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Background

Amblyopia is a reversible deficit of vision that has to be treated within the sensitive period for visual development. Screening programmes have been set up to detect this largely asymptomatic condition and refer children for treatment while an improvement in vision is still possible. The value of such programmes and the optimum protocol for administering them remain controversial. Amblyopia commonly known as “lazy eye” is an abnormal binocular experience due to a mismatch between the images perceived with each eye. This situation may be caused by visual deprivation due to congenital cataract, unequal refractive errors or strabismus. This is known as the 'critical period'. In some situations, the critical period may be extended. The developing visual system relies on good quality visual images. Amblyopia can develop when the image coming into one or both eyes is either blurred or obscured. It develops through an abnormal binocular cortical interaction and results in a loss of acuity, contrast sensitivity, and/or positional disorder. The aetiology is often a high refractive error, anisometropia, strabismus or a combination of these factors.

Amblyopia is the leading cause of monocular visual impairment in children, affecting 2-3% in the United States. Amblyopia has traditionally been viewed as a monocular disorder that can be treated by patching the fellow eye to force use of the amblyopic eye. Patching can improve visual acuity for 73% to 90% of children with amblyopia, but 15% to 50% may never achieve normal visual acuity after a lengthy course of treatment. Amblyopia recurs after successful treatment in 25% to 50% of children, and normal binocularity is rarely restored after patching treatment. In recent years, virtual reality (VR) has emerged as a new tool for neuro rehabilitation of different childhood and adulthood conditions. Virtual reality-based therapies can induce cortical reorganization and promote the activation of different neuronal connections over a wide range of ages, leading to contrasted improvements in motor and functional skills.

In Malaysia, children with amblyopia is treated mainly with patch as no virtual reality yet available within the Ministry of Health (MOH) facility. Hence, this technology review is conducted to review the effectiveness/efficacy, safety, cost/cost-effectiveness and organisational issues related to this virtual reality in the management of amblyopia. This review was conducted upon request by our MOH National Head Advisor (Ophthalmology) from Hospital Shah Alam to review the best current scientific evidence on VR for amblyopia.

Objective/aim

To review the best current scientific evidence on effectiveness/efficacy, safety, cost/cost-effectiveness and organisational issues related to this virtual reality in the management of amblyopia.

Results and conclusions

From a total of 67 titles identified through the Ovid and PubMed interface, four studies were included in this review which consisted of two randomised controlled trials, one single arm study and one pre- and post- intervention study. The included articles were published between 2016 and 2020. Most studies were conducted in United States of America, United Kingdom, Spain and Slovakia.

Effectiveness:
There was very limited fair level of retrievable evidence to suggest the use of VR was associated with best corrected visual acuity (BCVA) and stereoacuity for treating amblyopia.

- at the 2- and 4- week, a larger improvement in amblyopic eye BCVA was found with the binocular game compared with patching, with a mean (SD) improvement of 0.15 (0.08) logMAR (mean [SD], 1.5 [0.8] lines) versus 0.07 (0.08) logMAR (mean [SD]], 0.7 [0.8] line improvement); (mean difference, 0.07 logMAR [0.7 line]; 95% CI, 0.01 to 0.14 logMAR [0.1-1.4 lines]; $p = 0.02$).
- mean stereoacuity changed from a value of 263.3 ± 135.1 before dichoptic training to a value of 176.7 ± 152.4 s of arc after training ($p < 0.01$).
- the visual acuity improved in all three groups at weeks 3, 6 and 10 with the average improvement of vision at week 6 of 0.07 logMAR which was sustained at week 10. This improvement was significant at all three time points ($p< 0.001$)

Safety:
There was no retrievable evidence on use of VR reported in the included studies. Virtual reality from VIVID® Vision was registered with USFDA in 2018.

Cost/Cost-effectiveness:
There was no retrievable evidence on the cost or cost-effectiveness of VR treatment for amblyopia (lazy eye). However, various price or fees of VR devices of the treatment for lazy eye/amblyopia. Ranging price from USD 129 to USD 399 (~RM1800). Costs estimation of VR therapy is around USD2,000 – USD6,000 (MYR 8 400 - MYR 25 100) for all evaluations, therapy, progress examinations, and follow-up post-therapy visits per patient.

Organisational:
There was no guideline retrieved which specifically addressed the use of virtual reality reported.

Methods
Electronic databases were searched through the Ovid interface; Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) 1946 to 1 September 2021, Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily 1946 to 1 September, 2021, Ovid MEDLINE(R) and In-Process, In-Data-Review & Other Non-Indexed Citations 1946 to 1 September 2021, Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily 2017 to 1 September 2021, Ovid MEDLINE(R) 1946 to September Week 1 2021, Ovid MEDLINE(R) 1996 to September Week 1, Ovid MEDLINE(R) Epub Ahead of Print 1 September 2021, Ovid MEDLINE(R) Daily Update 1 September 2021 and Ovid MEDLINE(R) 2017 to September Week 1 2021. Searches were also run in PubMed, INAHTA, Cochrane Library and US Food and Drug Administration. Google was used to search for additional web-based materials and information. Additional articles were identified from reviewing the references of retrieved articles. Last search was conducted on 1 September 2021.