

STUDY ON THE IMPACT OF HOME-BASED DICHOPTIC THERAPY ON YOUNG ADULTS WITH ANISOMETROPIC AMBLYOPIA

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ABSTRACT

Among all amblyopia types, anisometropic amblyopia is the most common. For many eye care professionals, treating amblyopia, including anisometropic amblyopia, has proved challenging. Although optical rectification followed by individual eye fixing is the highest quality level for treating amblyopia in youngsters, not all patients recuperate their ordinary visual acuity as a result of this treatment. Anaglyphic red-green channels will be used to test the impact of privately situated dichoptic visual therapy on a sample of young adults with non-strabismic anisometropic amblyopia's stereo acuity. The research was cross-sectional and observational in nature. Young individuals with non-strabismic amblyopia were isolated into two groups (exploratory and control) and contrasted with an age-matched control group without amblyopia using purposive inspecting. Before getting locally situated dichoptic treatment, all patients in the two groups were required to wear their scene amendment continuously for no less than about four months to work with refractive adaption. The Sound system Fly test was used to quantify sound system acuity when 40 hours of locally established dichoptic treatment. From pattern information, the progressions in sound system acuity following ten weeks (40 hours) of preparing were found. The Mann-Whitney U-test was used to think about the middle distinctions between the trial and control groups, with P value < 0.05. Young individuals with moderate non-strabismic anisometropic amblyopia profited from locally situated dichoptic treatment for their sound system acuity. Thus, demonstrating that the binocularity could further develop in anisometropic adult amblyopes through a therapeutic methodology that might be more useful and preferable suit their requesting way of life over conventional centre based treatment.

KEYWORDS: dichoptic treatment, amblyopia

INTRODUCTION

Amblyopia is a condition wherein visual acuity stays inadequate regardless of refractive rectification and the shortfall of an underlying sickness. Its pervasiveness, which shifts by geology, is assessed to be somewhere in the range of one and two percent. Amblyopia is likewise a typical reason of visual impedance in youngsters, occurring almost multiple times more frequently than retinopathy of prematurity, optic nerve rot, and juvenile nystagmus[1].

Wearing eyeglasses for complete refraction correction is the primary option for treating amblyopia, however it has been observed that only about 30% of individuals benefit from doing so. Therefore, the most popular supplemental treatment is occlusion therapy, which involves wearing an eye patch. By obstructing the sound eye, it seeks to increase visual acuity by forcibly using the amblyopic eye. Occlusion therapy does, however, have certain negative side effects, such as occlusion amblyopia, emotional anguish, and skin irritation. Occlusion therapy is only used for around 50% of the recommended occlusion time because of its low compliance.[2] Additionally, it has been noted that compliance declines as the length of the treatment time increases. Alternately, binocular open amblyopia treatment gadgets that desire to work on visual acuity by introducing separate visual stimuli to the sound eye and the amblyopic eye have been made of late. These gadgets, alongside the eye-fix based occlusion treatment, work on visual acuity by forever working on the exhibition on perceptual errands as a outcomes of involvement and practice. Visual stimuli are given to the sound and amblyopic eyes autonomously in binocular open amblyopia treatment gadgets. The uniqueness between the visual acuities of the amblyopic and sound eyes augments with suppression in amblyopic individuals, which spoils stereoscopic vision. [3]By incorporating the visual data from each eye and adjusting the input from each eye, devices for dichoptic treatment of amblyopia mean to chip away at visual acuity and stereoscopic vision with practices like games. Furthermore, binocular opening prompts suppression in the visual cortex, it is the cause of amblyopia. Treatment for amblyopia is carried out differently at the point when one eye is covered by an eye fix than when the two eyes are open, which results in

suppression. [4] Then again, because it preserves binocular opening and stimulates the amblyopic eye, amblyopia treatment under binocular opening may be more convincing for suppression end. Computerized contraptions including tablet terminals, cellphones, and head-mounted shows have all been made as dichoptic treatment gadgets for amblyopia. Due to the particular equipment, handling, and applications that these gadgets require, the climate for amblyopia treatment is obliged. It is necessary to produce a more economical and user-friendly dichoptic treatment device for amblyopia because these electronic gadgets are difficult to obtain and expensive compared to an eye patch [5].

To do this, we have created a therapy system for dichoptic amblyopia utilizing polarizing films. This method's therapeutic efficacy hasn't yet been evaluated in comparison to other therapeutic approaches. We subsequently analyzed the viability of amblyopia treatment in this study between dichoptic cure with polarizing film and one of the eye covered with eye patches.

