*https://doi.org/10.33472/AFJBS.6.2.2024.882-891*

African Journal of Biological Sciences

Research Paper Open Access

# Effect of Alternate Occlusion on Intermittent Exotropia in Children.

**Osama Abdallah Elmorsy, Ahmed Ismael Ramadan, Finan Talaat Abdelaziz Shaaban *, and Manar Fawzy Dawoud**

Ophthalmology Department, Faculty of Medicine, Menoufia University, Menoufia, Egypt

Article History

Volume 6, Issue 2, April 2024

Received:19 April 2024

Accepted: 27 May 2024

Published: 27 May 2024

doi: 10.33472/AFJBS.6.2.2024.882-891

**Abstract: Objective:** Objective: To evaluate the effect of alternate occlusion on intermittent exotropia in children aged 3 to 8 years.
**Patients and Methods:** This non-randomized, prospective study was conducted on 23 patients with intermittent exotropia who underwent alternate occlusion at the ophthalmology outpatient clinic of Menoufia University from April 2022 to February 2023. The eyes were alternately patched for 2 hours a day in cases with no dominant eye. In cases with a strongly dominant eye, the dominant eye was patched for 5 days a week and the non-dominant eye for 2 days a week.
**Results:** For all children, with a mean age of 5.52±1.61 years, far control of deviation improved significantly after 3, 6, and 9 months of treatment using both control scales when compared to pretreatment ($p=0.045$, $p=0.024$, and $p=0.012$ for the 3-point scale, respectively) and ($p=0.048$, $p<0.001$, and $p=0.009$ for the 6-point scale, respectively). Near control showed no significant improvement after 3, 6, and 9 months of treatment using both control scales ($p=0.565$, $p=0.229$, and $p=0.246$, respectively, for the 3-point scale; $p=0.592$, $p=0.409$, and $p=0.115$, respectively, for the 6-point scale). The mean change in near and far exotropia angles improved significantly post-treatment compared to pretreatment ($P<0.001$ and $P<0.05$, respectively). The most improvement was achieved after 9 months in both angles. Stereopsis improved significantly after 9 months of treatment ($p=0.012$).
**Conclusions:** Although it may be thought that occlusion disrupts fusion, thereby possibly reducing control, our results show that deviation angle, control, and stereopsis improve with a 9-month period of treatment. Alternate occlusion is a low-cost, non-invasive treatment with minimal side effects that can improve control and postpone the need for surgical intervention

**Keywords:** *Alternate Occlusion, Children, Intermittent Exotropia*

## Introduction

Exodeviation, characterized by an outward turning of the eye, can occur due to various impediments to the establishment or maintenance of binocular vision or due to dysfunction of the medial rectus muscle. This condition can be categorized as primary, secondary (linked with impaired vision), or consecutive (developing from esotropia (ET) over time or following surgical correction) [1].

Based on fusion control, exodeviation can manifest as latent (exophoria (X)), remaining symptom-free as long as fusion is maintained, but causing symptoms such as eye strain, blurred vision, photophobia (closing one eye in bright light), or diplopia when fusion is lost; as constant exotropia (XT), where the outward deviation is

always present; or as intermittent exotropia (XT), where the deviation varies in frequency, with a large exophoria occasionally breaking down into an exotropia [2].

Intermittent exotropia is the most prevalent type of childhood exotropia, with an incidence rate of 32.1 per 100,000 children under 19 years old [3]. This form of strabismus is marked by the periodic outward deviation of one eye, interspersed with periods of proper alignment [4]. The variable nature of this strabismus often complicates accurate measurement of the deviation, and without thorough observation and evaluation, intermittent exotropia can be easily overlooked [5]. Patients with intermittent exotropia typically exhibit normal ocular alignment and sensory fusion during the phoric phase, disrupted by episodes of misalignment involving suppression, abnormal fusion, or both during the tropic phase [6,7].

