

Effect of Occlusion Therapy on the Deviation Angle in Patients with Partially Accommodative Esotropia and Amblyopia



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ABSTRACT

Purpose: To assess the impact of occlusion therapy on the deviation angle in patients with partially accommodative esotropia (ET) and amblyopia.

Study Design: Retrospective chart review.

Place and Duration of Study: The medical records of patients attending the pediatric ophthalmology clinic at Elite Hospital, Riyadh, Saudi Arabia between June 2014 and September 2021 were reviewed.

Methods: We retrospectively analyzed the pre- and post-therapy, angle of deviation of 63 children with partially accommodative ET who underwent occlusion therapy for amblyopia.

Results: The mean angle of deviation before and one month after using the full cycloplegic prescription glasses was 31.74 PD (range, 12–85 PD) and 16.5 PD (6–45 PD), respectively. After occlusion therapy (6–18 months), the mean angle of deviation decreased to 10.03 PD (0–45 PD). Thirteen patients (20.63%) underwent surgery after completion of occlusion therapy, which was significantly less than the number of patients that would have been scheduled for surgery before proper occlusion therapy (n = 41, 65.07%).

Conclusion: Amblyopia therapy should be completed before surgical intervention in patients with hypermetropia, partially accommodative ET, and amblyopia. There was a significant reduction in ET angle following occlusion therapy. Furthermore, it decreased the number of patients requiring surgery and the angle to be corrected.

Key Words: Accommodative Esotropia, Occlusion therapy, Amblyopia, Strabismus, Prism Diopters.

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INTRODUCTION

Esotropia (ET) can be diagnosed in the early years of life, usually before the age of 3 years.^{1,2} In USA, Approximately 2% of the population has ET, and 50% of them have accommodative ET.³ The most common form of strabismus in childhood is accommodative ET. Furthermore, when stimulated by accommodative

targets, children with this condition have a wider angle of deviation for near than for distance.⁴ Accommodative ET has various etiologies. Fully accommodative ET can occur due to uncorrected hyperopia.² Accommodative ET may also be seen in children without high hyperopia due to high AC/A ratio.⁵

There is limited data concerning the need for hypermetropia correction and amblyopia therapy prior to the surgical correction of residual ET angle in Saudi Arabia. Thus, we conducted a retrospective study to determine the influence of hypermetropia correction and amblyopia therapy on the preoperative angle of partially accommodative ET and its effect on reducing

the number of patients that require surgical correction of residual deviation angle and the angle to be corrected.

METHODS

The study was approved by the King Saud Medical City Ethics Committee. The medical records of patients attending the pediatric ophthalmology clinic at Elite Hospital, Riyadh, Saudi Arabia between June 2014 and September 2021 were reviewed. Children of any age, male or female gender, patients with partially accommodative any age compliance with both prescription and occlusion therapy and patients followed up for a minimum of 1.5 years were included. Partially accommodative ET was defined as ET associated with different degrees of bilateral hypermetropia, residual angle of deviation of >10 prism diopter (PD) after immediate full cycloplegic correction, and normal AC/A ratio. Amblyopia was defined as a difference in visual acuity of more than 2 lines on Snellen's or symbol chart, according to the patient's age and cooperation and a positive Worth 4-dot and a regarding whether surgery was performed during the follow-up period were also collected.

Children with an ocular disease or history of surgery that could affect visual acuity or refraction, systemic developmental delay or neurological disease, or lack of strict compliance with both prescription and occlusion therapy as well as follow-up visits were excluded from the study.

All patients underwent full ophthalmological and orthoptic assessment at the initial visit and at 1, 3, 6, 12, and 18 months. The examination included the following: slit lamp or portable slit lamp examination of the anterior segment, indirect ophthalmoscopy, uncorrected and best corrected visual acuity using Snellen's or symbol chart according to the patient's age and cooperation, cycloplegic refraction using a retinoscope, 30 minutes after obtaining full cycloplegia with 2 drops of 1% cyclopentolate administered 5 min apart. Orthoptic assessments included ocular motility testing, cover-uncover and alternate cover tests using an accommodative target, assessment of deviation angle using alternate prism cover test, binocularity using Worth 4-dot test at distance and near and Titmus test, and AC/A ratio using a gradient method (-3.00 D lens added at distance).

