technology involves the following methodology:

Virtual Reality Hardware: Cognihab utilizes advanced VR hardware & mobile VR hardware in combination with Cognihab's application to deliver different images to each eye of the patient.

Image Splitting: The virtual reality environment is divided into two images, one for the stronger eye and one for the weaker eye.

Signal Strength Modification: The strength of visual signals in the stronger eye is intentionally reduced or maintained the same, while it is enhanced for the weaker eye. This modification promotes collaboration between the eyes, facilitating their coordinated functioning. These adjustments are automatically made during the game based on the patient's performance.

Progressive Assistance Reduction: As the patient progresses through the treatment, they require less assistance. Consequently, the disparity in signal strength between the eyes gradually diminishes.

Skill Development: Through repetitive practice, the patient's two eyes learn to work together more effectively, improving their coordination and functioning.

The ultimate goal of the treatment is for patients to no longer rely on image modification to combine visual inputs and consistently perceive depth. Till date a total of

more than **170** patients participated in the research and the treatment was given to people ranging from the age of 5 to 35 and above and a large section of patients were above the critical age of 9 years. Initial results indicate that among compliant patients who participated in follow-up evaluations, an encouraging **85%** reported a minimum improvement of one line in their vision. Additionally, a significant number of patients reported enhancements in stereopsis (perception of depth). These early findings demonstrate the potential effectiveness of **Cognihab's** VR-based amblyopia treatment and highlight its promise as a non-invasive and engaging therapeutic approach. Cognihab's on-going research in virtual reality-based amblyopia treatment shows promising outcomes in enhancing visual acuity, depth perception, and overall visual integration. By harnessing the capabilities of virtual reality, Cognihab aims to transform the approach to amblyopia treatment, ultimately enhancing the lives of patients worldwide. Continued research and collaboration with medical institutions will contribute to refining treatment protocols, expanding the patient population, and increasing accessibility to this innovative solution.

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