

## Binocular treatment for amblyopic children: a review

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### Abstract

The narrative review was planned to investigate the efficiency of binocular treatment for amblyopic children, and to compare it with the standard methods. Literature search was conducted for articles in English language available on PubMed, Cochrane Library, Embase, Medline and PsycInfo databases as well as through bibliographies of peer-reviewed studies. Studies in the field of binocular treatment for amblyopia were included. Visual outcomes considered were visual acuity, types of amblyopia and stereoacuity. Studies on deprivation amblyopia, animal studies, literature review of amblyopia treatment, case reports, and trials targeting participants in whom previous amblyopia treatment had failed were excluded. Of the 40 studies found, 21(52.5%) met the inclusion criteria. Visual acuity and binocular function improved with binocular treatment for treating amblyopia in children by decreasing suppression depth extent and increasing stereopsis. Binocular treatment for amblyopic children was found to be an effective and fast process for the recovery of visual functions, especially in the critical time of visual development.

**Key Words:** Amblyopia, Children, Binocular treatment, Perceptual learning

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### Introduction

Children develop visual problems, such as amblyopia during the first few years of lives.<sup>1</sup> The early detection of pathological visual disorders during childhood is essential to stop visual deficits and obtain normal vision.<sup>2</sup> Amblyopia is a widespread visual disorder in children, defined as a unilateral or bilateral reduction of best-corrected visual acuity (BCVA) resulting from abnormal visual development from birth up to 8 years.<sup>2</sup> Amblyopia is associated with strabismus, refractive error, and deprivation (e.g., congenital cataract, ptosis),<sup>3</sup> which can

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result from partial or full lack of clear visual response either to one or both eyes.

Amblyopes may have insufficient accommodation and exhibit oculomotor deficits, such as unstable fixation, delayed and additional changes, like saccades initiation, and imprecise following pursuits.<sup>4</sup> There are further visual functions that are affected monocularly, such as contrast sensitivity, vernier and grating acuity functions, reducing their quality of life (e.g., difficulty in academic activities and everyday tasks).<sup>5</sup> Amblyopic vision causes disorders at some levels of supra-threshold, including perceived three-dimensional (3D) alteration, like orientation and positional misperception.<sup>6</sup>

The diagnosis of amblyopia must meet all or some of the following criteria: BCVA  $\leq$ 20/40 in at least one eye; hyperopia of more than or equal to 6 spherical equivalent diopters (D); strabismic amblyopia, including the presence of ocular deviation, like esotropia and exotropia; anisometropic amblyopia, including anisometropia of more than or equal to two spherical equivalent Ds; and children with an anterior segment or fundus abnormalities impeding clear vision.<sup>7</sup>

Amblyopia treatment aims at correcting any underlying ocular disease (e.g., congenital cataract). Traditional treatments reveal unfortunate results in many amblyopic children treated with penalisation of the good eye. Optical correction corrects refractive errors and/or occlusion or atropine penalisation therapy for the dominant eye.<sup>8</sup> However, noncompliance with patching can lead to treatment plan failure.<sup>9</sup> Compliance with occlusion therapy is crucial for an ideal result.<sup>10</sup> Atropine can be more tolerated than occlusion in regard to compliance, and distraction of social relation problems,<sup>11</sup> although atropine has some side effects, including anticholinergic and photophobia.<sup>12</sup>

The human visual system demonstrates plasticity and might be benefited from treatment pointing to decreased suppression and returning binocularity.<sup>13</sup> Perception alterations can increase the interest in the binocular treatment for amblyopia as the monocular treatment of amblyopes is regarded as a functional method of treatment. Existing approaches confirm the significance of binocular activities of the amblyopic eye and suggest binocular treatment as a possibly significant method to

attain effective treatment outcomes. Perceptual learning (PL) binocularly,<sup>14-18</sup> iPad treatment,<sup>19-24</sup> and dichoptic training (i.e., a dissimilar picture presented facing each eye)<sup>25,26</sup> were proven to yield significant outcomes for the purpose of treating interocular suppression as the essential reason of refractive and strabismic amblyopia. Progression in digital technology has accepted the use of several tools, such as iPad, iPod and laptop, with suitable software programmes, for the binocular dichoptic therapy. Previous studies provided solutions related to the importance of binocular therapy and its functions for amblyopia treatment.<sup>15,17,21,24,25</sup> The current narrative review was planned to investigate the efficiency of binocular treatment for amblyopic children and to compare the outcomes with standard treatments.

