

Effect of Binocular Dichoptic Therapy v/s Monocular Patching Therapy on Visual Acuity and Stereoacuity in Amblyopic Patients

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Abstract

Purpose: Aim of this study was to determine the difference in visual acuity and stereo acuity by using monocular patching therapy and binocular game therapy in amblyopic patients.

Method: 30 sample size was used in which both sexes were included having either anisometric or strabismic amblyopia aged between 7-18 years. Visual acuity was tested by using LogMar chart and stereo acuity was tested by using Titmus Fly Test both with and without the use of glasses. Half (15) of the subjects were given home-based binocular dichoptic game therapy by using anaglyph glasses to play for 6 hours per day for 4 weeks, and other half (15) subjects were given monocular patching therapy for 6 hours per day for 4 weeks. After 4 week follow up their visual acuity and stereo acuity was again tested.

Result: The result of this study showed that visual acuity with patching therapy showed significant changes i.e. increased ($P < 0.05$) with average mean \pm S.D 0.09533 ± 0.05998 and stereo acuity also showed significant changes i.e. ($P < 0.05$) with average mean \pm S.D 29.333 ± 31.952 after patching therapy. The visual acuity of dichoptic training increased and showed significant changes ($P < 0.05$) with average mean \pm S.D 0.26067 ± 0.05982 and stereo acuity also showed significant changes ($P < 0.05$) with average mean \pm S.D 90.667 ± 109.510 after the dichoptic treatment. Independent test showed insignificant result, the value ($P > 0.05$) which shows visual acuity and Stereoacuity after both treatment option does not have much difference.

Conclusion: This study concluded that both the therapies showed almost same change in visual acuity and stereo acuity after the follow-up. But compliance rate was much higher in binocular dichoptic game therapy then monocular patching therapy.

Keywords: Amblyopia; Dichoptic; Patching; Stereoacuity; Visual Acuity

Introduction

Amblyopia by definition refers to either unilateral or bilateral decrease in the best corrected visual acuity. Clinically, defined as when there is two Snellen line difference of visual acuity between two eyes. Visual acuity and contrast sensitivity reduced in amblyopia when the primary visual cortex is abnormally visually processed [1]. This anomaly is usually monocular and several ocular conditions results in amblyopia e.g. anisometropia, strabismus, obstruction of the visual axis and muscle imbalance in which muscles of the eye are imbal-

anced which causes deviation of eye and both eye will not work together. Refractive difference between two eyes, deprivation of vision because of any reason will prevent the clear vision of the eye. It should be treated urgently [2]. Amblyopia results because of abnormal visual development at the early stages of life. Logically, it is believed that inputs from rods and cones are reduced in the lazy eye which causes neurophysiologic changes and is transmitted to the central nervous system which will activate amblyopia [3]. Causes of unilateral amblyopia are the same but mostly are strabismus, anisometropia [4]. Risk factors of amblyopia are if media is not clear (cataract, opacities), children with conditions which increase the risk of strabismus, unequal refractive errors, media opacities which as a result increase risk of amblyopia.

General pathology disrupts normal visual development which results in blurring of vision and this disruption mostly occurs in a critical period of age (first 8 to 10 years of age). Blurred retinal images in one eye hinder normal visual development which results in suppression and deviation, binocularity loss and visual acuity reduction. Mostly children do not complaint about any symptom of amblyopia as they don't realize this. But still head tilting, squinting, decreased vision, misalignment of eyes and poor depth perception etc. can indicate amblyopia [5]. One of the major signs seen in amblyopic patient is poor stereo acuity. Stereo acuity can be thought of as a synonym to depth perception. When a visually normal human sees an object, each eye sees it from different angles, and these pictures are sent to the brain. The two images are integrated into a single image creating a 3D effect. The children having some potential for developing stereopsis, their 3D vision can be improved when they will have proper visual functioning in both eyes.