Role of Dichoptic therapy

In the beginning, clumsy psychophysical apparatus was used in the clinic to develop dichoptic treatment. It has lately been converted into a more practical hand-held gadget, though, which may be used both at home and in clinics. It has become more convenient because individuals with busy schedules may now complete the training in the comfort of their own houses, which might increase compliances. The inability to combine the disparate information perceived by the two eyes into one, which impairs depth perception or stereoacuity, is one of the main effects of amblyopia. The shift in the stereoacuity is the study's main result. When binocular visual functions, or stereo-acuity, are improved in amblyopia, the quality of life is also improved [6].

Individual with amblyopia which has passed the crucial period of visual cortex headway have shown that conduct mediations increment visual functions like visual acuity, contrast responsiveness, and sound system acuity. Recent research has demonstrated that suppression is the root cause of amblyopia's absence of binocular integration. Therefore, an increase in binocular vision results from a decrease in suppression. Dichoptic treatment is one of the behavioural therapies that has been demonstrated to improve stereo-acuity in various kinds of visual function by lowering suppression in adults [7].

Symptoms of amblyopia

In daily tasks, visual cognition is crucial, but in amblyopes, this mental function is atypical. As per Wang et al., both the amblyopic and individual eyes show impeded mid-and late-stage mental handling during the developmental stage in amblyopia. Researchers have recently suggested the use of behavioural therapies like dichoptic training, video gaming, and perceptual learning to help adults with various forms of amblyopia see better. 14 The goal of the monocular amblyopia treatment was to enhance the amblyopic eye's visual capabilities. However, a number of experts now contend that because this therapy strategy does not specifically address suppression, it may not be as effective as it could be. As a result, viewed as ineffectual in adults have passed the crucial stage in the improvement of the visual cortex. Because of this, amblyopia is at times alluded to as a binocular issue. [8] The two eyes are visually weakened in instances of binocular amblyopia, such as isoametropic amblyopia, while in occurrences of monocular amblyopia, the unfortunate vision of 1 eye causes a binocular malfunction. In light of these characteristics, amblyopia is often regarded as a binocular issue.

- ❖ A sideways or inward-looking eye
- ❖ Uncoordinated eyes
- ❖ a poor sense of depth
- ❖ blinking or closing one eye
- ❖ Head cocked
- ❖ Abnormal screening test results for vision

Impact of Age

Age from long time has been linked as a key element in children's amblyopia treatment that works. Therefore, it makes sense to assume that age, regardless of age, performs a crucial part in the effective cure of the amblyopia. As per the study, the results of VA, stereoacuity, and contrast sensitivity in individuals receiving dichoptic therapy may not be significantly influenced by age. The age group, irrespective of age, improved significantly with the dichoptic therapy, although more investigation on the impact of dichoptic treatment on age is required to spread out this. This proof suggests that the visual cortex of adults actually holds its adaptability into adulthood, which is certified by malleability in visual consideration and learning in typical vision. Dichoptic treatment may likewise be used to quickly re-establish visual discernment in adult person with the anisometropic, strabismic, and mixed amblyopia [9].

Duration of training

The study found that training length had little bearing on the improvement of VA, stereoacuity, or contrast sensitivity. Binocular fusion can be reached out to all differences throughout half a month of dichoptic therapy, in any event, when the individual eye was taking in stimuli spontaneously. [10] Therefore, the crucial query is: Is there a negligible length required for dichoptic therapy treatment of anisometropic or mixed amblyopia? It would take a thorough clinical trial with systematic monitoring of improvements in visual outcomes utilizing dichoptic therapy to provide an answer to this topic. It may not matter how long a person receives therapy, whether it be dichoptic therapy, perceptual learning, or video gaming. Treatments with shorter time requirements would be preferable to occlusion therapy, nonetheless, given the length of usage and the requirement for compliance with these therapies. Although these medicines have no known negative

effects, caution should be exercised when utilizing them because none of them have been normalized, and a huge clinical control preliminary has not yet been conducted[11].

Types of amblyopia

Our study revealed that participants with various forms of amblyopia displayed distinctive patterns of impairments. When compared to anisometropic amblyopia treated with dichoptic treatment, studies have shown that strabismic and blended amblyopia had all the more awful outcomes. This might be due to the variable degrees of suppression, which could influence how much binocularity exists in these different amblyopes, causing the impacts of dichoptic treatment to fluctuate across these shifting kinds of amblyopia. Nonetheless, comparable results were acquired in research among lenticular and anaglyphic stages. From the surveys, we don't have persuading verification regarding the compelling standard utilized in dichoptic making arrangements for confining the stimuli between the amblyopic eye and strong eye.

