The Outcome Of Combining Home Based And Clinic Based Amblyopia Therapy Among Preschool Children

Rokiah Omar, PhD*, Victor Feizal Knight, MBBS, MHP**, Duratul Ain Hussin, BOptom, MSc***,

*Optometry & Vision Science Programme, School of Healthcare Sciences, Faculty of Health Sciences, Universiti Kebangsaan Malaysia. **Faculty of Medicine & Defence Health, National Defence University of Malaysia. ***Department of Ophthalmology, Hospital Ampang, Kuala Lumpur, Malaysia

SUMMARY
This study determined the outcome of combining home based and clinic based amblyopia therapy among preschool children. A total of 479 preschool children were randomly selected for vision screening. Amblyopic therapy was prescribed to children whose visual acuity (VA) could not be improved to <0.1 LogMAR after a 6 week adaptation period with glasses. Intensive near work activities were conducted daily at home for 12 weeks, monitored by parents while weekly therapy was conducted at the optometry clinic by an optometrist. Six preschool children were diagnosed with refractive amblyopia, spherical equivalent (SE) was -1.25D to +0.75D. Significant improvement was found in the VA of right eye, t(6) = 3.07, left eye t(6) = 3.07 and both eyes t(6) = 3.42, p<0.05, at the end of the 12 week therapy. Combining home based and clinic based amblyopia therapy among preschool children showed a positive improvement in VA after 12 weeks of therapy.

KEY WORDS:
Preschool children, visually impaired, amblyopia

INTRODUCTION
Amblyopia results from degradation of retinal images during the sensitive period of visual development, which historically has been thought to be the first 7 years of life. Degradation of retinal images, and the subsequent central suppression that leads to amblyopia, results from one of three causal processes which are strabismus, anisometropia and stimulus deprivation. Anisometropia is a difference in the amount of diopter refractive error between both eyes causing blurred images on the fovea over one eye while on the fovea of the other eye the image is focused and sharp. Strabismus occurs when ocular alignment is not parallel or when eye spatial deviation occurs causing the fovea of both eyes to receive different visual images and thereby causing suppression of the retinal image from one eye. Lastly, any form of stimulus deprivation such as ametropia, cataract, corneal opacity and ptosis which prevents the formation of a clear image on the retina thereby causing an unclear image or the retina to be unstimulated and so causing suppression of the image or lack thereof.

Amblyopia is the most common cause of monocular vision loss in children1. The clinical features of amblyopia include a reduction of visual acuity (VA) in both eyes or difference of two or more lines between the eyes with the best VA. Amblyopia occurs in the absence of organic causes or ocular pathology2-4. The prevalence of amblyopia in children aged 5-17 years is in the range of between 0.2% - 5.3% depending on the study population. However amblyopia prevalence in school children aged 7-15 years has been found to be higher, i.e. between 2.0% - 12%5-8. Unfortunately, the prevalence of amblyopia among preschool children in several countries has been found to be in a lower range of between 0.2% - 1.8%9-12. With regards the treatment of amblyopia, the Pediatric Eye Disease Investigator Group (PEDIG 2006) study has shown that there was an increase in the VA from base line, with a mean of 1.1 lines with the use of eye occlusion therapy for 2 hours a day for 16 weeks compared to only 0.5 lines (p = 0.01) without any therapy13. However, the effect of occlusion was only effective if compliance with the occlusion period was followed. Another study showed that compliance with amblyopia therapy was poor when it was conducted only at home14. Therefore this study aimed to determine the outcome of combining home based and clinic based amblyopia therapy among preschool children.

MATERIALS AND METHODS
The vision screening was conducted in the Sentul District in the state of Perak, Malaysia from January to October 2007. Twenty one kindergartners with a total of 596 children aged 4-6 years were selected randomly for this study. Vision screening information and consent forms were distributed to parents two weeks prior to the examination date. Only preschool children who returned the consent forms and were present on the day of examination were included in this study. 479 children participated with the consent of their parents. This study was approved by the Research and Ethics Committee for Medical Research, Universiti Kebangsaan Malaysia and assigned the project code IF-107-2007. All study procedures were in compliance with the conditions set by the Declaration of Helsinki15.