The initial treatment for amblyopia is to prescribe spectacles for full time for 3 - 4 months if still there is no improvement in the vision then move towards the patching technique. In this technique, a part-time patch over the better-seeing eye is placed and the amblyopic eye is forced to see the image. This lets the stimulation of visual pathways between the lazy eye and brain, thus improving the vision [6]. Another new therapeutic approach to amblyopia, in which there is a separate simulation of both eyes, is dichoptic training. The amblyopic eye sees dynamic interesting stimulus on the screen while Good eye sees static stimulus on the screen so the attention of the brain is drawn to the content viewed by lazy eye [7]. This dichoptic game requires the tessellation of falling blocks. Some blocks of strong contrast introduced to the weaker eye and some blocks of low contrast introduced to the stronger eye. This binocular method improves amblyopic eye Visual Acuity and Stereopsis [8]. Relationship of amblyopic eye visual acuity and stereo acuity is intricate. In amblyopia, when vision of one eye is degraded, it results in impaired stereopsis [9]. With different therapies, amblyopia can be improved and there will be significant improvement in visual acuity and stereo acuity [3].

In our study we targeted suppression, which results in significant improvement in both binocular and monocular visual acuity and stereopsis in subjects with amblyopia. Dichoptic stimulus induces a higher level of plasticity than forced use of an amblyopic eye alone. This therapy aims at promoting binocular vision by strengthening fusion and reducing suppression.

Materials and Methods

This study was conducted at Ophthalmology Department, Madina Teaching Hospital, Faisalabad and Ophthalmology Department, Allied Hospital, Faisalabad. 30 children aged 7 - 18-year-old were included in this study after taking ethical approval from research committee of university of Faisalabad. Patients were divided into 2 groups. Group 1 consists of subjects that were given patching therapy and Group 2 consists of those subjects that were given dichoptic game therapy. Group 1: First of all, informed and detailed history which includes family, medical, social, ocular history of patient was taken. If any previous prescription used by patient was also noted down. Subjective refraction of patient was done to achieve best corrected vision and confirming the amblyopic patient. Then Stereoacuity was taken using the Titmus fly test after explaining the procedure to patient briefly. Patient was asked to wear the filter glasses while holding the titmus fly test booklet at reading level (40 cm). Then using circle pattern test which consists of 4 circles one being a little different from other appears like floating or 3D, stereoacuity was noted. Then patients were given detail briefing on patching therapy its usage and this

therapy was prescribed to them for 6 hours daily for 4 weeks and told them to come back after 4 weeks for follow up (Figure 1). Group 2: First of all, informed consent and detailed history was taken. Any previous prescription used by patient was also noted down. Subjective refraction of patient was done. Then after amblyopic patient was confirmed Visual acuity using LogMAR chart was noted. Stereoacuity was taken using the Titmus fly test after explaining the procedure to patient briefly. Patient was asked to wear the filter glasses while holding the titmus fly test booklet at reading level (40 cm). Then using circle pattern test which consists of 4 circles one being a little different from other appears like floating or 3D stereoacuity was noted. After that patients were given detail briefing on dichoptic game for treating amblyopia this game was downloaded in their mobile phones and patient were taught how to play it and set the colors according to patient’s amblyopic eye and anaglyphic glasses (Figure 2). We gave the patient the anaglyphic glasses and prescribed this game therapy for 6 hours for 4 weeks. We kept in contact with patients or patient’s guardians through messages or voice calls to check up on them if there are doing their respective therapies. After 4 weeks of follow up, again visual acuity was recorded using logMar and stereopsis was checked using titmus fly test in the same set up as before. Compliance of patient was also recorded.



Figure 1: Child using patching therapy.



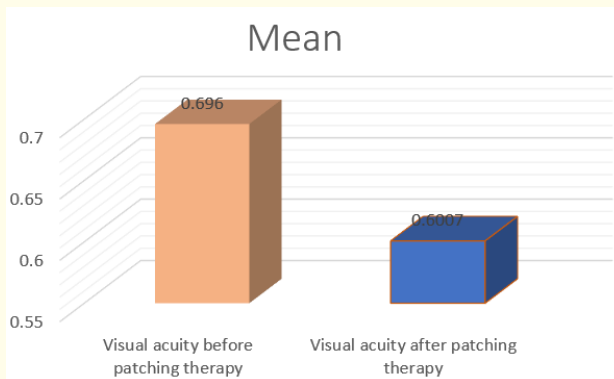
Figure 2: Child playing dichoptic game.