Review of Literature

Leon et al. (2008), [12] there is a chance that anisometropic amblyopia will become more prevalent during early childhood and become more severe. It is challenging to address the severity and beginning of anisometropic amblyopia in youngsters because it includes both the predominance of a situation that is difficult to recognize because there is no obvious ocular misalignment and the amblyopia could slip through the cracks because measuring visual acuity during earliest stages is difficult. These factors, in combination with insufficient school vision screening programs, might be to be faulted for the high pervasiveness of anisometropic amblyopia, one of a few sorts of amblyopia that for the most part burden young adults due to the inadequacy of early distinguishing proof.

Feldman et al. (2014) [13] The neuronal coding that underlies vision is sent from the thalamus to the cells of the even geniculate nucleus and a brief time frame later to the cells of the visual cortex. In the occipital curve, close the calcarine sulcus, the visual cortex is where excitatory and inhibitory binocular convergence occur. Cortical synaptic associations coordinate a divided portrayal of the scene and the item to produce a conspicuous visual picture. Amblyopia is brought on by morphophysiological changes connected to deserts in visual handling. A contrary inbetween the neuronal systems based on 'two eyes' effects on cortical neurons leads to vision impairment in monocular visual loss. Amblyopia results from the input from the eye with a better capability for perceiving vision being suppressed by the input from the other eye.

Katsuki et al (2014) [14] believed that adding contrast to amblyopic eye inputs might lead to a reversal of visual sensitivity and attention, which would increase excitatory interactions. A recent study by Chun et al.9 demonstrated that amblyopia, particularly strabismic amblyopia, is related with an ideal reduction in the excitatory participation to binocular cooperation in the visual cortex.

Vedamurthy et al (2015) [15] By standing out monocular film seeing from the amblyopic eye with a videogame play (VGP) tournament variation of dichoptic treatment, Vedamurthy likewise shown similar changes conversely, responsiveness. The dichoptic computer game group showed a bigger improvement interestingly, responsiveness, with a typical increment of 0.4 log units, contrasted with the monocular film group, which further developed exclusively by 0.2 log units. Contrast awareness changed from 1.69 to 2.3 log units for anisometropic patients who played the dichoptic videogame, from 1.7 to 1.8 log units for anisometropic amblyopes who watched motion pictures monocularly, from 2.4 to 2.6 log units for the dichoptic videogame group with strabismic amblyopia, and from 1.7 to 1.97 log units for the individuals in the monocular films group with strabismic amblyopia.

RESEARCH METHODOLOGY

There were 40 participants in this forthcoming (observational, cross-sectional) study, with a comparable number of men and women in each group. The testing office, which is housed in a confidential work on setting, recruited 20 subjects with anisometropic amblyopia (25.04 5.64 years) for the amblyopic group and 20 without amblyopia (25.10 5.60 years) for the control group.

The sample size was calculated using sample size for a boundless population;

$$SS = \{Z^2P(1-P)\}/C^2$$

(SS = sample size,

Z; Z-value for the confidence level of 95% = 1.95,

P; mean percentage of the population in decimal = 0.01276,

C; confidence level in decimal = 0.05).

The control group was used in this study as a trial of the authenticity of dichoptic treatment to check if the impact of dichoptic treatment displayed in the amblyopic group might be found in the control group. The members as a whole — control and amblyopic — were between the times of 19 and 35 (24.06 ± 5.67 years) and had never undergone surgery, vision therapy, or amblyopic therapy before. In the wake of expenditure the main hour with the specialist figuring out the most effective method to play the game, all individuals were drawn closer to continue at home after the clinician was fulfilled that they knew how to do accordingly. All subjects underwent a thorough visual assessment before enrolment, including a visual acuity test, refraction, keratometry, cut light bio microscopy, Worth Four digit test, variety vision

evaluation, contrast responsiveness test, cover and uncover test, sound system acuity test, and ocular motility test. Participants with any ocular comorbidities, neural abnormalities, or stimulus deprivation amblyopia were excluded.

Collection of Data

After every member had been instructed over the dichoptic treatment utilizing a Tetris game on a Mac iPad, 9.6 inches, the members were dispensed to a locally situated treatment routine for one hour out of each day at 20-minute stretches for quite some time to finish a sum of 50 hours.

