



To assess the vision improvement in amblyopic children aged 5-15 years after refractive correction and patching therapy

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Abstract

Aim- To assess the vision improvement in amblyopic children aged 5-15 years after refractive correction and patching therapy

Method- In this study, children who visited, ophthalmology department in ITM Hospital, Gwalior underwent overall comprehensive eye checkup. In these children we performed refraction (both dry and wet). SLOAN, HOTV, LOGMAR, KAY pictures and LEA symbol charts were used to measure the Visual acuity in 5-15 years old children. Regarding project chosen a group of school going children and toddlers of 120 eyes of 60 patients those falling into inclusion criteria.

Objective: Children having Visual acuity difference in two eyes (2 lines or more than 2 lines difference) are suffering from this condition known as Amblyopia. Amblyopic patient lacks the normal fusion and stereopsis and becomes difficult doing the day to day activities and also affects their career in future. So, our target of this study is to determine the visual prognosis after the patching and refractive error correction which eventually benefits and contributes the binocular vision restoration.

Conclusion-Overall the observation has shown the vision improvement in 5-10 years of age was better than in the children aged 11-15 years.

Keyword: Vision improvement, Amblyopia, patching therapy

Introduction

Amblyopia can be interpreted as the loss of visual acuity of at least two lines that is not caused by the pathology or correctable by ordinary refractive means. The two lines difference in visual acuity will be there even after the best possible correction. It is the condition in which the brain is not able to verify the stimulation sent by the eye over the period of time after a long deprivation of proper stimulation, simply means there lacks the eye-brain co-ordination unlike the normal eye. It is observed that the amblyopic patient aged <45 years will have the loss of vision more than the ocular disease and trauma combined together.

Amblyopes don't compromise with the visual acuity alone, also compromises with the contrast sensitivity functions, accommodative control, eye movement's precision, pursuit and spatial judgements.

Abnormal visual processing of the primary visual cortex in Amblyopia reduces Visual acuity & Contrast Sensitivity & a number of ophthalmic conditions can cause Amblyopia including uncorrected refractive errors like squint & Central Visual axis Obstruction.

The concept of bilateral refractive Amblyopia can simply be understood the amblyopia generated due to lack of formation of a clear foveal image in the both eyes that cause in abnormal development of the visual cortex.

Uncorrected Hypermetrope children with astigmatism <1.5D are not supposed to develop the amblyopia as they accommodate enough to form the clear images in the fovea.

Classification:

1. **STRABISMIC AMBLYOPIA:** Amblyopia caused by the squint (Eso, exo, hyper or hypo deviation of the eye) as the suppression occurs in the deviated eye.
2. **ANISOMETROPIC AMBLYOPIA:** Mostly seen in the clinical practice, caused due to the difference in the power between two eye 2D or >2D
3. **MERIDIONAL AMBLYOPIA:** Occurs as the consequences of the uncorrected high astigmatism.
4. **ISOAMETROPIC AMBLYOPIA:** Bilateral condition in which the refractive error so great that a clear retinal image cannot be obtained anywhere, causing decreased in bilateral VA
5. **STIMULUS DEPRIVATION AMBLYOPIA:** As the result of deprivation of stimulus due to any opacification in the media such as corneal opacity, scarring, cataract, ptosis involving the visual axis etc

Literature review

Ziylan et al study in the children below 10 years suffering from high hyperopia of 5D or more Isoametropicvisual outcome in high hyperopic Isoametropc.It was concluded that after the hyperopic correction for more than 1 year,the visual acuity was found to be increased upto 6/6 by 43% and rest below 6/12.

Werner and Scott et al reported 6 cases of unilateral Hypermetropic Amblyopia with spherical equivalent of at least +5.00 D and initial visual acuity worse than 20/40 in one eye. All 5 patients with follow up improved with glasses alone and 2 of these 5 had visual acuity worse than 20/40 in one eye with follow up less than 1 year.

A study was published in 2013 by American journal of ophthalmology in 217 children less than 5 years and 6-20 years having Isoametropic amblyopia(Spherical equivalent ≥ 5.00 D).The BCVA of childrenwas $\leq 20/40$ of less than 5 years old and $\leq 20/30$ for children of 6-10 years.. The VA improvement after full spectacle correction from previous VA to 20/25 was observed to be 74.7 % and $> 20/25$ in 28.6 %.

A retrospective study was carried out by Klimek et al in 418 Isoametropic Amblyopic children of moderate to high hyperopia. The childrenhaving spherical equivalent of 4.50Ds without any an isometripiawas picked up along with children having VA of 20/40 or less with bilateral amblyopia was added. The 13 of the selected children which is 36% were found to be the responder of refractive error correction and patching therapy.