## Methods and Results

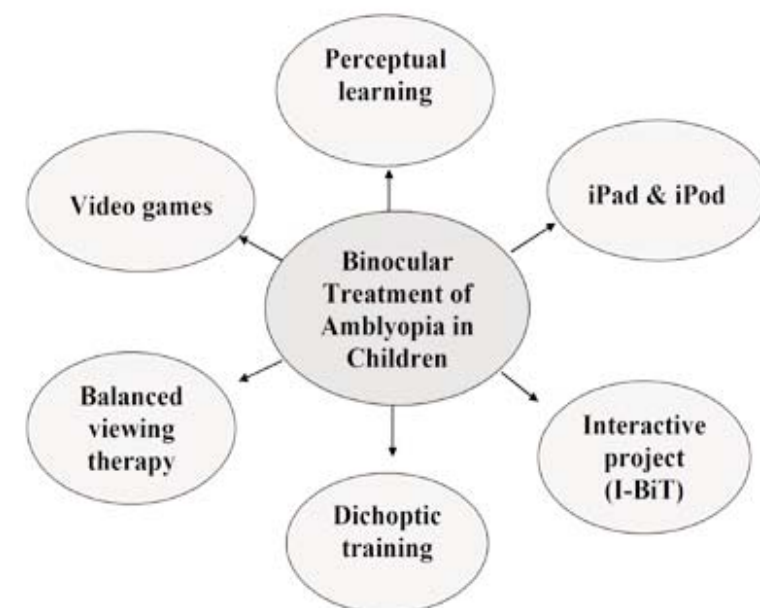
For the narrative review, literature search was conducted for articles in English language available on PubMed, Cochrane Library, Embase, Medline and PsycInfo databases as well as through bibliographies of peer-reviewed studies. Those in the field of binocular treatment for amblyopia were included. The following search terms were used: "binocular treatment for amblyopia", "perceptual learning treatment for amblyopia", "binocular treatment for amblyopia using video games", "dichoptic training using head-mounted displays", "binocular iPod treatment of amblyopia", "interactive binocular treatment project", "balanced binocular viewing therapy", and "binocular iPad

treatment of amblyopia". The topics and abstracts of the studies were initially assessed by the principal researcher. Those that met the inclusion criteria were selected.

**Inclusion criteria:** Recent reported research in the field of binocular treatment for amblyopia in children with data about VA, types of amblyopia (e.g., strabismic amblyopia, anisometropic amblyopia, or high isoametropic refractive error or a combination of conditions) and stereoacuity, in addition to the follow-up period and assessment of treatment compliance. All types of binocular treatment, including PL, binocular iPad treatment, binocular iPod treatment, binocular video games treatment, head-mounted display with dichoptic training, interactive binocular therapy project (I-BiT), and balanced binocular viewing (BBV) therapy, were included.

**Exclusion criteria:** Studies conducted on amblyopia caused by deprivation, including animal research, literature reviews of amblyopia treatment, case reports, and editorial letters were excluded. In addition, studies that did not mention the binocular treatment period and outcome measures, like contrast sensitivity or motion sensitivity, and those that included participants with medical issues were also excluded.

Of the 40 studies reviewed, 21 (52.5%) met the inclusion criteria. These studies showed and supported the interest of the binocular treatment for amblyopia (Table). Binocular treatment methods, including PL, video games, dichoptic training using head-mounted displays, binocular iPad and iPod treatment, I-BiT and BBV therapy, were the focus of the review (Figure). New technologies were integrated with standard treatment for amblyopia to understand the pathological and physiological foundation of amblyopia.



