

**THE EFFECT OF OVERMINUS PRESCRIPTION ON POSITIVE FUSIONAL VERGENCE VALUE
AND ACCOMMODATION AMPLITUDE AFTER WATCHING VIDEO AT 6 METRE**

NUR SHAZLIYANA BINTI AMER HAMZAH, Bptom. (Hons.)
DEPARTMENT OF OPTOMETRY AND VISUAL SCIENCES, INTERNATIONAL ISLAMIC
UNIVERSITY MALAYSIA, JALAN SULTAN AHMAD SHAH, BANDAR INDERA MAHKOTA,
25200 KUANTAN, PAHANG.
shazliyanahamzah@gmail.com

MOHD HAFIDZ ITHNIN, PhD (CORRESPONDING AUTHOR)
DEPARTMENT OF OPTOMETRY AND VISUAL SCIENCES, INTERNATIONAL ISLAMIC
UNIVERSITY MALAYSIA, JALAN SULTAN AHMAD SHAH, BANDAR INDERA MAHKOTA,
25200 KUANTAN, PAHANG.
mohdhafidz_ithnin@iiu.edu.my

ABSTRACT

Introduction: The study aimed to investigate the effect -1.00 DS overminus prescription on positive fusional vergence (PFV) and accommodation amplitude (AA) after watching video at 6m. **Method:** Thirty normal participants without binocular vision anomalies (23.50 ± 1.50 years) were involved in this quasi-experimental study. All subjects wore additional -1.00 DS on the spectacle prescription for 15 minutes while watching video at 6m. The distance (6m) and near (40cm) PFV and AA were measured before and after 15 minutes watching video at 6m with the overminus prescription. **Results:** The result demonstrated the right eye (RE) AA reduced significantly ($p < 0.05$) while the reduction on the left side was insignificant ($p > 0.05$). The changes of near and distance PFV was found insignificant ($p > 0.05$) after 15 minutes watching video at 6m with overminus prescription. **Conclusion:** Overminus prescription of -1.00DS for 15 minutes at distance fixation that presented in this study reduced the ability of accommodation. There were no changes in vergence system after intervention of -1.00 DS overminus prescription for 15 minutes at 6m.

Keywords: Overminus prescription, accommodation amplitude, positive fusional vergence

INTRODUCTION

The overminus therapy is particularly given when active visual therapy such as Brock string is unsuccessful or poor patient compliance and it can be used to treat some cases of decompensated exophoria. (Caltrider & Jampolsky, 1983; Mangad, Mohan, Vijayalakshmi, Krishnan, & Babu, 2018). This prescription has a reasonable rate of success in the medium term of therapy and may be advised as primary therapeutic alternative for exotropia, particularly intermittent cases, in order to decrease the deviation. (Bayramlar, Gurturk, Sari, & Karadag, 2017; Reynolds, Wackerhagen, & Olitsky, 2018).

The effectiveness of the overminus prescription in the treatment of exo deviation, particularly intermittent type has also been discovered by Chen et al., (2016). This full randomized clinical trial investigations found that overminus prescription reduced the exodeviation after 8 weeks in children aged 3 to <7 years with IXT. They postulated that the reduction of the deviation might be contributed by the stimulation of accommodation, thus the convergence was stimulated as, leading to the occurrence of fusion (Franzén, Richter, & Stark, 2000; Plainis, Charman, & Pallikaris, 2014).

The similar finding was reported by Bayramlar, Gurturk, Sari, & Karadag, (2017). The retrospective study stated that from the total of 19 children were prescribed overminus prescription, 84% showed a marked improvement on both qualitative and quantitative.

Nevertheless, the previous reports only stated the effectiveness of overminus prescription among childhood. The findings regarding young adulthood, particularly are still under-explored. Therefore, the purpose of this current study was to investigate the effect on -1.00DS overminus prescription on accommodation and vergence system after 15 minutes watching video at 6m.