Susan A Cotter et al, 2013 prospective study in 146 (strabismic and anisotropic) amblyopic children of 3to <7 years old children treated with spectacle correction alone shows the meaningful improvement of visual acuity without any additional treatment.

A prospective study was performed by the group of ophthalmology of Dr Irene Gottlob, in 322 children with strabismic,anisometropic,and mixed amblyopes .They were provided with patching therapy more than 3 hours shows VA improvement of 6/12.It was found that the VA improved more in anisometropic and strabismic children with more than 75% followed by poor visual prognosis in mixed amblyopes which was 64%.

Methodology

Purpose:To assess the vision improvement in amblyopic children aged 5-15 years after refractive correction and patching therapy

Sample size: Group of school going children and toddlers of 120 eyes of 60patients (46 males and 39 females)

Inclusion criteria:

- Children aged 5 to 15 years.
- Children responsive to LEA symbol ,SLOAN, KAY pictures and LOGMAR charts
- VA taken monocularly and correction finalized by cyclorefraction

Exclusion criteria:

- Any pathological condition other than amblyopia
- On pre-treatment of amblyopia or atropine drop usage
- Patient who has undergone LASIK surgery
- Contact lens usage in between the study
- Children giving variable responses in VA assessment

Procedure:

In this study we have included the hyperopic children $>+3.00D$ and myopic children with $>- 2.50D$ and astigmatism $> \pm 1.50 D$. They have the visual acuity worse than 20/40 in either eye. The spectacle correction was confirmed by wet refraction using cyclopentolate or homide as per the patient's condition. The following protocols were followed during the comprehensive eye checkup.

- Children aged 10 – 15 years VA was taken with SLOAN or LOGMAR as per their convenience.
- Children aged 5-9 years VA was tested with LEA symbol, Kay pictures or LOGMAR charts.
- The children were prescribed with the spectacles finalized by cyclorefraction.
- The parents or the attendants of the children were counselled and advised to make their child wear the spectacle all the time and patching therapy procedure.
- The 3m opticlude patch was advised for the patching therapy and was asked to make the children do the near task which would make their amblyopic eye work slowly.
- They were asked for 3-4 follow ups with 4 weeks gap .The 1st follow up was after the 4 weeks of the first visit.
- The improved BCVA and stereopsis was noted in every visit of the follow ups.

Outcome measure: - The improved VA in the 1st follow up (4 weeks), 2nd follow up (8 weeks), 3rd follow up (12 weeks) and 4th follow up (16 weeks) resulted from the spectacle correction and patching was noted properly.

Results: Out of 60 patients, who met the inclusion criteria of our study, 46 Patients were males & 39 were females

Statistical analysis: Microsoft Excel 2010 on windows 8.1 software.

Data analysis

Table 1: unaided visual acuity before patching therapy		
Visual acuity	No. of eyes	Percentage
VA (<20/200)	40	33.33%
VA (20/200-20/100)	54	45.00%
VA (20/100-20/50)	26	21.66%

Table 1: Shows the unaided visual of the patient who visited the clinic with comprehensive eye examination done where VA (<20/200) were of 33.33%, VA (20/200-20/100) were of 45.00% and VA (20/100-20/50) were of 21.66%.

Table 2: Visual acuity after 6 hours of patching therapy for 4 months		
Visual acuity	No. of eyes	Percentage
VA (<20/200)	06	10.00%
VA (20/200-20/100)	14	25.00%
VA (20/100-20/50)	12	20.00%
VA (>= 20/50)	28	45.00%

Table 2 : Shows the visual acuity of the patient with patching done for 6 hours strictly comprehensive eye examination with follow up and observed after 4months VA(< 20/200) were of 10.00%,VA (20/200-20/100) were of 25.00%,VA (20/100 – 20/50) were of 21.66% and VA improvement of patients (>= 20/50) were of 43.33%.

Table 3: Visual acuity after refractive correction for 4 months		
Visual acuity	No. of eyes	Percentage
VA (<20/200)	25	42.33%
VA (20/200-20/100)	28	46.66%
VA (20/200-20/100)	07	11.22%
VA (\geq 20/50)	0	0

Table 3: Shows visual acuity of patient with Refractive error correction ,3 hours minimum ,No patching done were included VA (<20/200) were of 42.33% with no patching were patient were not cooperative and parental negligence, VA (20/200-20/100) were of 46.66%, VA (20/100-20/50) were of 11.22% and VA (\geq 20/50) with no improvement noted.