Result

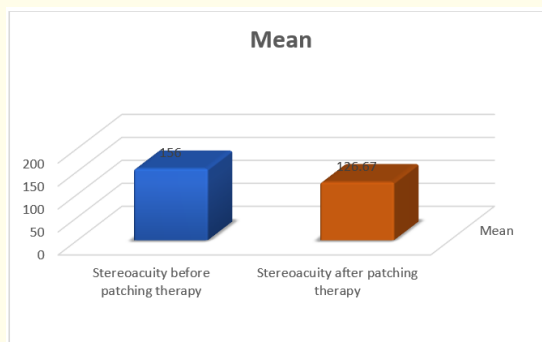
The study included 30 amblyopic patients 15 were given dichoptic game therapy and 15 were given patching therapy as a treatment option after recording their visual acuity and stereoacuity. This study assessed and compared the effect of patching therapy and dichoptic game therapy on visual acuity and stereo acuity in anisometric and strabismic amblyopic subjects. Mean visual acuity before patching therapy was 0.6960 LogMar \pm 0.23394. Mean visual acuity after patching therapy was 0.6007 LogMar \pm 0.21674. Mean stereoacuity before patching was 156.00 \pm 49.685. Mean stereoacuity after patching therapy was 126.67 \pm 45.774. Mean visual acuity before dichoptic therapy was 0.8873LogMar \pm 0.29060 and mean visual acuity after dichoptic therapy was 0.6267 \pm 0.28950. Mean stereoacuity before dichoptic therapy was 213.33 \pm 140.746 and mean stereo acuity after dichoptic therapy was 122.67 \pm 39.182.

The mean difference in visual acuity after patching therapy and after dichoptic therapy was -0.01600 it shows no difference in visual acuity after patching therapy and dichoptic therapy. There was no significant difference between them; both therapies are equally effective. The mean difference in stereoacuity after patching and after dichoptic therapy was 4.000. It shows no difference in stereo acuity after patching therapy and dichoptic therapy. There was no significant difference between them; both therapies show the same result.

The patching group



Graph 1: This graph shows us that us the mean value of visual acuity before patching therapy in amblyopic patients was 0.6960 and for visual acuity after patching therapy was 0.6007.

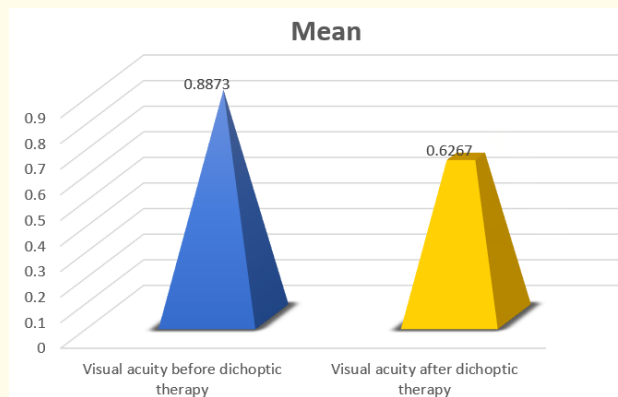


Graph 2: This graph shows the mean value of stereoacuity before patching therapy was 156.00 and for stereo acuity after patching therapy was 126.67.

