Case Series

Virtual Reality for Treatment of Amblyopia in Adults

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ABSTRACT

Purpose: To observe efficacy of Virtual reality technology as a potential treatment for improving vision in anisometropic amblyopia without the need of occlusion or penalization.

Study Design: Experimental case series.

Place and Duration of Study: Isra University Hospital, Hyderabad, from Nov 2020 to Oct 2021.

Methods: Patients (more than 12 years of age), with Anisometropic amblyopia, were included in this study. Patients with history of strabismus, cataract or any active ocular surface disease were excluded. Unaided visual acuity, pinhole test and best-corrected visual acuity were recorded, before and after treatment. LogMAR chart was used for this purpose. Crowding phenomenon was also checked. Anterior segment and posterior segment examination was done to rule out any organic cause of disease. A head mounted device-virtual reality glasses (HMD-VR) was used 40 min daily for 03 months to improve visual acuity. All the data was recorded on a proforma. SPSS version 22.0 was used for data analysis and P-value of <0.05 was considered significant.

Result: Mean age of the patients was 24.2 years (range 14 – 35 years). Out of 14 registered cases, 08 (57.1%) patients showed improvement after 08 weeks of initiation of treatment with VR glasses. Two (14.3%) patients showed improvement after 12 weeks and two showed no improvement, while two (14.3%) patients lost to follow up. After applying paired t test the value of p was < 0.001, which was statistically significant.

Conclusion: This HMD VR glasses seems to be an effective option for treatment in adults with anisometropic amblyopia.

Key Words: Anisometropic Amblyopia, Head mounted Virtual reality glasses, Neuroplasticity.

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INTRODUCTION

Plasticity is the ability of the nervous system to rewire its synaptic connections, to improve functioning. Worldwide, 1.5:100 people are suffering from normotypic vision due to amblyopia and another 1:4000 have retinal dystrophies.[1] Various techniques have been developed to rehabilitate vision.[2] There is a good and noticeable preservation of visual pathway from retina to visual cortex, which can be stimulated in any age group.[3,4] Cells in human cortex have the capability to divide and assume a wide range of cognitive functions. In Lieu of pluripotency hypothesis, cognitive function is a ubiquitous phenomenon in human cortical development.[5,6] Patients with amblyopia present with reduced contrast sensitivity and visual acuity. Amblyopia is treated by prescribing the accurate eye glasses, correction of any underlying organic cause and or occlusion. Recent studies have shown that certain other techniques can be applied to reinstate normal visual function (i-e video games, 3-D devices, which stimulate neurons at cognitive level).[7] These technologies are user friendly and are well-tolerated.

Virtual reality glasses have been reported to enhance brain functions and improve visual output in a short duration of period. As local data regarding such

type of amblyopia therapy is scarce, our aim is to evaluate the visual potential of an amblyopic eye in adults after treating it with head mounted device i-e VR glasses.

METHODS

This case series was conducted at Isra University Hospital, Hyderabad, from November 2020 to October 2021. Patients were recruited from out-patient department. Patients above 12 years of age with anisometropic amblyopia were included in this study. Patients with strabismus, any ocular organic disease and previous ocular surgery were excluded. Unaided Visual acuity, pin hole acuity and best corrected visual acuity were recorded, before and after treatment using logMAR chart. Crowding phenomenon was also checked with the help of logMAR chart. Anterior segment and posterior segment examination was done to rule out any organic cause of disease. A head mounted virtual reality device was used for 40 minutes, daily for 03 months. Data was recorded on a specific designed proforma. P-value of < 0.05 was considered significant. SPSS version 22.0 was used for data calculation.