Table 4:Detailed VA improvement	No. of eyes	Percentage
1 line	04	5.00%
2 lines	10	16.66%
More than 2 lines	44	75.00%
No improvement	02	3.33%

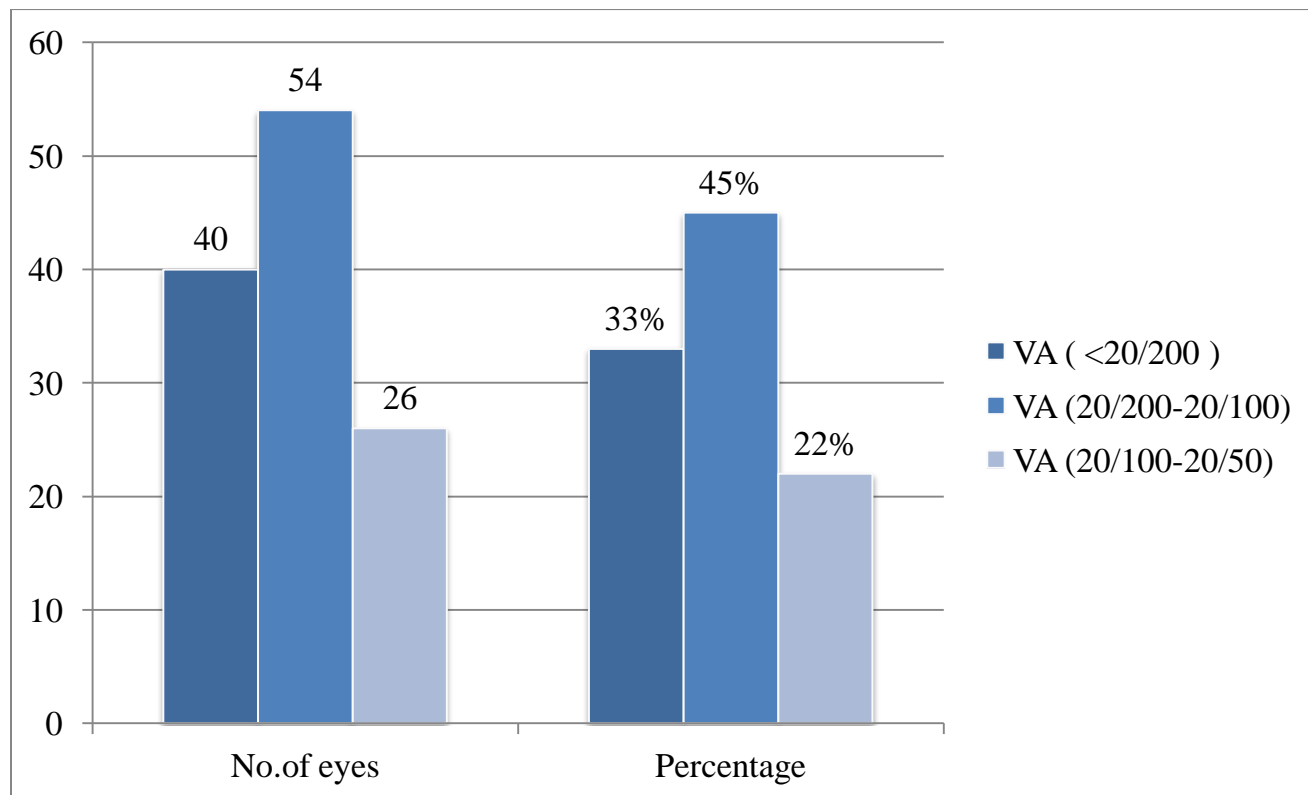
Table 4: This shows visual acuity line improvement of patient with successful patching 6 hours with given compliance ,with 1 line improvement of poor patching were of 5.00%,2 line improvement were of 16.66%, > 2 line improvement were of 75.00% and No improvement with patient un cooperativeness were of 3.33%.