At each follow-up visit, full cycloplegic refraction

was performed to determine strict compliance. Partial occlusion therapy was performed for the amblyopic eye using an eye patch (3M Nexcare Opticlude) for 2–4 hours daily according to the degree of amblyopia and patient's age.

Data were collected, stored, managed, and coded using Microsoft Excel (version 2010). Data were analyzed using SPSS (version 22.0; IBM Inc., Chicago, Illinois, USA). Descriptive analysis was primarily performed. Categorical variables are presented as frequencies and percentages. Normality tests were conducted. Continuous variables were presented as means and standard deviations (SDs). The independent t-test was used to compare the means between the two groups, and the chi-square test was used to compare proportions between the groups. A p -value of <0.05 was considered statistically significant.

RESULTS

A total of 63 children were included in the study. Of the 63 children, 25 (39.7%) were female and 38 (60.3%) males. The mean value for age of the children was 28.8 ± 12.4 months and mean age at onset of esotropia was 12.1 ± 4.0 months.

The mean occlusion therapy period was 12.1 ± 4 months, with a mean follow-up period of 15.8 ± 4.6 months. The mean refractive error of the amblyopic

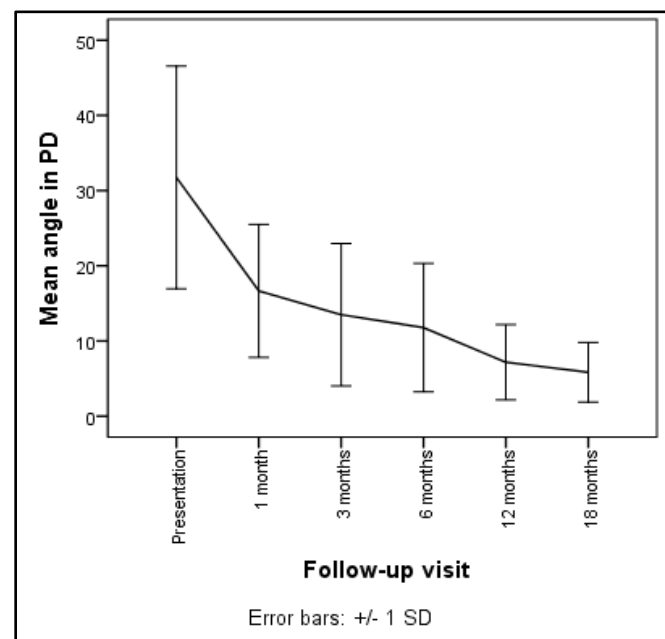


Figure 1: Change in the mean deviation angle over the follow-up period.

eye was $+4.6 \pm 2.2$ D, and that of the sound eye was $+4.2 \pm 2.1$ D. Over the follow-up period, the mean angle of deviation decreased (baseline: 31.7 ± 14.8 PD; 1 month: 16.7 ± 8.8 PD; 3 months: 13.5 ± 9.5 PD; 6 months: 11.8 ± 8.5 PD; 12 months: 7.3 ± 4.9 PD; 18 months: 5.96 ± 3.9 PD) after full cycloplegic refraction and partial occlusion therapy of the amblyopic eye. The mean visual acuity of the amblyopic eye improved over the course of the follow-up (baseline: 0.54 ± 0.18 ; 1 month: 0.58 ± 0.18 ; 3 months: 0.71 ± 0.14 ; 6 months: 0.83 ± 0.15 ; 12 months: 0.93 ± 0.10 ; 18 months: 0.95 ± 0.09) (Figures 1 and 2).