RESULTS

Twelve patients with more than 12 years of age, were diagnosed with Anisometropic amblyopia between November 2020 to October 2021. They were treated with HMD-VR glasses. There were nine males (64.3%) and five females (35.7%) with mean age of 24.2 years (range 12-35 years). Pre-treatment visual acuity was 0.80 logMAR. There was 3 logMAR lines improvement in 08 patients (57.1%) after 08 weeks while there was 2 line improvement in 02 (14.3%) patients at 12 weeks and no improvement in 02 (14.3%) patients even at 12 weeks and two patients lost to follow up (Table 1). Mean visual Acuity at baseline was 0.07 ± 0.12 logMAR. After HMD-VR it was improved to 0.15 ± 0.12 logMAR ($p < 0.001$). There were no ocular or systemic adverse effects during or after the use of head mounted VR glasses.

Table 1: *Clinical Characteristics of Patients.*

Characteristics	Value
Mean age in years	24.2
Gender	
Male	9 (64.3%)
Female	5 (35.7%)
Visual Acuity	
Visual Acuity (Pre treatment)	0.80 ± 0.12 logMAR
Visual Acuity (Post treatment)	0.15 ± 0.12 logMAR
08 weeks (3 line improvement)	08 (57.1%)
12 weeks(2 line improvement)	02 (14.3%)
12 weeks (no improvement)	02 (14.3%)
Lost to follow up	02 (14.3%)
Total	14 (100%)

DISCUSSION

In patients with Anisometropic amblyopia, virtual reality glasses play an important role in rehabilitation of visual acuity. They are cost effective and easily available.

Activation of neurons leads to advanced synaptic stimulation that enhances strength between neurons and thus changes occur at the level of sensory-motor networks.[8] Viston-VR™ system was proposed by Qiu and colleagues.[9] In this system, the main feature was using two dissociated optical systems that provided independent displaying contents for each eye. Each eye was stimulated by viewing different cartoon films or playing interactive VR games by means of specially devised glasses. This is in contrast to our study, in which we used head mounted VR glasses that are portable and easy to use and also safe and well tolerated by the individuals. Gottlob and Stangler-Zuschrott, introduced levodopa for the first time to treat low levels of dopamine in adults having amblyopia.[10] Increased contrast sensitivity and decrease in scotoma was observed with the single dose administration of levodopa. In our study, we did not measure dopamine levels or its effects while using virtual reality glasses, though the levels of dopamine should be monitored during and after successful sessions of VR glasses.

There are different opinions regarding the treatment modalities of amblyopia after the sensitive period of 9 years that might lead to diplopia, strabismus and may not be able to be treated with prisms or surgery.[11] In our study, no such adverse effects like diplopia or strabismus were observed during or after the successful sessions with VR glasses.

Similarly, Eaton et al. suggested that visual acuity could only be regained after repetitive visual experience.[12] In our study, we also advised continuous visual stimulation through virtual reality glasses which became the cause of improvement in visual acuity. Sengpiel, also claimed that repetitive visual training

promoted acuity and enhanced stereopsis.[13] However, we did not record stereopsis in our study.

Stimulation of primary visual cortex with the help of electrophysiological activity, was also reported in patients with retinal diseases.[14] However one of the study claimed that improvements in visual acuity with binocular treatment occur much faster than monocular with patching. The study reported gains of almost 2 lines occurring in just 4 – 8 weeks rather than with 4 – 6 months of patching.[15]

Despite our success of treating amblyopia with HMD VR glasses in adults, further work need to be done in this field. We did not include strabismic amblyopia and children less than 09 years of age in our study. A large study should be conducted in adults as well as in pediatric age group.

CONCLUSION

There is a crucial role of neuroplasticity in the recovery of visual system in adults having anisometropic amblyopia. HMD VR glasses are a good option in such cases.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board **(IUH/ASST DEAN(CS)/04/30).**

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Authors' Designation and Contribution

Rebecca; *Concepts, Design, Literature search, Manuscript editing.*

Murtaza Sameen Junejo; *Data analysis, Manuscript preparation.*

Muhammad Tahir; *Statistical analysis.*

Fahad Feroz Shaikh; *Manuscript review, Final approval of Manuscript.*

Nazir Ashraf Laghari; *Manuscript review, Final approval of Manuscript.*