The vision screening test include visual acuity testing using the Lea Symbols chart, cover test, Hirschberg's test, external observation and ophthalmoscopic examination. The referral
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Table I: Type of tests and fail criteria for preschool vision screening

<table>
<thead>
<tr>
<th>Type of Tests</th>
<th>Fail Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual acuity test</td>
<td>&gt; 0.3 LogMAR</td>
</tr>
<tr>
<td>Cover test (distance &amp; near)</td>
<td>Any ocular deviation</td>
</tr>
<tr>
<td>Hirschberg's test</td>
<td>Any corneal reflex deviation</td>
</tr>
<tr>
<td>External eye examination</td>
<td>Any external eye abnormalities</td>
</tr>
<tr>
<td>Diphthalmoscopy</td>
<td>Any fundus profile abnormalities</td>
</tr>
</tbody>
</table>

Table II: Mean spherical equivalent (SE) and range of refractive error for preschool children by age group

<table>
<thead>
<tr>
<th>Age (Year)</th>
<th>RE (in D)</th>
<th>Eye</th>
<th>LE (in D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-5.13 ± 0.76</td>
<td></td>
<td>-5.19 ± 0.93</td>
</tr>
<tr>
<td>(n = 2)</td>
<td>(+1.00, -1.25)</td>
<td>(+1.13, -1.50)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-0.65 ± 1.22</td>
<td></td>
<td>-0.32 ± 1.45</td>
</tr>
<tr>
<td>(n = 13)</td>
<td>(+1.50, -2.50)</td>
<td>(+3.00, -1.25)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>-0.83 ± 0.89</td>
<td></td>
<td>-0.74 ± 0.83</td>
</tr>
<tr>
<td>n = 13</td>
<td>(+1.00, -2.50)</td>
<td>(+0.75, -2.13)</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1: Improvement of VA for the preschool children undergoing the combined home based and clinic based amblyopia therapy over a period of 12 weeks.

RESULTS

Out of 596 consent forms distributed, only 479 preschool children returned the consent forms and were screened. The mean age was 5.3±0.7 years old. 52% of the preschool children were males. The predominant ethnic group was Malay (59.9%), followed by Chinese (26.7%) and Indian (9.6%) and other ethnicites (4.8%). A total of 45 preschool children failed the visual screening and were referred to the optometry clinic for further examination. Standard optometric examination found that 32 children (67% of the original subjects) were truepositive and visually impaired. The remaining eight preschool children were found to be false positive for visual impairment while a further three preschool children were not cooperative and unable to undergo the standard optometric examination and therefore were excluded from the study.

Refractive Errors

A total of 28 out of the 32 true positive preschool children with vision problems were found to be due to uncorrected refractive errors. Therefore, the prevalence of refractive error was 5.8% of the overall age group. Overall, the mean SE for right eye (RE) was -0.69±0.98 D (range: -1.12 to 1.50 D) and left eye (LE) was -0.57±0.69 D (range: -1.15 to 1.00 D). The mean SEs for RE and LE by age group are described in Table 2. A total of 17 subjects were found to have myopia (35.8%) and the balance hyperopia. It was also found that myopia (SE>0.50D) was present in the RE of preschool children aged 4 years old. It then increased to 61.5% at the age of 6 years. RE myopia correlation test was found significant for SE and age, r=0.57, p=0.02. Astigmatism was found to occur in a range from -0.75 to 4.50D. Most cases of astigmatism (77.5%) were due to 'with the rule' astigmatism (WTR). After wearing spectacles with prescription correction for 4 weeks, 8 preschool children were still able to achieve 6/6 VA. These children were then referred for a combination of home based and clinic based amblyopia therapy.

Amblyopia Therapy

A total of 6 preschool children were identified and recruited for the amblyopia therapy. The prevalence of amblyopia in this study was found to be 0.8%. All these children followed the combination of home based and clinic based amblyopia therapy for 12 weeks. At follow up, the visual acuity assessment was conducted on the eye with the worst VA or RE if the VA on both eyes were equal. Figure 1 shows the individual progress of each child's VA. As a whole the analysis showed that there was a significant improvement in the VA after the combination therapy was implemented where r(6)=6.67, p<0.01 (effect size: 0.67, power: 80.0%).
was also noted that significant VA improvement can be seen in the first 8 weeks after the combined home-based and clinic-based ambylopic therapy was started.

All the preschool children in this study had normal stereo acuity. A paired t-test was conducted on the stereo acuity findings of the six preschool children. The analysis showed that there was no significant difference, t(6)=1.00, p=0.36, between the stereo acuity and the duration of the ambylopic therapy. This means that children's stereo acuity level did not change significantly through the therapy duration.