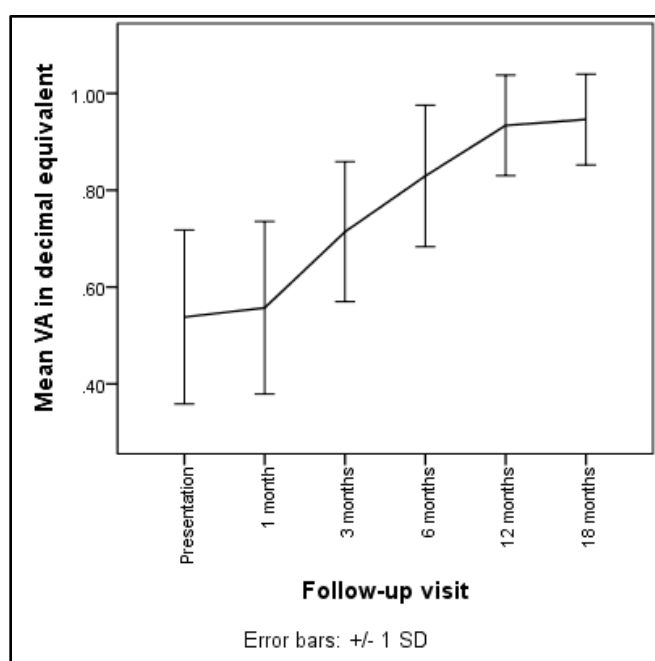


Figure 2: Change in the visual acuity over the follow-up period.

The children were further divided into two groups: group A, children who children were angle improvement to <10 PD and complied with spectacle correction and occlusion therapy ($n = 51$, 81.0%), and group B, children who failed to demonstrate adequate improvement of the deviation angle to <10 PD and required early surgery ($n = 12$, 19.0%). The subgroup data were analyzed and compared to determine the factors influencing the course of angle improvement and the treatment plan for patients with partially accommodative ET.

The difference in the angle of deviation at presentation and its progression over the follow-up period and the difference in duration of follow-up and

occlusion between the two groups were statistically significant (Table 1).

In group B, the angle at initial presentation was large, and eight patients (72.7%) underwent surgery before or at the 1-year follow-up. Of the eight patients, two (18.2%) underwent surgery before or at the 6-month follow-up and one (9.1%) underwent surgery after the 1-year follow-up.

Table 1: Characteristics of the patients of Group A and Group B.

| Characteristic | Group A | Group B | p-value P value |
|-------------------------------------|---------------------------|---------------------------|--------------------|
| | (n = 51) Mean \pm SD | (n = 12) Mean \pm SD | |
| Sex | | | |
| Male, n (%) | 29 (56.9) | 9 (75.0) | 0.334 |
| Female, n (%) | 22 (43.1) | 3 (25.0) | |
| Age, months | 52.7 \pm 28.3 | 52.6 \pm 31.9 | 0.995 |
| Age at onset, months | 29.4 \pm 12.7 | 26.5 \pm 11.0 | 0.477 |
| Occlusion therapy duration, months | 12.9 \pm 3.8 | 9.0 \pm 3.6 | 0.002* |
| Follow-up duration, months | 17.1 \pm 3.6 | 10.0 \pm 3.5 | <0.001 * |
| Refraction of amblyopic eye, D | 4.7 \pm 2.2 | 3.9 \pm 2.0 | 0.267 |
| Refraction of normal eye, D | 4.2 \pm 2.3 | 3.8 \pm 1.9 | 0.496 |
| Baseline angle, PD | 26.6 \pm 8.4 | 53.8 \pm 16.1 | <0.001 * |
| Angle at 1 month, PD | 13.1 \pm 3.8 | 31.7 \pm 8.3 | <0.001 * |
| Angle at 3 months, PD | 9.7 \pm 3.5 | 29.8 \pm 9.5 | <0.001 * |
| Baseline VA, decimal equivalents | 0.51 \pm 0.51 | 0.58 \pm 0.52 | 0.653 |
| VA at 1-month, decimal equivalents | 0.53 \pm 0.51 | 0.67 \pm 0.50 | 0.397 |
| VA at 3 months, decimal equivalents | 0.94 \pm 0.24 | 0.75 \pm 0.45 | 0.043* |

*Statistically significant at 5% level of significance

In both groups, most of the change in deviation angle was observed in the first 6 months of follow-up. A less drastic change in deviation angle was noticed after 6 months, especially in group A.