Treatment for exodeviations is recommended if the patient experiences symptoms and binocular function is compromised. Both surgical and non-surgical treatments aim to reduce episodes of manifest exotropia by decreasing the angle of deviation and enhancing fusion control [8,9]. The decision to opt for surgery is often debated and depends on specific case factors, including the patient's age, deviation angle, symptoms, fusion potential, medical history, onset, and prognosis [10]. Non-surgical correction is also considered for various reasons, including patients wishing to avoid surgery and those preferring to delay surgical intervention for clinical or personal reasons. Sometimes, non-surgical treatments alleviate symptoms to the extent that surgical intervention is not required [11].

Occlusion therapy, considered an anti-suppression therapy, can decrease the frequency and amplitude of the deviation and alter its nature [12]. For patients with a dominant eye, occlusion is applied part-time or full-time to the dominant eye; if there is no dominant eye, occlusion is alternated between both eyes [13]. This study was conducted to assess the impact of alternate occlusion on intermittent exotropia and its sensory status.

**METHODS**

A prospective, non-randomized study was conducted involving 23 patients with intermittent exotropia who attended the ophthalmology outpatient clinic at Menoufia University between April 2022 and February 2023 to undergo alternate occlusion therapy. For patients without a dominant eye, each eye was alternately patched for 2 hours daily. In cases with a pronounced dominant eye, the dominant eye was patched for 5 days a week, and the non-dominant eye was patched for 2 days a week over a 3-month period, repeated for three cycles. If there was a change in eye dominance status, the occlusion therapy was adjusted accordingly.

**Ethical Considerations and Confidentiality**

The study followed procedures approved by the ethical committee of the Menoufia Faculty of Medicine and adhered to the Declaration of Helsinki. Participants were provided with comprehensive information regarding the study's aims, objectives, and methods before enrollment. Written informed consent was obtained from all participants by the principal investigator.

**Inclusion Criteria**

Children aged between 3 and 8 years with intermittent exotropia, who were able to cooperate with the evaluation and attend regular follow-up exams, were included in the study. The participants had a spherical equivalent cycloplegic refractive error ranging from −4.50 to +3.50 D, anisometropia less than 1.50 D, and no other ocular or systemic diseases apart from strabismus. There was no prior treatment history for exodeviation among the participants.

**Exclusion Criteria**

Exclusion criteria encompassed any ocular or neurological diseases affecting vision other than refractive error and exodeviation, such as inflammation or retinal diseases. Patients with a history of treatment for intermittent exotropia (XT), including both surgical and non-surgical methods like previous part-time occlusion (PTO) therapy, were excluded. Additionally, patients with anisometropia or amblyopia were not eligible for inclusion in the study.

**All patients were subjected to:**

Each patient underwent a comprehensive history-taking process, which included collecting information on their age, sex, perinatal history, development, any history of trauma, surgeries, allergies, and any family history of strabismus.

**Examinations**

Patients were meticulously examined prior to occlusion therapy and subsequently at 3-, 6-, and 9-months intervals following occlusion. At the time of enrollment, a full eye examination was conducted between 8 and 11 a.m.

**External Appearance**

The patients' external appearances were evaluated, noting any abnormal head postures, globe conditions such as proptosis, and lid abnormalities like ptosis.

**Strabismus Assessment**

Strabismus assessment involved evaluating eye motility by examining the ductions and versions (cardinal positions of gaze) of both eyes together and each eye independently. The alignment of the eyes was also assessed.

**Control of Deviation**

Deviation control was assessed at both near and far distances using two distinct scales: an office control 3-point scale commonly used in eye clinics, and an office control 6-point scale.

The 3-point scale categorized exodeviations as good, fair, or poor. Good control was defined as deviation occurring only during eye covering, with rapid re-establishment of fusion upon cover removal without blinking or re-fixation. Fair control was characterized by deviation only during eye covering, with fusion re-established by blinking or re-fixation upon cover removal. Poor control was identified when deviation occurred spontaneously without covering, and re-establishing fusion was difficult, requiring considerable effort and time.

The 6-point scale classified control into groups numbered 0 to 5, based on 30 seconds of observation. Constant exotropia was ranked as 5, exotropia present for more than 50% of the observation time was ranked as 4, and exotropia present for less than 50% of the observation time was ranked as 3. If exotropia was not observed within 30 seconds, classification was based on the speed of deviation control and fusion return within 10 seconds after covering the eyes. Fusion return in more than 5 seconds was ranked as 2, between 1 and 5 seconds was ranked as 1, and less than 1 second was ranked as 0.