Table 5: Detailed VA improvement	No. of eyes	Percentage
1 line improvement	20	33.33%
2 lines	16	27.00%
More than 2 lines	02	3.33%
No improvement	22	37.00%

Table 5: This shows visual acuity line improvement of patient with successful refractive correction given compliance where patient was not cooperative ,with 1 line improvement of poor patching were of 33.33%,2 line improvement were of 29.00%, > 2 line improvement were of 0% and No improvement with patient un cooperativeness were of 38.33%

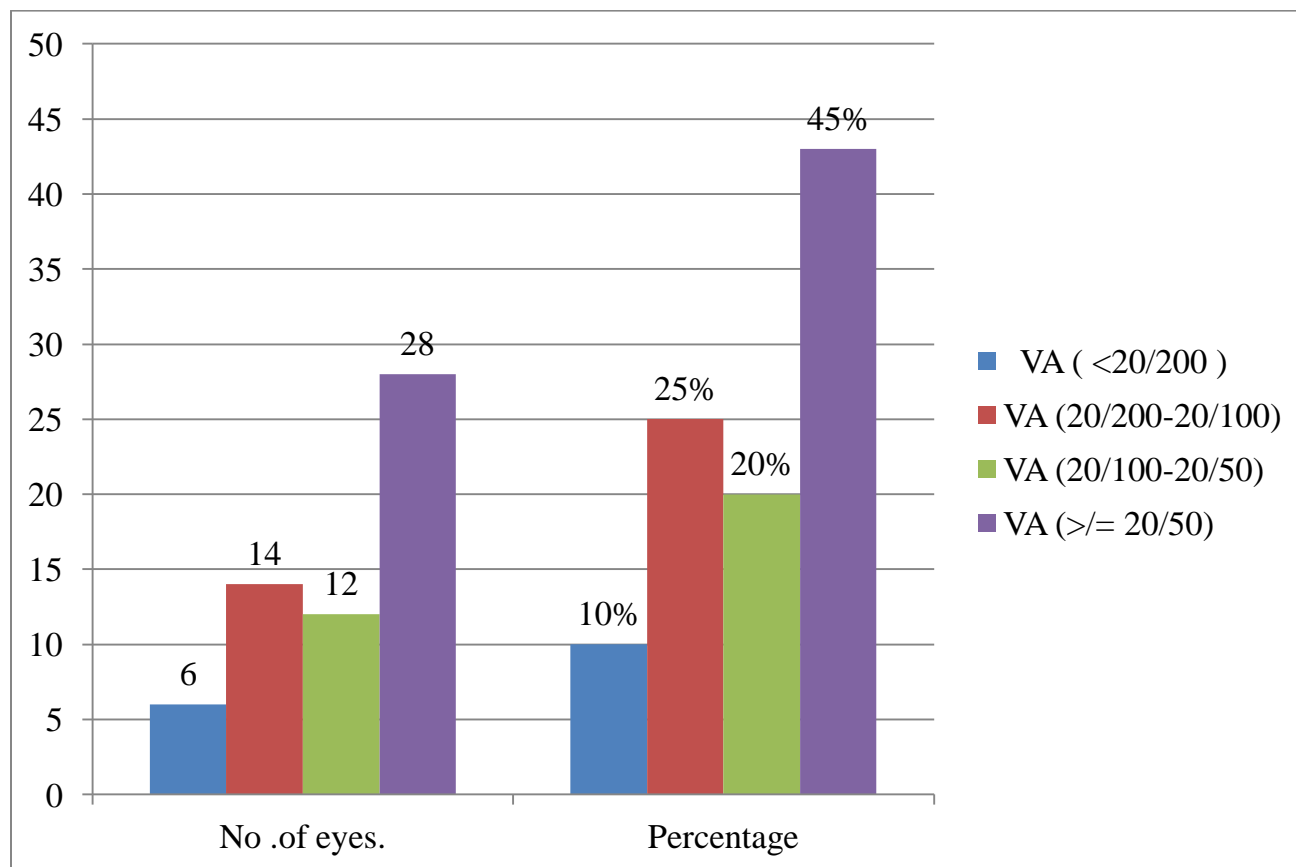
Results

The result was consider on the data annalysis done where the patinets data had been retrospectively collected and the patient where divided into 2 group. one group 1 with strict patching for 6 hours and group 2 with irregular patching ,parents neglegence,child un cooperative and depended on refractive correction