METHODOLOGY

Participants

The study was conducted at the Department of Optometry and Visual Science, Kulliyah of Allied Health Sciences (KAHS), International Islamic University Malaysia (IIUM), Kuantan, Pahang, Malaysia. The purposive sampling was conducted in recruiting participants and the selection participants were based on the inclusion and exclusion criteria. Subjects with aged from 18 to 25 years old were recruited in this study. Subjects were included if they had (i) best corrected visual acuity (VA) of 6/6 with refractive error, (ii) refractive error <-4.00DS for spherical correction and <-1.00DC for astigmatism prescription (iii) TNO test of 60 seconds of arc or better (iv) amplitude of accommodation ranged from 10.00 to 12.50D, and (v) phoria ranged from 1 esophoria to 2 exophoria at 6m, while orthophoria to 6 exophoria at 40 cm. Participant with any ocular and systemic health problems, as well as taking any medication were excluded in this study.

Materials and Methods

This quasi-experimental study adhered the Declaration of Helsinki and the ethical approval was obtained from the Institutional Review Board. All subjects were explained about the purpose and procedure of the study and if the agreement was achieved, the written informed consent was signed by both subjects and examiner.

This screening procedure was started with measurement of VA and refractive error. The subject's refractive error must be fully corrected before starting this study. Then, the procedure was continued by the assessment of stereopsis by TNO test to evaluate the normality of binocular vision. Subsequently, the heterophoria was assessed using Howell Card for distance and near. The slit lamp biomicroscopy and ophthalmoscopy were also conducted to observe any abnormality found on anterior and posterior segment of the eye.

The pre-intervention procedure was started with the measurement of maximum ability of accommodation, which is also known as amplitude of accommodation (AA). The amplitude was assessed using Royal Air Force (RAF) rule. A word of N5 size was used as fixation target. The AA measurement was started with right eye by occluding the left eye. Subjects fixated the target at 40cm and then the target was slowly moved closer to the eye until first sustained blur image was obtained. The target was slowly moved away until the subjects reported the first clear image was seen. The measurement was repeated three times to obtain the mean. Both first sustained blur and clear images points were recorded but the blur point was taken for the data analysis. Similar steps were repeated on the left eye by occluding the right eye. If the AA found was below than 10.00 D and more than 12.50D on one or both eyes, the subjects were excluded in this study.

Then, the assessment of positive fusional vergence (PFV) at 6m using prism bar was evaluated. Subjects fixated at a 6/9 letter and then, the low base-out prism dioptic power was placed before the right eye using prism bar. The prism dioptic power was slowly increased until they reported the image became double which is known as break point. Subsequently, the power of the prism dioptre was decreased until the single image was reported (recovery point). Both outcomes were recorded but the break point were taken for the data analysis. Similar procedure was repeated on the near PFV by using a 6/9 reduced letter as a target at Gulden fixation stick. The distance of the near PFV test was 40cm.

The intervention procedure was conducted by watching the "Anime Janggeum's Dream" video for 15 minutes with added -1.00 DS on spectacle correction in both eyes at 6-meter distance. After finished for 15 minutes watched the video, the added -1.00DS was removed. The accommodation amplitude (AA) and PFV at 6m and 40cm were re-measured. The participant was discharged and all data was recorded and analysed.

The data was analysed by using Statistical Package for Social Science (SPSS) software (V12.0.1 for Windows; SPSS Science, Chicago, Illinois, USA). The study compared the p-value that obtained from statistical analysis with significant level was set, p- value was 0.05. The paired sample t- test which is parametric test had been used to compare the means of a numerical variable between pre and post result of AA and PFV after watching the video for 15 minutes.

RESULTS

Thirty participants consist of 12 males and 18 females (mean age: 23.50 ± 1.50 years) were involved in this study. The means and standard deviation of all measured parameters were calculated, given in table 1. For all parameters which were right and left AA, distance and near PFV, paired t-test was used to analyse the data since normality assumption of data is met as the number of participants was thirty. Chang et al., (2006) stated that the distribution is considered as normal if the number of sample size is thirty and more due to the theory of central limited theorem. P-value of 0.05 or less was considered statistically significant throughout the study.

Thus, the paired t-test was conducted to compare the effect of overminus lens (-1.00 DS) before and after watching video at 6m for 15 minutes on AA and PFV. Right eye (RE) In terms of

statistical analysis, AA decreased significantly after 15 minutes of -1.00DS overminus inducement at 6m fixation ($p < 0.05$). However, the reduction of AA on the left side was not statistically significant ($p > 0.05$). The increment of distance and near PFV after the inducement of -1.00DS overminus for 15 minutes were demonstrated in the statistical analysis. Nevertheless, the differences were not statistically significant ($p > 0.05$).