**Figure:** Most common methods for binocular treatment of amblyopia in children

### Binocular treatment of amblyopia in children

**Perceptual learning (PL):** The PL technique entails providing a single visual percept binocularly at the same time or in monocular seeing conditions.<sup>14</sup> It was reported that monocular PL can lead to an improvement in binocular vision and treating amblyopia.<sup>15</sup> It was suggested that visual functions can be enhanced with the frequent training of specific measured visual activities.<sup>16</sup> Many visual activities are distinguished as a means for PL, such as positional discrimination, vernier acuity, letter identification in noise, contrast detection, Gabor detection, and position discrimination in noise.<sup>16</sup> Previous studies showed an increase in contrast sensitivity and improvement in VA and

**Table:** Summary of clinical studies involving the use of binocular treatment of amblyopia in children along with those in adults when applicable.<sup>a</sup>

Treatment	Age (range) <sup>b</sup>	Follow-up <sup>c</sup>	Average baseline VA (LogMAR)		Average baseline stereoacuity (seconds of arc)		Ref
			Per-treatment	Post-treatment	Pre-treatment	Post-treatment	
			Perceptual learning	7.3 (7–8)	NA	0.50	
	22.5 (19–27)	NA	1.200.29	1.03	415.344.1	244.232.3	20
iPad	8.5 (5–13)	4–16	0.51	0.41	2000	0	22
	(1) 4.8	4	(1) 0.48±0.25	(1) 0.31±0.20	(1) 3352	(1) 1967±181	24
	(2) 6.4		(2) 0.40±0.90	(2) 0.18±0.50	(2) 3552	(2) 175±106	
	(3) 6.4 (5–9)		(3) 0.60±0.11	(3) 0.18	(3) 3552	(3) 53±41	
	14.3 (13–16)	4–16	20/30–20/200	1 line	0	None	26
	6.5 (4–12)	4–13	0.47±0.19	0.39±0.03	NA	NA	25
	5.6 (3.7–6.9)	4–13	0.43±0.18	0.34±0.03	NA	NA	23
	32.8 (13–50)	3–13	0.36	0.25	1388	344	31
Video games	21.5 (7–55)	3–24	0.53 ± 0.16	0.47	NA	NA	29
Dichoptic training	31.2 (17–69)	4	0.58 ± 0.35	0.43±0.38	263.3 ± 135.1	176.7±152.4	28
	8.5 (6–14)	1	0.51±0.27	0.42±0.28	NA	NA	27
	9 (7–38)	4–16	0.47±0.20 <sup>d</sup>	0.49±0.26 <sup>d</sup>	3000 (7.3±2) <sup>d</sup>	200 (6.7±2.6) <sup>d</sup>	30
			0.53±0.21 <sup>e</sup>	0.51±0.18 <sup>e</sup>	3000 (7.3±2) <sup>e</sup>	140 (6.7±2.6) <sup>e</sup>	
Interactive treatment	5.4 (4–8)	2–6	0.57	0.39	NA	NA	32
Balanced viewing therapy	6.6 (3–11)	3–24	0.78±0.35	0.51±0.34	170 <sup>f</sup>	85 <sup>f</sup>	33

<sup>a</sup>The reported studies included subjects with all types of amblyopia (i.e., anisometropic, strabismic, and mixed amblyopia). <sup>b</sup>Mean of age and the range are represented in years. <sup>c</sup> Follow-up is represented in weeks. <sup>d</sup>Full treatment. <sup>e</sup>Sham crossover. <sup>f</sup>Anisometropic amblyopes. VA: Visual acuity, LogMAR: Logarithm of the Minimum Angle of Resolution, NA: Not applicable.

letter-recognition training in addition to decrease in the crowding effect completed by frequent visual training.<sup>15–17</sup>