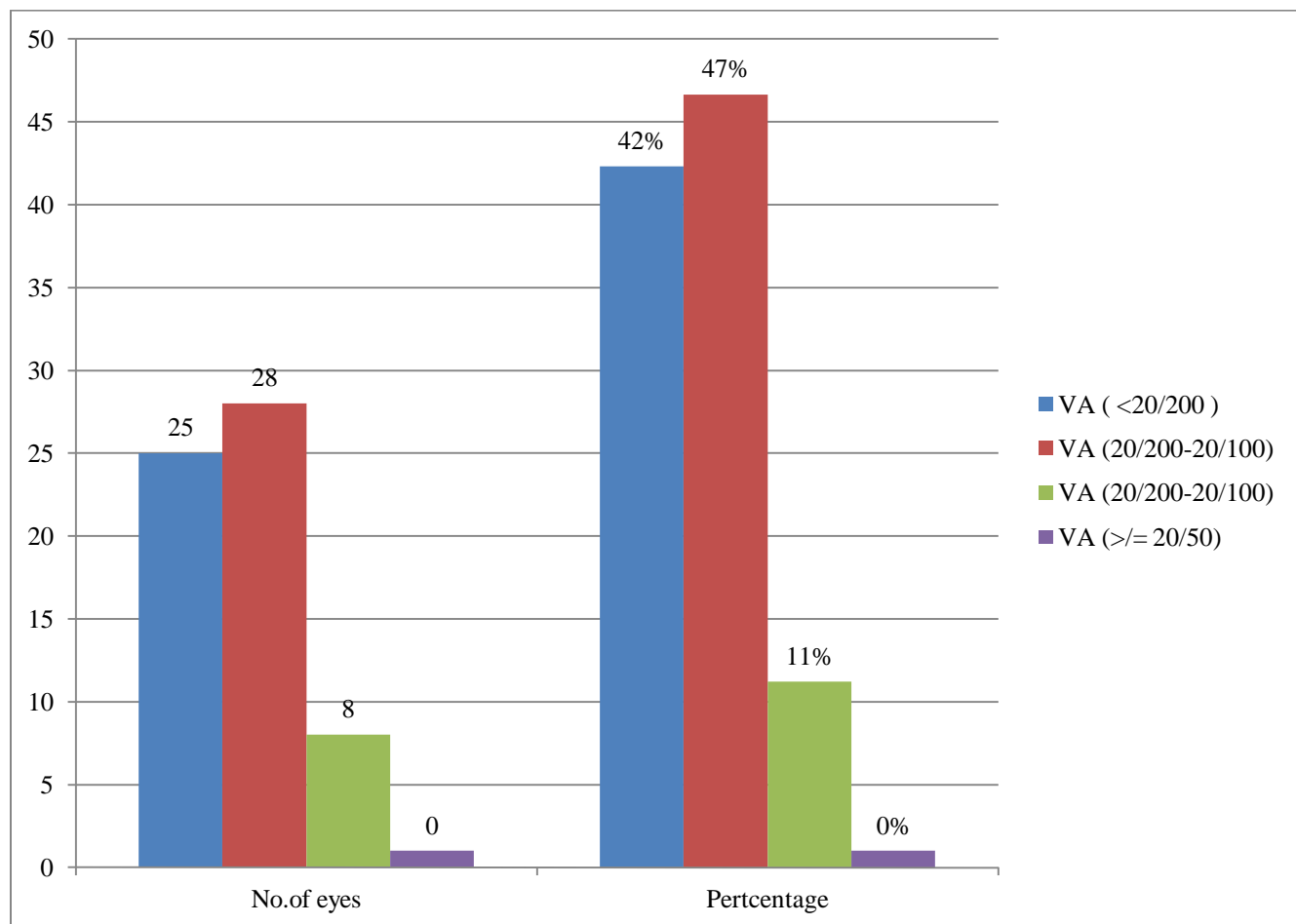
Graph 1: Shows the unaided visual acuity of the patients of group 1 and group 2 of 120 at first time visit to the clinic where the 20 patients have VA (<math>< 20/200</math>) were of 33.00%, 27 patient have VA ($20/200 - 20/100$) were of 45.00% and 13 patient, Whose VA falls between ($20/100-20/50$) was of 22%