Table 1: AA and PFV between pre and post watching video using paired t-test, n= 30

Variable		Pre-intervention Mean \pm SD	Post- intervention Mean \pm SD	95 % CI	t	p- value
AA	RE	9.37 \pm 1.43	8.83 \pm 1.39	0.12 to 0.95	2.64	0.01
	LE	9.40 \pm 1.25	9.10 \pm 1.40	-0.12 to 0.72	1.47	0.15
PFV	6m	21.23 \pm 8.48	21.60 \pm 8.40	-3.88 to 3.14	-0.21	0.83
	40cm	21.60 \pm 10.69	22.20 \pm 9.53	-3.36 to 2.06	-0.46	0.65

SD = standard deviation, CI = confidence interval

DISCUSSION

In this current study, the fixed overminus lens which was -1.00 DS was used as an intervention of this study. The fixed amount of overminus prescription was selected to be the intervention, as participants were fully corrected and were assumed the image was placed near on the retina. The overminus prescription was chosen because it is the minimum overcorrection prescription for the treatment of intermittent exotropia based on previous reports (Bayramlar et al., 2017; Chen et al., 2016; Mangad et al., 2018; Rowe, Noonan, Freeman, & DeBell, 2009) In addition, that amount of overminus was chosen in maintaining a constant accommodative demand in all participants (Chen et al., 2016). Thus, the fixed amount of overminus prescription was given to all participants.

Overall, the findings of the present study showed no significant changes in PFV values at 6m and 40 cm after 15 minutes wearing -1.00 overminus prescription at distance during watching video. In this study, PFV was measured after a few minutes of AA measurement. The alteration of PFV might wash out during these few minutes. The result of this study supported by Wolfe & O'Connell, (1987) which stated that vergence adaptation will recover within a shorter period which is 3 minutes.

In contrast, based on prospective non-randomised longitudinal cohort study, about fifty-two percent of total 21 patients with overminus prescription had good outcome and were success in reducing outward deviation (Rowe et al., 2009). However, this study conducted for at least one year follow up, which was not applied in the current study.

The current finding demonstrated that only RE AA was significantly reduced after the overminus prescription. This result might be due to the inducement of overminus which could lead to the focused image located behind the retina, resulting in retinal blur (Charman, 2008). The retinal blur stimulates the inferior division of oculomotor nerve, hence, producing contraction of ciliary muscle to increase the thickness of the crystalline lens. Eventually, the accommodation occurs at distance viewing to clear the image (Franzén et al., 2000).

However, the continuous of accommodation at distance fixation for 15 minutes might cause the accommodative fatigue. As reported by Hasebe, Graf, & Schor, (2001), the fatigue of accommodation is caused by the repetitive of accommodation. Therefore, the reduction of AA was demonstrated in this current study, even though the intervention was only for 15 minutes. Nevertheless, the significant reduction of AA on the left side was not shown. It might be due the sequence of testing procedure whereby the RE AA was measured first, followed by the left side. The

delay time of assessment due to the sequence could lead to the adaptation of the vergence and accommodation systems, which was mentioned by Wolfe & O'Connell, (1987).

The changes on the parameters measured in this study were demonstrated especially on the ability of accommodation. However, the improvement of this current study can be suggested in future discovery such as longer duration of overminus prescription intervention. Moreover, the impact on higher overminus prescriptions on additional parameters of accommodation and vergence, such as accommodative facility, relative accommodation, phoria, negative fusional vergence (NFV), and vergence facility could be evaluated in future. Apart from that, it is suggested that other groups of age such as young children, pre-presbyopia, and presbyopia groups can be included.

CONCLUSION

In conclusion, the 15 minutes of -1.00 overminus prescription during watching video at 6m could lead to weakness of accommodation system. This reduction of accommodation system might be caused by the divergence lens wear, resulting the image is placed behind the retina, and subsequently stimulates retinal blur. Thus, the accommodation system needs to be stimulated in order to bring the image on the fovea for clear vision, even though at distance fixation. Thus, the longer duration of the overminus wear could lead to visual fatigue that disrupts the eye focusing system. Nevertheless, the short-term of overminus prescription intervention could not help in the improvement of positive fusional vergence.

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