Study Method

The Stereo Fly test was utilized to assess stereo-acuity. Prior to the start of dichoptic therapy, pre-therapy stereo acuity was measured. Following a one-hour training session in the middle with the subject matter expert, individuals were requested to continue the treatment step by step at home for a sum of 6 hours out of every week at a 20-minute range multiple times every day to equal an hourly training routine. [16] Their sound system acuity measures were taken again in the centre at the conclusion of every week and recorded as post-treatment sound framework acuity measurements for each week, for a sum of 9 post sound structure acuity measurements. Until every member had completed their 50 hours of treatment, this process took place over the course of 10 weeks. The last post-stereo acuity evaluation was at this point. Each week where a participant returned to the clinic, their gaming APP log data was continuously analysed. The timer in the app tracks how much time was spent playing the game each day. The consistence rate was computed considering the typical treatment of 6 days of the week for a broad time period and was communicated as a level of the mean cumulative time kept in the Application log history. The first week's game play time limit was discovered to have been exceeded by two participants, and they were informed of the outcome. These participants' extra playtime was deducted from the next week. Playtime compliance rates of seventy-five percent (75%) and higher were considered to be favourable.

Dichoptic Treatment

With a red-green anaglyph place of intermingling channel worn with the red mark of combination on the right eye and the green place of union on the left eye paying little mind to what the amblyopic eye, a hand-held nine-inch Macintosh iPad tablet was used to show the Tetris game at a standard room lighting (160-500 lux). Blocks in the Tetris game are red and green. The red blocks that drop from the most noteworthy mark of the screen pivoted continuously to shape a shimmering block at the lower part of the screen, where they changed green as they plunged. The individuals see the red blocks with the eye behind the red channel and the green blocks with the eye behind the green channel thanks to the anaglyph focal point channels, which separate the pictures.

Preceding getting treatment, members in the two groups were required to wear their latest sets of restorative focal points for no less than about four months. Each part had a red-green anaglyph cut on point of convergence set over their eye, and they were required to wear their helpful eyewear reliably during the training session. When the member revealed that the difference in the two eyes was equal, the differentiation in the great eye was brought down. At all phases of differentiation re-adjusting during the course of treatment, the rate distinction conversely, arrived at after the contrast re-adjusting was utilized as a mode of suppression. Predicated on the level of the suppression, the treatment depends on the possibility that on the off chance that contrast responsiveness is diminished in the solid eye, there is a value for the fusion that will result in an improvement on the other hand, mindfulness in the amblyopic eye.

Stereo-Acuity

The Stereo Fly test, which evaluates stereopsis from 3500 to 50 seconds of circular segment, was used to measure stereo-acuity a way off of 40 cm. The Stereo Fly test uses spellbound vectograph plates with three columns of five creatures with one creature for each line standing apart from the others (measures stereo-acuity somewhere in the range of 400 and 100 sec of curve), a housefly, and nine arrangements of four circles organized in a jewel design. Stereo-acuity is measured from 800 to 40 sec of bend for each arrangement of circles (methods stereo-acuity from 3600 to 40 sec of circular segment). A housefly was displayed to every member while they were instructed to wear spellbound focal points over their best-rectified habitual sight focal points (500 lux). Assuming the member had the option to accurately squeeze the housefly's wings between the thumb and fingers over the plate, stereopsis was available. The next step was to ask them to look at the quartet of patterns and to name the circle that appeared to "float" in front of the others in each quartet. The last category that was correctly classified was the patient's stereo-acuity, which is thought to be the pinnacle of binocular coordination.

Outcomes

The standard qualities of the sample for the trial (amblyopic) group and control group are recorded in Table. Before the therapy, four of the 20 members in the amblyopic not set in stone to have extreme amblyopia (V/A more prominent than 0.90 Log MAR), and 15 of the still up in the air to have moderate amblyopia (V/A somewhere in the range of 0.30 and 0.90 Log MAR). 14 For similar group, 14 of the 20 members had serious anisometropia (circular contrast between according to >4.00 DS), and five people had moderate anisometropia (round distinction between according to 1.00 DS to 2.00 DS). Three members had nearsighted astigmatism, while 17 others had hyperopic astigmatism, consequently the sort of refractive deformity was likewise considered.