Polat et al. in 2009 conducted a prospective study on children diagnosed with different types of amblyopia (i.e. strabismic, anisometropic amblyopia or both) with BCVA ranging between 0.3 and 0.7 logarithm of the minimum angle of resolution (LogMAR).<sup>17</sup> The PL technique was used with stimuli that exhibited on a Philips multiscan 107P colour monitor. The stimuli were limited gray-intensity screens with spatial frequencies of 1.5–12 cycles per degree (cpd), which adapted from a luminance of 40 cd/m<sup>2</sup> in the background. The efficient dimension of the monitor screen (24×32cm) applied for a seeing distance of 150cm subtended a visual angle of 9×12°. Two treatment periods were taken by subjects weekly (one hour per period) with a total of no more than 40 sessions. It was found that VA was recovered by 1.5 Snellen lines or 2.12 lines in ETDRS VA chart. Contrast sensitivity was also enhanced with PL training and achieved the normal value after the treatment.<sup>17</sup> Similarly, Zhang et al. in 2014 trained adult amblyopes after a training plus exposure (TPE) procedure. The amblyopic eyes exercised orientation, contrast, or vernier discrimination at single

orientation for 6–8 periods. The amblyopic or non-amblyopic eyes were subjected to an orthogonal direction through performing unrelated tasks. The practice was completed at a lower spatial frequency (SF) at the beginning of the training, and then it was performed at a higher SF near the cut-off frequency of the amblyopic eye. An improvement in the VA by 1.5 to 1.6 lines (p<0.001) in the amblyopic eyes and the stereoacuity by 53% (p<0.001) was achieved.<sup>18</sup>

**Binocular iPad treatment:** Computer games played on a tablet or a smartphone used for binocular visual stimulus were reported as an effective treatment method for improving VA and binocular vision.<sup>19</sup> The procedure involves presenting low-contrast pictures in front of non-amblyopic eye and high contrast pictures in front of the fellow amblyopic eye to stabilise the cortical inputs and overwhelmed interocular suppression. Holmes et al. in 2016 compared the improvement of VA in amblyopic children after playing binocular iPad game for 60 minutes a day versus part-time occlusion for 120 minutes a day for school-aged children. An improvement in the VA of 1.05 lines was achieved in children playing binocular iPad games, and 1.35 lines in children treated with part-time occlusion.<sup>20</sup> Similarly, Kelly et al. in 2016 compared

binocular treatment with occlusion in amblyopic children with mean BCVA of the amblyopic eye of 0.48 LogMAR, and children used binocular game and children treated with occlusion treatment for 14 days. After two weeks of visiting, it found that the improvement in BCVA in the amblyopic eyes was better in binocular game group in comparison to occlusion treatment group, with a mean improvement of 6/7 compared with 6/30 after 14 days of treatment. Children who used patching treatment for amblyopia were switched to binocular game treatment, and all children were asked to play a game for an extra 14 days. No difference in BCVA between the groups, and children who switched the treatment plan to binocular games caught up with those treated with binocular games, for a mean improvement of 0.17 LogMAR for the binocular game compared to 0.16 LogMAR for occlusion treatment.<sup>21</sup>

Bokhary et al. in 2020 compared the visual performances among children with uncorrected amblyopia who were treated with different binocular iPad games and/or patching.<sup>22</sup> Three groups of amblyopic children were included in the study: vamblyopic children treated with patching, amblyopic children treated with patching in addition to the binocular snake iPad game, and amblyopic children treated with patching in addition to the binocular blocks iPad game. It was found that binocular treatment with iPad games was effective for the treatment of amblyopia, resulting in an improvement of one line in the VA in the patching group, two lines in the VA with the snake game, and three lines in the VA with the blocks game. These binocular games could be used with patching therapy to reach greater outcomes of VA and stereoacuity in a shorter period than patching alone.<sup>23</sup> Another randomised clinical trial study compared VA in school-aged amblyopic children caused by strabismus, anisometropia, or both, assessed by the binocular iPad game in addition to continual optical correction versus optical correction only. After four weeks of treatment, an improvement was noticed in VA in the amblyopic eye by 1.3 lines with binocular treatment, and by 1.7 lines with the continued spectacle correction alone. Letter scores were not significantly different between the groups when the assessment was repeated after two months of amblyopia treatment.<sup>23</sup>