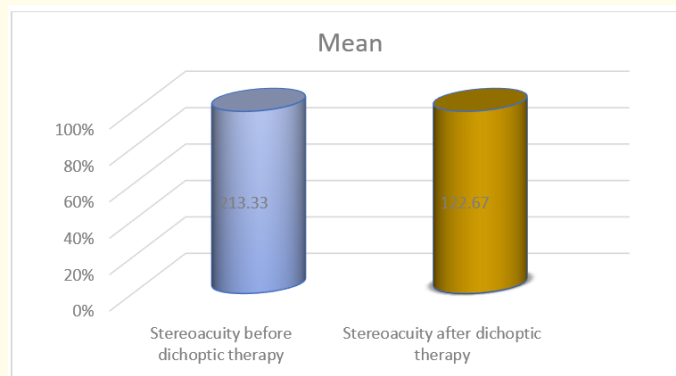
Paired Sample T Test				
1. Visual acuity before patching therapy - visual acuity after patching therapy	Mean	Standard deviation	Standard error mean	Significant value
	0.09533	0.05998	0.01549	0.00
2. Stereo acuity before patching therapy - stereo acuity after patching therapy	29.333	31.952	8.250	0.003

In the above mentioned table, it shows significant difference in visual acuity before and after patching therapy in amblyopic subjects that $p < 0.05$ (i.e. $p = 0.00$ paired sample t test). It shows visual acuity significantly increase after patching therapy. The table also shows us significant difference in mean value of Stereoacuity before and after patching therapy in amblyopic subjects that $p < 0.05$ (i.e. $p = 0.003$ paired sample t test).

The dichoptic therapy group



Graph 3: This graph shows us that us the mean value of visual acuity before dichoptic therapy in amblyopic patients was 0.8873 and for visual acuity after dichoptic therapy was 0.6267.



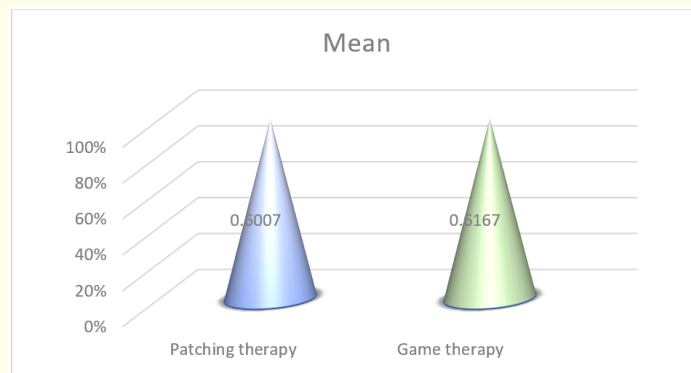
Graph 4: This graph shows the mean value of stereoacuity before dichoptic therapy in amblyopic patients was 213.33 and for stereo acuity after dichoptic therapy was 122.67.

Paired Sample T Test				
1. Visual acuity before dichoptic therapy - visual acuity after dichoptic therapy	Mean	Standard deviation	Standard error mean	Significant value
	0.26067	0.05982	0.01544	0.00
2. Stereo acuity before dichoptic therapy - stereo acuity after dichoptic therapy	90.667	109.510	28.275	0.006

In the above mentioned table, it shows us there is significant difference in visual acuity before and after dichoptic therapy in amblyopic subjects ($p < 0.05$) and it shows significant difference ($p = 0.000$ paired sample t test). The table also shows significant difference in mean of Stereoacuity before and after dichoptic therapy in amblyopic subjects that ($p < 0.05$) and it shows significant difference ($p = 0.006$).