DISCUSSION
Uncorrected refractive errors are one of the main causes of ambylopia especially among children. Therefore the role of VA correction using optical intervention in the management of ambylopic eye is very important. In this study, it was found that optical intervention i.e. wearing prescription spectacles was able to restore VA within 4 weeks to an optimum level of 0.1 LogMAR for the majority of the preschool children (85.0%). The mean VA improvement was 0.05 LogMAR. The improvement in the VA is the effect of the adaptation period after being prescribed spectacles which has played an important role in enabling these children to have a better prognosis for a normal VA.

The level of improvement was dependent on the base level of ambylopic VA and the magnitude of hypermetropia. It should be noted that ambylopic therapy is recommended to commence with refraction treatment for at least 4 weeks before beginning occlusion therapy. This stepwise progression facilitates ambylopic therapy and allows the children to appreciate their vision improvement over time.

Ambylopic prevalence (0.8%) in this study is not very different from the prevalence found in studies which have been reported elsewhere. For example, the prevalence was found to be 1.8% in Singapore, 0.4% in South Korea and 2% in the Netherlands. It was also observed that the prevalence of ambylopic among preschool children is lower than its prevalence among school children. For example, the prevalence found in a study on refractive error among school children in Malaysia was 3.0%, 12.0% in India, 5.5% in Chile and 9.0% in Nepal. This study found that all the ambylopic children showed significant improvement (t(6)=6.67, p<0.05) of VA at the end of the ambylopic therapy.

The improvement in VA can be seen after 8 weeks of occlusion using combined home-based and clinic-based therapy. This clearly proves that ambylopic can be treated successfully if it is detected at a preschool age such that intervention can be given during the critical period of visual development of a child before they reach 8 years of age.

Assessment of stereo acuity showed no significant difference before and after the ambylopic therapy in this study. This is because of the beginning of therapy, only one child was found to have an abnormal level of stereo acuity. Furthermore, all six cases in this study only had moderate refractive ambylopic. Stereo acuity is not normally affected unless the level of ambylopic is severe, especially for the strabismus and anisometropia types of ambylopic. This is because of the adaptation that occurs to visual function through the mechanism named abnormal retinal correspondence results in a significant decrease in the stereo acuity level. The stereo acuity test is a useful test to be carried out during follow-up assessment of the ambylopic therapy since it can give some indication of the state of binocularity.

Standard ambylopic management include prescription of optical devices such as glasses and occlusion therapy which was conducted by parents at home only (home-based therapy). The children will be reviewed at the clinic every three months by the treating optometrist. In this study, we introduced the home-based therapy as per standard protocol and clinic-based therapy where the treating optometrist at the optometry clinic will provide occlusion therapy and monitor the children weekly for 12 weeks. Combining home-based and clinic-based occlusion therapy showed 100% improvement in the VA of all the preschool children in this study. This improvement was seen because the treatment was started at an early age where the visual system development was still within its range of plasticity. In addition, the majority of children in this study had refractive ambylopic with a moderate magnitude of high power correction and a low magnitude of hypermetropia. The combined home based and clinic based intervention contained in a structured ambylopic therapy program featuring near work activities for two hours a day together with a weekly closely monitored session at the clinic by an attending optometrist. This promotes the compliance of the children with the ambylopic therapy to better ensure its effectiveness. Although this program did incur relatively greater travel costs for the parents, but indirectly it did strengthen the motivation for parents and their children to comply with the ambylopic therapy to ensure a successful outcome.

This study only looks at the six preschool children (0.8%) identified from the 479 children who participated. While this prevalence appears to consistent with expected prevalence of ambylopic in the population as described in a number of studies (0.2% - 5.3%), it should be noted that this information is not available for a Malaysian population. As such generalisation to the general population should be done with caution. The successful outcome of the ambylopic treatment was from a small number of cases and may not truly reflect the efficacy of the treatment when used in the general population. The success of the treatment is also dependent on the access to trained professionals who are able to implement the treatment and the ability of the patients (and their families) to present for follow-up sessions.

It is suggested that a broader study among a mixed population both urban and rural in this age group in Malaysia would be able to determine a more accurate prevalence of ambylopic among preschool children. This would then facilitate the conduct of wider application of this treatment approach to better assess its efficacy. This further study should also look at the delivery mechanism of the treatment method with specific attention to patient access, the need for a screening program, the tools used for the near task training and program outcome assessment methods.
CONCLUSION
In conclusion, this study found that the prevalence of amblyopia among preschool children enrolled in preschool programs in Siirawan was 0.8%. Home based and clinic based amblyopia therapy intervention can give a positive outcome in the management of preschool children with refractive amblyopia.

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