The novel home-based binocular treatment is an effective technique for amblyopic children who wore anaglyphic spectacles while playing binocular iPad games for four hours a week for a period of four weeks. It reported an improvement in the VA in amblyopic eye with binocular iPad treatment from  $0.47 \pm 0.03$  LogMAR at the baseline to  $0.39 \pm 0.03$  LogMAR at a month, which was maintained for

three months after the termination of treatment although stereoacuity remained constant.<sup>24</sup>

**Dichoptic training by head-mounted displays:** The dichoptic process of visual training involves the introduction of dissimilar stimuli to both amblyopic and good eyes to accomplish the activities in which combination of both stimuli is required. For instance, the object of the game is introduced to the amblyopic eye, while the good eye is introduced by the background. This is contrary to the activities of PL where one stimulus is introduced similarly to both eyes. Dichoptic training depends on enhancing binocular visual function and therefore eliminates the underlying suppression of the amblyopic eye to enhance in visual function and sensory function.<sup>25</sup>

Elhusseiny et al. in 2021 evaluated the BCVA and stereoacuity in children aged 7 years and adults with unilateral amblyopia treated with a prototype virtual reality formed binocular amblyopia treatment method for eight weeks.<sup>26</sup> The study used application of medicinal software for virtual reality headset or a sham-crossover group for a month, using sham treatment then binocular treatment for a month. VA did not improve in the amblyopic eyes of older children and adults using a prototype virtual reality binocular treatment, but the stereoacuity significantly improved compared to the baseline<sup>26</sup>.

Binocular iPod treatment: Pieces of evidence were provided using dichoptic training as a treatment process while combining it with a technique in a handheld iPod tool using the popular video game Tetris.<sup>27</sup> Hess et al. in 2014 investigated the effect of handheld video game treatment used at home on amblyopic children and compared the anaglyphic version of the iPod-based video game to the lenticular version.<sup>28</sup> The home use of a portable video game in 14 cases for about 10-30 hours re-imposed simultaneous binocular perception together with notable progresses in the VA ( $0.11 \pm 0.08$  LogMAR) and stereopsis ( $0.6 \pm 0.5$  LogMAR) in addition to the identical effect of anaglyphic and lenticular platforms. The iPod devices could record a comprehensive and precise image of compliance with treatment. This study determined that home-based dichoptic iPod therapy represented applicable treatment for adult amblyopes.<sup>29</sup>

**Binocular video games treatment:** Binocular treatment for amblyopia using video games is considered a valuable form of treatment to improve the VA and binocular vision among children and adults. A double-blind, randomised study evaluated the efficiency of novel video game-based binocular treatment for amblyopic adults and children

aged >7 years.<sup>30</sup> The primary result was improvement in BCVA at distance in the amblyopic eye from the baseline to six weeks after randomisation. The other results involved improvement in interocular suppression, stereopsis, distance and near VA, and deviation of strabismus determined at the baseline and 3, 6, 12 and 24 weeks after randomisation. It was reported that interocular suppression was the major pathogenetic structure in amblyopia, although the findings following six weeks of video game therapy did not meet the study hypothesis because the results were not different between subjects who underwent treatment and the placebo group.<sup>29</sup>

**Interactive binocular treatment (I-BiT) project:** A virtual reality-based system was developed recently for amblyopia treatment. Children can watch digital video discs (DVDs) and special video gameplays to activate the vision of the amblyopic eye while the vision in the good eye is not compromised. The I-BiT project was designed for amblyopia treatment using video games/video footage which can be seen with three-dimensional (3D) technology.<sup>30</sup> The rule behind this is that amblyopia is a binocular anomaly that needs a binocular solution, and dichoptic training can provide it. The system of I-BiT can permit receiving an image by both eyes. However, in this method, the amblyopic eye can view the critical parts of the image only. The treatment comprised also playing games in the device for objects interest (e.g., collecting coins).<sup>30</sup>