DISCUSSION

Literature shows that appropriate assessment and early referral lead to better treatment outcomes, especially if the surgery is performed adequately before the age of 2 years.⁶⁻¹⁰ Furthermore, early correction of refractive error prevents the development of strabismus and amblyopia, leading to a significant improvement in visual acuity and accuracy of accommodation.¹¹⁻¹⁵ This is especially true when using a combination of full

spherical correction and prism base-out or bifocals plus addition lenses for binocular vision recovery.⁵ One in three concomitant ET cases is partially accommodative, specifically those associated with hypermetropia, with or without amblyopia. Such patients are frequently seen in pediatric ophthalmology clinics.¹⁶⁻¹⁸

Full cycloplegic correction of hypermetropia as well as unilateral partial occlusion therapy for amblyopia should be performed before determining the need for surgical correction of the residual ET angle. If not, instability of the postoperative angle and consecutive exotropia may occur.¹⁹⁻²¹ These instabilities and amblyopia can be avoided while significantly restoring the binocular vision. Thus, the optimum time for surgically correcting and stabilizing the residual angle depends on strict cycloplegic correction and amblyopia therapy.²²⁻²⁴

One of the most challenging aspects of managing patients with partially accommodative ET and amblyopia is determining the optimal time for surgery. Performing surgical correction too early carries the risk of overcorrection and consecutive exotropia. However, delaying surgery to adequately treat amblyopia carries the risk of delayed development of binocular vision.²³

In this study, we examined the relationship between surgical timing and the following preoperative variables: patient age; age at onset; duration of follow-up and occlusion; preoperative refraction and visual acuity, and their interpretation as amblyopia; response of refraction, visual acuity, and amblyopia to occlusion therapy over the at onset preoperative angle of deviation, and its response to conservative treatment over the follow-up period. These variables have previously demonstrated a strong relationship with surgical timing.

All our patients with a preoperative angle of deviation ≥ 45 PD demonstrated insufficient improvements to >10 PD after a follow-up period of 3 to 6 months. Insufficient patients were scheduled for early surgery. All our patients with a preoperative angle of deviation of ≤ 30 PD demonstrated sufficient improvement to ≤ 10 PD. Thus, conservative treatment was continued in these patients until the end of the follow-up period. However, exceptional cases with a preoperative angle of 35PD (one patient in each group) and 40PD (three patients in the early surgery group and two patients in the conservative treatment group)

were found in both groups irrespective of their response to treatment in the early follow-up period.

This finding in addition to the finding that most of the changes in deviation angle was observed in the first 6 months of follow-up, irrespective of the subsequent change, indicated that patients with angles of deviation of ≥ 45 PD will require surgery after 6 months of follow-up. However, patients with angles of deviation ≤ 30 PD can safely be followed up to 1.5 years to avoid postoperative angle instability and binocular vision development.

Most of the patients in group A who underwent early surgery demonstrated a mild difference in both refraction and visual acuity, which was associated with a lower degree of amblyopia. Thus, the preoperative angle of deviation and degree of amblyopia determine the timing of surgery.

The duration of occlusion demonstrated statistically significant difference between both groups. However, this difference may be accidental because occlusion groups. However, by early surgical intervention. Thus, duration of occlusion cannot be considered a occlusion cannot, which differs from the findings of previous studies.^{23,24} In addition, according to Çakır B et al, neither strabismus surgery nor amblyopia have an effect on refractive status in patients with accommodative ET.²⁵

The limitations of this study are the differences in the number of patients included in each group and the fact that the preoperative and postoperative degree of stereopsis was not evaluated. Further studies that assess these changes in patients with partially accommodative ET and higher angles of deviation are needed.

CONCLUSION

Amblyopia therapy should be completed before surgical intervention in patients with hypermetropia, partially accommodative ET and amblyopia. There was a significant reduction in ET angle following occlusion therapy. Furthermore, it decreased the number of patients requiring surgery and the angle to be corrected.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board (IORG #: IORG0010374)

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Saleh A. AlKhaldi; PHD: *Concepts, Design, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript preparation.*