The cover was initially placed over the right eye for 10 seconds, and the time required for re-fusion was recorded. The left eye was then occluded for 10 seconds, and the re-fusion time was similarly recorded. A third trial was conducted on the eye that took the longest time to re-fuse. The worst of the three 10-second trials was recorded as the response. Deviation control was evaluated at distances of 40 cm and 6 m. Each child was assessed by two different examiners. If results varied, re-examination was conducted by both examiners at least one week later, and if differences persisted, the worse rank was recorded as the control scale.

**Angle of Deviation:** The angles of both near and far deviation were measured.

**Stereoacuity:** Stereoacuity was assessed at a distance of 40 cm using the Titmus stereo test.

**Fusion Assessment:** Fusion capability was evaluated using the Worth 4-dot test.

**Visual Acuity**

Visual acuity was measured with the Snellen chart. For cycloplegic refraction, cyclopentolate 1% was administered twice at 5-minute intervals, and refraction was performed after 45 minutes. Appropriate corrective glasses were prescribed if significant refractive errors were detected.

**Anterior Segment Examination:** The anterior segment of the eye was examined using a slit lamp biomicroscope.

**Posterior Segment Examination:** The posterior segment of the eye was examined using an indirect ophthalmoscope after pupil dilation.

**Statistical Analysis**

The results were organized and analyzed using MICROSOFT EXCEL 2019 and SPSS version 25 for MICROSOFT WINDOWS 10. Quantitative data were described using the mean (±SD), while qualitative data were summarized using frequency and proportion. The mean represents the average of all observations, calculated by dividing the sum of all observations by the number of observations. The standard deviation indicates the extent of variability or dispersion of individual data points around the mean. The Chi-Squared ($\chi^2$) test was employed to compare groups based on a qualitative variable. A paired t-test was used to assess the difference between two variables for the same subject, often comparing measurements taken at different times. A p-value of less than 0.05 was considered to indicate statistical significance.

**RESULTS**

The study included a total of 23 patients. The mean age was 5.52±1.61 years. Of these patients, 16 (69.6%) were male, and 7 (30.4%) were female. Most patients had an uncorrected visual acuity (OD and OS) of 6/6, with 8 patients (34.78%) having 6/9. Additionally, all patients (100%) had a best-corrected visual acuity (OD and OS) of 6/6, and none had 6/9. All patients had normal anterior and posterior segments, normal motility, no nystagmus, and no anomalous head posture (Table 1).

The mean spherical equivalent was 1.02 ± 1.53, spherical refractive error was 1.34 ± 1.04, astigmatism was -0.89 ± 0.41, hypermetropic anisometropia was 0.37 ± 0.22, and astigmatic anisometropia was 0.29 ± 0.15 (Table 2).

According to the 3-point control scale, far control of deviation at 3, 6, and 9 months post-intervention significantly improved compared to pre-intervention (p=0.045, p=0.024, and p=0.012, respectively). There was no significant difference in far control of deviation at 6 months compared to 3 months, and at 9 months compared to 6 months (p=0.367 and p=0.584, respectively). Near control of deviation showed no significant difference before and after the intervention at any of the visits (p=0.565 for 3 months, p=0.229 for 6 months, and p=0.246 for 9 months). Furthermore, according to the 6-point control scale, far control showed significant improvement at 3-, 6-, and 9-months post-intervention compared to pre-intervention (p=0.048, p<0.001, and p=0.009, respectively). No significant difference was found in far control at 6 months versus 3 months, and at 9 months versus 6 months (p=0.214 and p=0.523, respectively). Near control showed no significant difference before and after the intervention (p=0.592 for 3 months, p=0.409 for 6 months, and p=0.115 for 9 months) (Table 3).

The near exotropia angle was 21.50±4.56 degrees pretreatment and gradually decreased to 17.25±4.97 degrees after 3 months, 15.56±5.02 degrees after 6 months, and 13.02±5.06 degrees after 9 months. Similarly, the far exotropia angle was 21.78±4.78 degrees pretreatment and decreased to 18.60±3.44 degrees after 3 months, 17.88±4.10 degrees after 6 months, and 16.92±3.63 degrees after 9 months (Table 4).