The I-BiT system was extremely efficacious in improving the VA in amblyopic patients. A study was conducted on six amblyopic participants (age range: 5-8 years) divided into two groups; three conservative therapy "failures" and three conservative therapy "refusers".<sup>30</sup> The treatment plan included viewing video and playing games with software aiming specifically to permit flowed binocular image performance. The results demonstrated an improvement in the VA from 6/12 to 6/120 before the treatment to 6/7.5 to 6/24-1 after the treatment, with an average treatment duration of 4.4 hours.<sup>30</sup>

Developments in 3D viewing tool from the gaming business authorised for an extra user of friend through cellphone I-BiT system utilises "shutter spectacles".<sup>29</sup> A pilot study investigated the effect of I-BiT on VA in amblyopic children using market obtainable 3D shutter spectacles. The mean age of the participants was 5.4 years with all types of amblyopia. The VA of 90% of amblyopic patients was improved (mean = 0.18 LogMAR) for only half-an-hour a week.<sup>31</sup> However, Herbison et al. in 2016 conducted a randomised controlled double-masked study that included amblyopic children who used three

instruments (I-BiT DVD, non-I-BiT game, and I-BiT game). One instrument with footage DVD can be viewed by the amblyopic eye while a conventional background is visible to both the eyes. Another instrument included a modified shooter game (Nux) with targets introduced to the amblyopic eye. The third instrument included both centre and the background shown to both the eyes. It found no difference between treatment instruments, but considerably minimal gains in VA (mean = 0.07 LogMAR).<sup>32</sup>

**Balanced binocular viewing therapy:** A home-based binocular treatment system for amblyopia, known as BBV therapy, is a successful treatment method to encourage a high level of compliance in addition to the assessment of the basic of suppression in the reaction of children to binocular treatment. The method involves watching 3D dichoptic films while wearing spectacles with a special design, incorporated with playing an interactive game to measure suppression.<sup>33</sup> The method showed favourable outcomes, including the significant VA improvement of the amblyopic eye, and led to an increase in stereoacuity. A study was conducted on anisometropic and strabismus amblyopic children (3-11 years old) using a form of BBV therapy, which involved the daily viewing of dichoptic movies and gameplay to monitor compliance and suppression. The treatment lasted for a varied period between 8 and 24 weeks with a high level of compliance, and led to an enhancement in the acuity mean in amblyopic eye by 0.27 LogMAR. The technology is an effective binocular treatment method for amblyopia which could be administered by the subject at home.<sup>33</sup>

**Amblyopia prognosis after binocular treatment:** The recovery and maintenance of clear vision in an amblyopic eye depend on the interplay of many factors, such as child's age when treatment is initiated, severity of amblyopia and its cause, the interval between the beginning of the condition and the commencement of treatment, compliance and type of treatment. The value of binocular vision may be utilised as a good pointer for amblyopia treatment success.<sup>4</sup> Stereopsis function (depth perception) can be improved simultaneously with VA regardless of the cause of amblyopia. In comparison, a study conducted in a large population containing adults with amblyopia (90% of subjects) who had binocular vision disruption failed binocular function tests, even with normal limits of VA compared to about 64% anisometropia adults and 35% with anisometropic amblyopia given the binocular examinations.<sup>5</sup>

The prognosis for improvement of VA to 20/50 or better in deprivation amblyopia is considered good for a patient with unilateral congenital cataract if this cataract is

removed early within the first two months of life immediately after diagnosis. Unfortunately, the prognosis for a good binocular function remains poor in deprivational amblyopia, highlighting the need for frequent follow-up through the critical time of visual development to maintain VA improvements. The opportunities of improving VA to 0.2 LogMAR or better are considered good in amblyopia caused by hyperopia and astigmatic anisometropia, with success rate of recovery after binocular treatment estimated to be from 80% to 90%. In myopic anisometropic amblyopia, the success rate was estimated to be from 55% to 80%.<sup>34</sup> Post-amblyopia treatment follow-up is crucial to maintain treatment success. It was reported that some amblyopia patients experienced a reduction in the VA after treatment was completed.<sup>35</sup> Follow-up visits at 2, 4, 6 and 12 months during the first year after treatment of amblyopia are recommended even when treatment is successful.