	Control Group	Experimental Group
Sample Size	20	20
Mean age group (years)	25.10 ± 5.70	25.10 ± 5.80

Sex	9/10	10/9
Moderate amblyopia(6/12- 6/36)	-	16
Severe amblyopia (poorer then 6/36)	-	5

Table 1: Gauge Qualities of the Control and the Groups Amblyopia

Participant s	N	Baseline Stereo- Acuity (Sec of Arc)	Stereo- Acuity at Week 8 (Sec of Arc)	Change in Stereo-Acuity (Sec of Art)		Wilcoxon Sign Ranked Test	Mann-Whitney U-Test (Post Therapy)
		Mean (SD) Median	Mean (SD) Median	Mean Change (SD)	Median Change (IQR)		
Control group	19	49.43 ± 9.68 50 (40;50)	49.43 ± 9.59 50 (40;50)	0.00 (3.34)	0.00 (0; 0)	P =1.00	P < 0.001
Experime ntal (Amblyop ic) group	19	479.96 ± 213.35 400 (400;800)	133.68 ± 48.56 100.00 (100;200)	346.26 (184.87)	300 (260;600)	P < 0.001	

Table 2 shows the distinction in stereo-acuity between the control and trial (amblyopic) groups following ten weeks of locally established dichoptic therapy.

Dichoptic therapy conducted at home using stereoacuity

Just the amblyopic group saw a genuinely tremendous change in stereo-acuity from week zero to week ten, as per Table 2, and following ten weeks of locally established dichoptic therapy, there were enormous differences inbetween the movements in the amblyopic and control groups. Age didn't influence the speed of progress in stereo-acuity throughout the ten weeks of privately situated dichoptic therapy, according to a direct mixed influence model (P = 0.547).

The study exhibits that following ten weeks of locally established dichoptic treatment for the amblyopic group of anisometropic amblyopes, all individuals managed in stereo-acuity, with a mean improvement of 346.28 185.87seconds of arc.

Figure 1 further demonstrates the improvement that began in week 2 and peaked in week 3 with smaller improvements continuing through week 10 although at a slower rate. According to the results of the linear mixed effect of the modelling, the degree of amblyopia has no discernible influence on how quickly stereo-acuity improves (= 40.41; 95% CI: 97.10-15.27; P = 0.152).

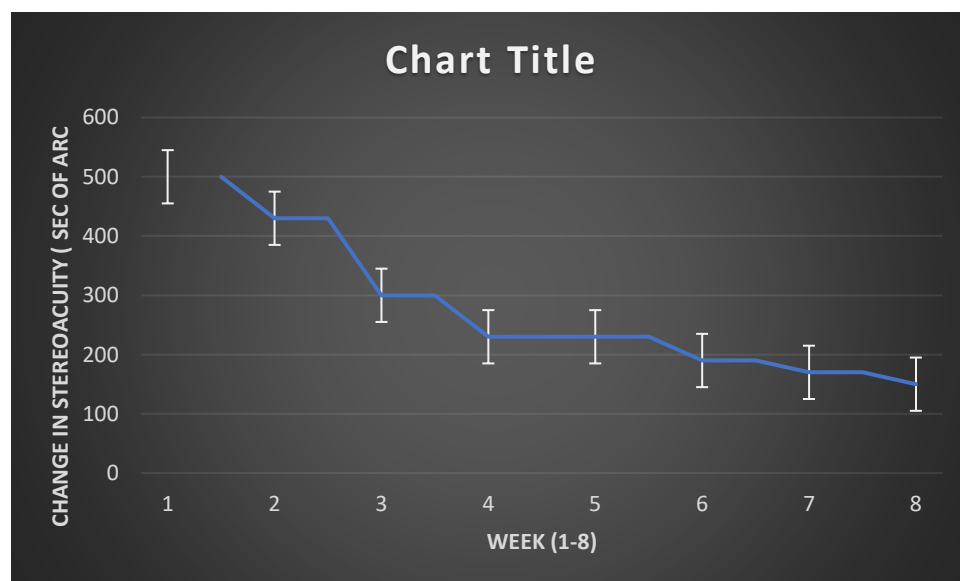


Figure 1: The impact of house-oriented dichoptic therapy on anisometropic individuals' stereoacuity after one to ten weeks