Graph 2: Visual acuity after 6 hours of patching therapy for 4 months



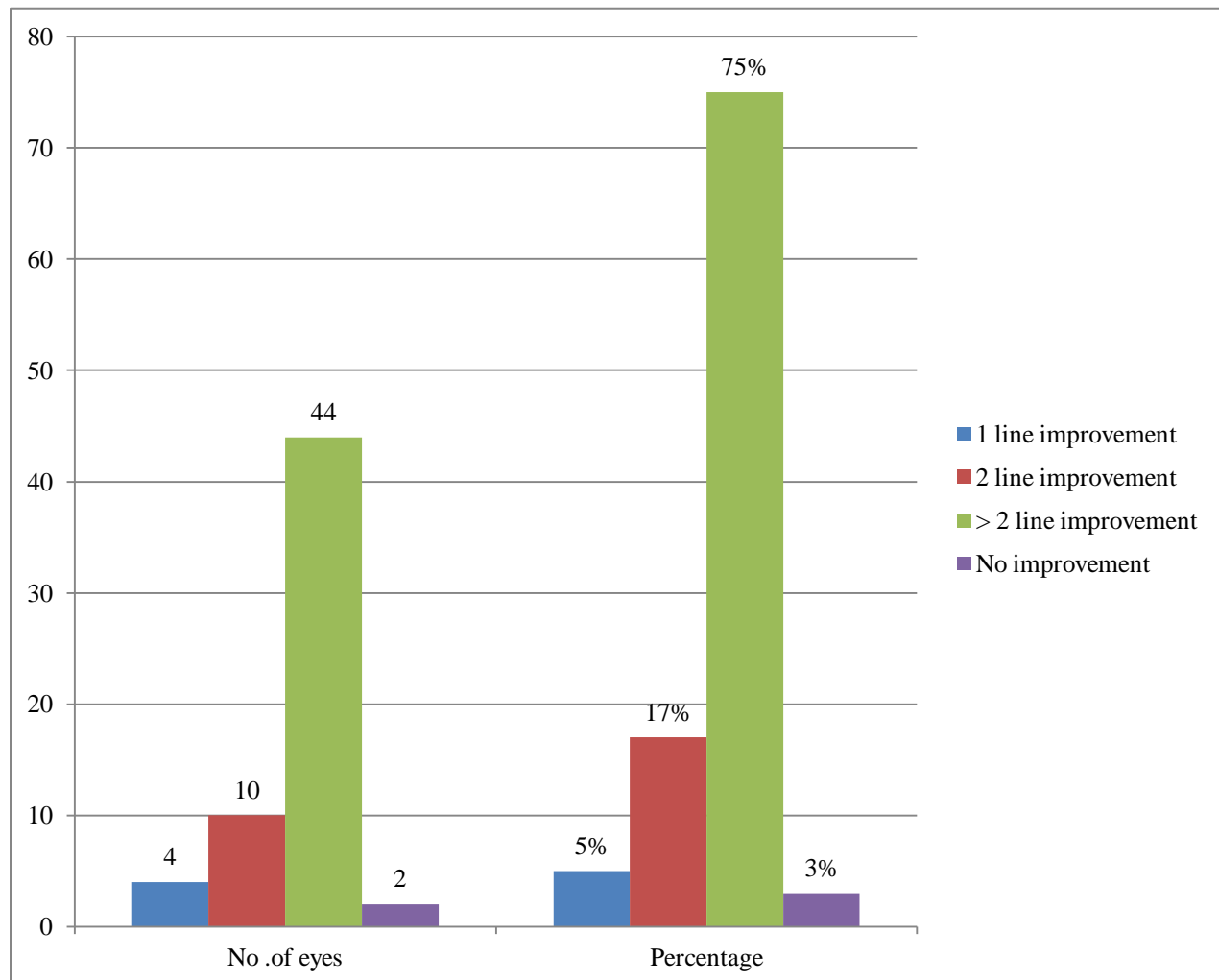
Graph 2: This graph shows visual acuity of patients Group 1 after 6 hours of patching where 3 patients showed VA of (20/200) were of 10.00%, 07 patients showed VA improvement of (20/200–20/100) were of 25%, 06 patient showed VA improvement of (20/200-20/50) were of 20 % and 14 patients showed VA improvement of (>= 20/50) were of 45%.