Comparing both therapies

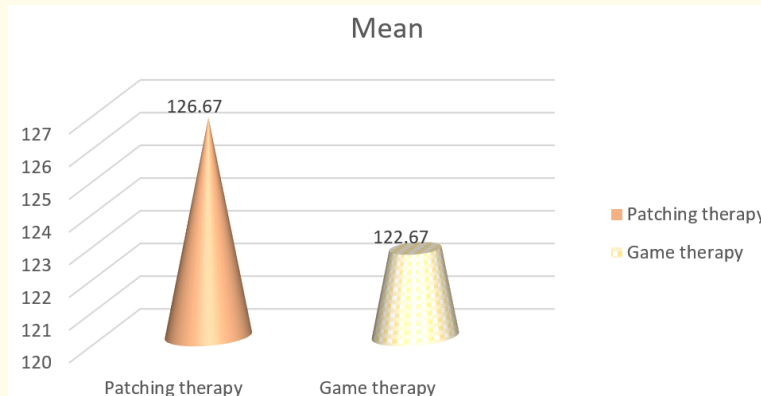
The result from comparing both the therapies by using independent T Test tells us that the mean visual acuity p value= 0.865 (i.e. $p > 0.05$) after patching therapy and dichoptic therapy. Their mean difference = -0.01600 so it shows no difference in visual acuity after patching therapy and dichoptic therapy. Both therapies are equally affective. There was no significant difference between them; both therapies show the same result. Similarly, independent T test of stereo acuity shows the mean stereo acuity p value= 0.799 (i.e. $p > 0.05$) after patching therapy and dichoptic therapy. There mean difference = 4.000 so it shows no difference in stereo acuity change after patching therapy and dichoptic therapy. There was no significant difference between them; both therapies show the same result.



Graph 5: This graph shows the mean value of visual acuity after patching and dichoptic therapy in amblyopia is 0.6007 and 0.6167 respectively.

Discussion

In present study, the main objective was the assessment of VA and stereo acuity in amblyopic subjects before and after using dichoptic training game and monocular patching therapy and also to compare the result of both of these therapy, dichoptic game and monocular patching therapy, to know which one is more effective. In Pakistan only patching therapy is widely use, this study gives new advancement in amblyopic treatment a chance. In this research 30 children aged 7 - 18 who fulfilled the inclusion criteria were taken and divided into two groups. Group 1 received patching therapy and group 2 received dichoptic game therapy.



Graph 6: This graph shows the mean value of stereoacuity after patching and dichoptic therapy in amblyopia is 126.67 and 122.67 respectively.

The result of the study showed that both patching therapy and dichoptic game therapy brings about same change in visual acuity and stereo acuity after the follow-up. Same level of improvement of visual acuity and stereoacuity was seen in patients given patching therapy and dichoptic game therapy. That shows us that this new advancement in amblyopia treatment i.e. dichoptic therapy can be used as a treatment option. We applied Paired sample t-test and independent sample t-test to the study to assess the difference in visual acuity and stereo acuity before and after the treatment and also the difference between both the treatments respectively. $P > 0.05$ tells us that both the treatments showed the same amount of changes in VA and stereo acuity. Our research study showed that dichoptic game was an effective treatment for amblyopia as within 4 weeks there was significant improvement of visual acuity and stereo acuity was also improved. Compliance of this treatment was also good.

Gargantini A in 2015 presented a paper for amblyopic rehabilitation by using a low cost virtual reality game. The main motive of this paper was so that they can provide the development and the sketch of a mobile application as a video game which aims the treatment of amblyopia while using a Google cardboard. Aim of the game was to provide a full treatment for the patients at home while making it enjoyable. The treatment requires Google cardboard which was virtual reality platform and was developed by Google. It consists of lenses and fold out cardboard in which the smartphone be inserted. It provides two different images to the eyes providing a stereo vision. The game settings were adjusted in a way that all details were seen by lazy eye and the fixing eye only views a scene of the game. The fusion was encouraged by stimulating the amblyopic eye. The game used was known as Car Racing Game (CRC). They concluded that the game provides an inexpensive treatment for amblyopia and the classical risk of patching therapy would be avoided by using this treatment. However, they told that there was no clinical evidence of effectiveness of the treatment through this game but clinical trials were being conducted [10].

Conclusion

We concluded that most of the patients withdraw themselves from patching therapy due to cosmetic purposes or the irritation of closing one eye but on the other hand children loves playing games and gave such good results in dichoptic training game. So, eye care professionals must be aware of this new therapy and it should be kept in mind while dealing with amblyopic patients. After both of these therapies i.e. monocular patching therapy and dichoptic training game equal amount of improvement in visual acuity while mean Stereoacuity after patching therapy was 126.67 and after dichoptic therapy was 122.67 were seen. There was strikingly more compliance seen

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