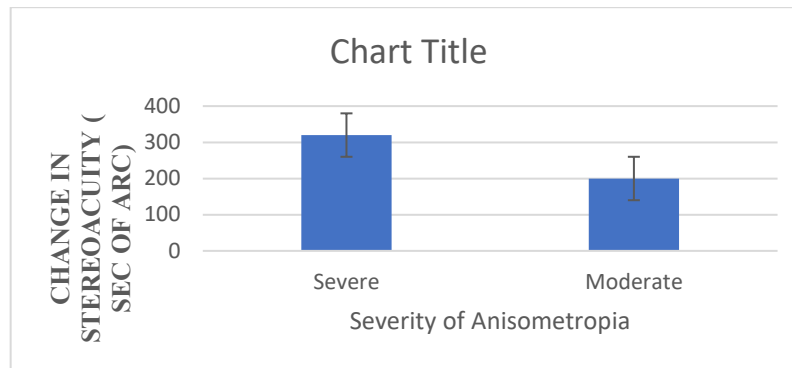


Figure 2: The impact of anisometropia severity on changes in stereoacuity. Participants with severe amblyopia showed greater gains in stereoacuity than those with mild amblyopia.

DISCUSSION

Our investigation has provided both fresh and confirming data that are in line with other studies on adult amblyopia. According to studies, clinic-based monocular and binocular therapy can help adults with amblyopia enhance their monocular abilities. Similar to what was observed in our investigation, [17]Hess et al prior studies found that reduced suppression worked on the stereo-acuity of individuals with anisometropic, strabismic, and blended amblyopia in six out of ten cases. As members played the game Tetris, the differentiation responsiveness of the great eye consistently diminished, which eventually resulted in less of the great eye suppressing the amblyopic eye. This addition in stereo-acuity was made conceivable. This study's improvement in stereoacuity is equivalent to gains made in before studies using the Randot test on subjects between the ages of 7 and 68. Rather than our study, when individuals' stereo-acuity changed by 213.44 sec of twist, it was found that individuals in these studies managed their stereo-acuity (from 200 to 128.80 sec of curve). Different studies that additionally used the Randot test on adult amblyopia (18-70 years) didn't arrive at similar conclusions, with the improvement in stereoacuity being displayed to run somewhere in the range of 258 and 1000 sec of curve[18].

Limitation of the Study

It is vital that prior research in this field used center-based settings, with few proof of locally situated therapy. Therefore, it will be crucial for future studies to decide the advantages and disadvantages, if any, of the home-based therapy approach compared to clinic-based therapy. The review demonstrates that employing the newest medicines, dichoptic, perceptual learning, and video gaming, persons' distance VA, stereo-acuity, and difference awareness expanded; be that as it may, nothing is known in regards to the use of dichoptic therapy in kids. [19]Future research, though, will need to use a uniform design due to the variety of study designs. Dichoptic therapy requires a rigorous and intensive training period to achieve the best results, particularly in cases of severe amblyopia. Future research must include a large number of individuals to lower the possibility of unintentional bias or severe outliers. The literature review's studies mostly lacked control groups. Future exploration must consider the value of controls while evaluating the impacts of dichoptic therapy on adults. The vast majority of studies didn't consider giving post-therapy subsequent meet-ups to help with surveying the impact of the therapies following a couple of months for any potential amblyopia inversions. Dichoptic therapy consistence has been laid out (using the iPad's set of experiences updates), but further home preliminaries should be conducted using multiple procedures to follow the numerous viewpoints, such as test distance adherence and device contrast resets, which are particular to home-based therapy.

Our study just included individuals with non-strabismic anisometropic amblyopia, though Hess et al. included individuals with anisometropic, strabismic, and blended amblyopia and unequivocal a 60% improvement. In the study just included anisometropic amblyopes, which could assist with understanding the reason why all individuals in the amblyopic group, including those with serious (0.80 Log MAR or more horrible) and moderate (0.20 to 0.80 Log MAR) anisometropic amblyopia, showed a 100 percent recuperation. Numerous anisometropic amblyopes still exhibit some stereopsis, rather than strabismic and blended amblyopes. The Randot circles test was passed by over half of anisometropic amblyopes contrasted with just 10% of strabismic amblyopes, according to Hess et al., which explains why fewer individuals in their study showed improvement. 20 Weekly found that extreme anisometropia was associated with worse stereo-acuity, which contrasted with our findings, which revealed that people with severe anisometropia improved more. [20]To corroborate this finding, additional research could be necessary given the sample's lower proportion of this group.

Comparable results were found in another work of persons through anisometropic amblyopia, and it were found that the dichoptic-based unique vision treatment utilizing the program "VisuoPrime" showed successful as the primary methodology in the persons through anisometropic amblyopia.

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