The prognosis for strabismic amblyopia patients is considered poorer than that for anisometropic amblyopia. Good patient compliance with the recommended treatment is the key to successful treatment for strabismic amblyopia. The duration of treatment needed to achieve success depends on the age as less time is needed for the treatment of younger children. In contrast, the treatment is longer for older children because they often develop eccentric fixation, which prolongs the treatment time and reduces the prognosis.<sup>3</sup> There is a strong chance for amblyopia to return for children, as the possibility to get alternative strabismus is significantly lower in young children.

## Discussion

The ideal treatment for amblyopia remains the focus of concern of paediatric optometry and ophthalmology clinics as traditional treatment methods do not constantly drive the consultants to improve the vision of amblyopic patients. A major disadvantage of the existing treatment approaches is dissatisfactory compliance among amblyopic patients. Binocular treatment drew considerable attentiveness from many investigators who aimed to join investigational results and developments of the technology to new therapeutic prototypes.<sup>22,26</sup> The current procedure, and an actual appraisal of the recent research, can emphasise the outcomes and simultaneously assert the problems that might be addressed.

A crucial evaluation of the existing literature discloses that various research set and performed exciting experiments with hopeful but restricted results.

Depending on the synchronous treating method for amblyopia treatment as a binocular instead of a monocular condition, researchers have succeeded in introducing new knowledge in amblyopia treatment. Recent findings were broadly home-based, which was a worthy use as they mimic actual-world situations, which are superior to clinical based research.<sup>24,33</sup> Considerable improvement in VA and stereopsis was notable in all findings, which support the scientific assumption of dysfunction in binocular treatment as the major amblyogenesis apparatus. Several studies reported no significant improvement in stereoacuity outcomes.<sup>26,27</sup> In contrast, many studies reported significant improvements in stereoacuity.<sup>34,35</sup>

A small number of studies assessed findings among age groups and found no significant VA improvement in younger children versus older amblyopes using iPad binocular treatment.<sup>23,24</sup> Although some studies have shown satisfactory outcomes from the binocular treatment, two large randomised controlled trials found binocular treatment to be inferior to standard treatment (patching) in managing amblyopia.<sup>33,35</sup> Additionally, and remarkably, all of the above-mentioned studies have shown noteworthy limitations. The participants' ages differed among different studies, which could prevent the origin of firm decisions taking into account the significance of age in visual development. Likewise, the treatment of amblyopic subjects in previous periods may have influenced the results as the subjects were not always coherent regarding the measurements. In addition, missed information of important findings of clinical studies, such as VA and stereoacuity before and after binocular treatment, is considered a great limitation.<sup>19,23,25</sup> Eventually, treatment compliance with plan is a valuable worry, despite investigators making effort to improve it.<sup>28</sup> In addition, bad adherence was recognised with home-based studies.

The limitations of previous studies demonstrated some rather frustrating results of randomised control trials<sup>23,32</sup> On the other hand, modifying the treatment assigned to patients of certain age groups and closely concentrate on treatment compliance were the strengths of some the existing studies.<sup>29,33</sup>

The development of technology may offer additional advanced devices, which could support upcoming research, along with further research concerning the amblyogenesis structures. Space Vision is a new game developed recently for vision screening and home-based monitoring, which could be effective for amblyopia treatment. The game was designed with a crucial aspect of children's game, using an early prototype to examine

player experiences through a sequence of evaluation periods. It was reported that greater physical tool support and digital incentivisation of body posture and head position are crucial to enhancing VA measurement.<sup>36</sup> Thus, the theory needs to be investigated for amblyopic children.

## Conclusion

Although binocular treatment may not be recommended as an alternative for traditional amblyopia treatment, binocular treatments are recommended in addition to patching and optical correction for amblyopia as they can obtain better results for recovery on normal vision.

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