Graph 3: Visual acuity after refractive error correction for 4 months



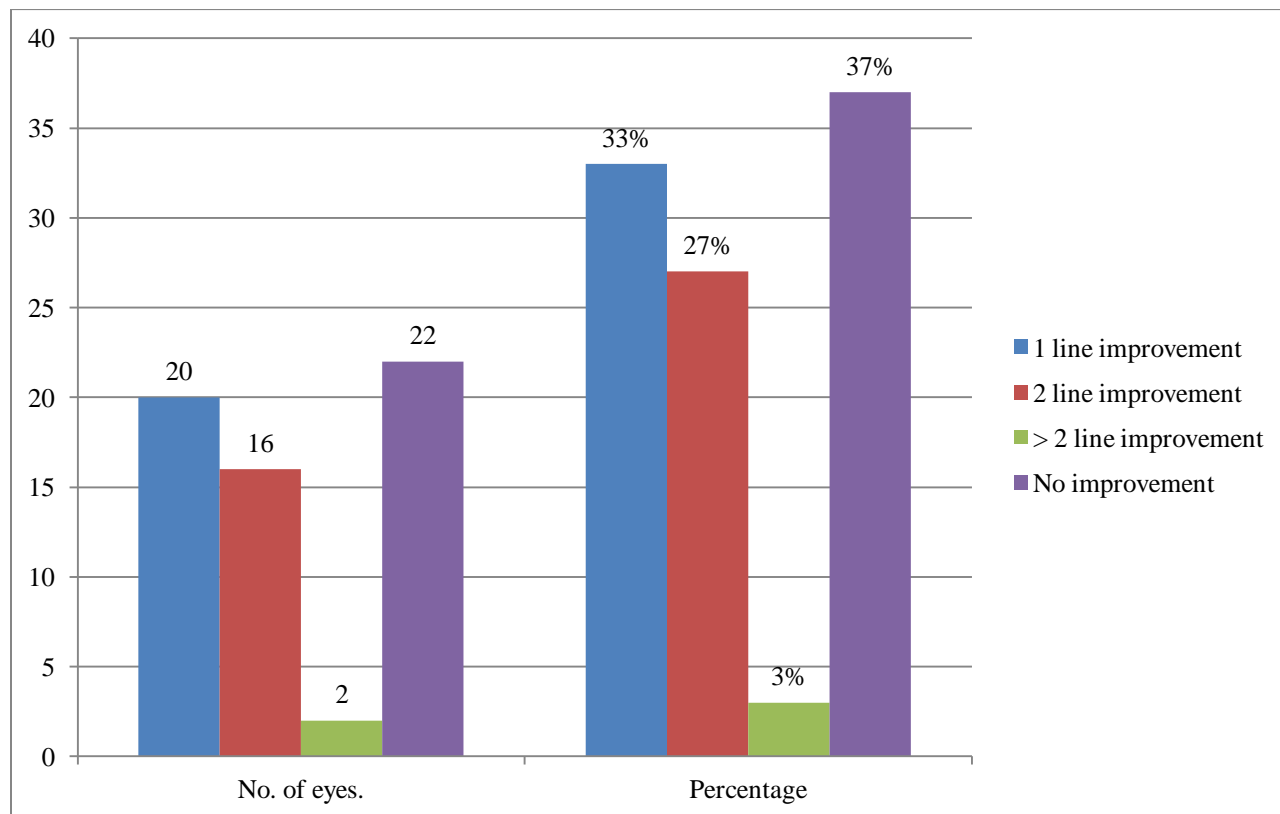
Graph 3: Shows visual acuity of patients of group 2 after refractive correction due to patient un cooperative where 12 patients showed VA (<20/200) was of 42%, 14 patients showed VA of (20/200 -20/100) was of 47%, 04 patients showed visual acuity of VA (20/200-20/100) was of 11% and patient have not improved VA (>= 20/50).

Graph 4: Detailed VA improvement after 6 hours of patching for 4 months.



Graph 4: Shows Detailed visual acuity improvement of the patient of Group 1 after 6 hours of patching 2 patient have showed VA improvement of 1 line were of 05%, 05 patients showed VA improvement of 2 lines were of 17%, 22 Patients showed VA improvement of >2 lines were of 75% and 1 patient Showed no VA improvement was of 3%.

Graph 5: Detailed VA improvement after refractive correction for 4 months.



Graph 5: Shows Detailed visual acuity improvement of the patient of Group 2 after Refractive error correction as the patient was no cooperative, parents negligence, depending on refractive correction alone 2 patient have showed VA improvement of 1 line were of 05% , 05 patients showed VA improvement of 2 lines were of 17%, 22 Patients showed VA improvement of >2 lines were of 75% and 1 patient Showed no VA improvement was of 3%.

Discussion

A study was carried out by Swathi Handa et al (2019), Singapore Medical J. in 180 fresh amblyopes of age 3-7 years. After 1 year of optical correction and patching therapy it was found out that in 150 (83%) children who returned to the follow up, VA of 6/9 or better in amblyopic eye of 121 (81%) children was observed.

In our study in ,30 children who followed strict 6 hours patching for 4 months ,the VA more than 2 lines improvement was noticed to be in 44 eyes (75%)s, 2 lines improvement in 10 eye(16.66%) and 1 line improvement in 4 eyes(5%) and no movement in 2 eyes(3.33%).The highest % of improvement in amblyopes i.e. 75% were noticed after strict 6 hours of patching along with correction.

In 30 children who were dependent in spectacle correction along with irregular or poor patching hour (1 hour or less) , only 2 eyes was observed to have more than 2 lines (3.33%) followed by 16 eyes with 2 lines improvement (27%) , 20 eyes with 1 line improvement (33.33%) and 22 eyes with no improvement at all (37%).

Conclusion

Amblyopia is happened to be abundantly found in day to day clinical practice in children. Patching therapy shows to be effective in this case. The greater improvement in vision is noticed in children practicing the patching therapy strictly as directed.

After this retrospective study it is concluded that the children who were under the strict patching therapy has shown the significant improvement. On the other hand the children who skipped the patching due to parent's negligence, their own nature of un-cooperation

For the improvement to be more and keeping the children's future in hand parent' should be the one who should encourage their children more and come up with innovative ideas to make the child do the patching. During patching, children should be encouraged to do the near tasks like coloring, drawing, painting, etc. Children who are un-cooperative for such activities can be asked to play video games, watch cartoons, use mobile phone, etc for the encouragement.

However, since this is a retrospective study observed in the clinical practice, the amblyopes were not categorized and the status of their visual prognosis according to the categorization after the patching in our study was not addressed properly. So, a prospective study with proper categorization can be more effective to estimate the proper visual prognosis and effectiveness of the treatment.

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Declaration

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Conflict of interest: There are no conflicts of interest.

Ethical approval: Ethical approval was done by the ethical committee of ITM University, Gwalior, Madhya Pradesh, India

References

1. Cantor, L. (1985). Binocular vision and ocular motility: theory and management of strabismus. *Ophthalmic Surgery, Lasers and Imaging Retina*, 16(9), 599-599.
2. London, R., & Wick, B. (2006). Patients with amblyopia and strabismus. In *Borish's Clinical Refraction* (pp. 1461-1478). Butterworth-Heinemann.
3. Simons, K. (2005). Amblyopia characterization, treatment, and prophylaxis. *Survey of ophthalmology*, 50(2), 123-166.
4. Klimek, D. L., Cruz, O. A., Scott, W. E., & Davitt, B. V. (2004). Isoametropic amblyopia due to high hyperopia in children. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, 8(4), 310-313.
5. Phillips, C. I., Crouch, E. R., & Schoenleber, D. B. (1987). Bilateral Hypermetropic Amblyopia/Response by Drs. Crouch and Schoenleber. *Journal of Pediatric Ophthalmology & Strabismus*, 24(6), 319-319.
6. Klimek, D. L., Cruz, O. A., Scott, W. E., & Davitt, B. V. (2005). Isoametropic amblyopia due to high hyperopia in children. *American Journal of Ophthalmology*, 139(3), 584-585.
7. Stewart, C. E., Moseley, M. J., Stephens, D. A., & Fielder, A. R. (2004). Treatment dose-response in amblyopia therapy: the Monitored Occlusion Treatment of Amblyopia Study (MOTAS). *Investigative ophthalmology & visual science*, 45(9), 3048-3054.
8. Wallace, D. K., & Pediatric Eye Disease Investigator Group. (2006). A randomized trial to evaluate 2 hours of daily patching for strabismic and anisometropic amblyopia in children. *Ophthalmology*, 113(6), 904-912.
9. Wallace, D. K., Lazar, E. L., Holmes, J. M., Repka, M. X., Cotter, S. A., Chen, A. M., ... & Pediatric Eye Disease Investigator Group. (2013). A randomized trial of increasing patching for amblyopia. *Ophthalmology*, 120(11), 2270-2277.

10. Pediatric Eye Disease Investigator Group. (2004). Risk of amblyopia recurrence after cessation of treatment. *Journal of American Association for Pediatric Ophthalmology and Strabismus*, 8(5), 420-428.
11. Solebo, A. L., Cumberland, P. M., & Rahi, J. S. (2015). Whole-population vision screening in children aged 4–5 years to detect amblyopia. *The Lancet*, 385(9984), 2308-2319.
12. Murali, K., Ramesh, A., Murthy, S. R., & Goyal, A. (2022). Binocular therapy as primary intervention in adults with anisometropic amblyopia. *Taiwan Journal of Ophthalmology*, 12(3), 317-324.
13. Weakley Jr, D. R. (2001). The association between nonstrabismic anisometropia, amblyopia, and subnormal binocularity. *Ophthalmology*, 108(1), 163-171.
14. Tacagni, D. J., Stewart, C. E., Moseley, M. J., & Fielder, A. R. (2007). Factors affecting the stability of visual function following cessation of occlusion therapy for amblyopia. *Graefe's archive for clinical and experimental ophthalmology*, 245, 811-816.
15. Agervi, P., Kugelberg, U., Kugelberg, M., Simonsson, G., Fornander, M., & Zetterström, C. (2010). Randomized evaluation of spectacles plus alternate-day occlusion to treat amblyopia. *Ophthalmology*, 117(2), 381-387.