Among patients with intermittent exotropia, the mean change in the near exotropia angle showed significant improvement post-treatment compared to pretreatment (P<0.001). The greatest improvement was seen after 9 months (8.48±0.50) compared to 6 months (5.94±0.46) and 3 months (4.25±0.41). Similarly, the mean change in the far exotropia angle improved significantly post-treatment compared to pretreatment (P<0.05), with the most improvement observed after 9 months (4.85±1.15) compared to 6 months (3.90±0.68) and 3 months (3.18±1.34) (Table 5).

Only 11 patients cooperated for the Titmus test, with stereoacuity ranging from 40 to 200 arc/sec. There was a significant improvement in stereoacuity post-patching compared to pre-patching (p=0.012). Pre-patching, most stereopsis was fine (<40, 54.55%), followed by moderate (60–200, 36.36%) and coarse (>200, 9.09%), with no significant difference (P=0.092). Post-patching, the majority of stereopsis was fine (<40, 81.82%), followed by moderate (60–200, 18.18%), and no coarse (>200) stereopsis, showing significant improvement (P=0.032) (Table 6).

All 11 patients who cooperated for the Worth 4-dot test had fusion at both near and far distances at the beginning of the study. There was no change in sensory fusion by the end of the study.

**Table (1):** Demographic data, visual acuity, and clinical examinations among the studied cases (N=23).

| Variable | Cases (N=23) | |
|---|---|---|
| **Age/year** | | |
| Mean ±SD | 5.52±1.61 | |
| Median (Range) | 6(3-8) | |
| **Variable** | **N** | **%** |
| **Sex** | | |
| Male | 16 | 69.6 |
| Female | 7 | 30.4 |
| **UCVA (OD)** | | |
| 6/6 | 15 | 65.22 |
| 6/9 | 8 | 34.78 |
| **UCVA (OS)** | | |
| 6/6 | 15 | 65.22 |
| 6/9 | 8 | 34.78 |
| **BCVA(OD)** | | |
| 6/6 | 23 | 100.00 |
| 6/9 | 0 | 0.00 |
| **BCVA(OS)** | | |
| 6/6 | 23 | 100.00 |
| 6/9 | 0 | 0.00 |
| **Anterior segment** | | |
| NAD | 23 | 100 |
| **Posterior segment** | | |
| NAD | 23 | 100 |
| **Motility** | | |
| Free | 23 | 100 |
| **Nystagmus** | | |
| Free | 23 | 100 |
| **AHP** | | |
| Free | 23 | 100 |

**UCVA:** Uncorrected Visual Acuity, **BCVA:** Best Visual Acuity, **O:** oculus, **D:** Dexterous, **S:** Sinister, **AHP:** Anomalous head posture.

**Table 2.** Distribution of refractive errors (diopter).

| | **Minimum** | **Maximum** | **M ± SD** |
|---|---|---|---|
| **Spherical equivalent** | −1.75 | 2.75 | 1.02 ± 1.53 |
| **Spherical refractive error** | −1.00 | 2.75 | 1.34 ± 1.04 |
| **Astigmatism** | 0 | −1.50 | -0.89 ±0.41 |
| **Hypermetropic anisometropia** | 0 | 0.75 | 0.37 ± 0.22 |
| **Astigmatic anisometropia** | 0 | 0.50 | 0.29 ± 0.15 |

**Table (3):** Far and near control based on office control 3 and 6-point scale.

| | **Pretreatment (n=23)** | | | | **3 months (n=23)** | | | | **6 months (n=21)** | | | | **9 months (n=20)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Near** | | **Far** | | **Near** | | **Far** | | **Near** | | **Far** | | **Near** | | **Far** | |
| | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** | **N** | **%** |
| **Good** | 16 | 69.57 | 4 | 17.39 | 17 | 73.91 | 12 | 52.17 | 17 | 80.95 | 11 | 52.38 | 16 | 80 | 10 | 50 |
| **Fair** | 4 | 17.39 | 13 | 56.52 | 5 | 21.74 | 7 | 30.43 | 4 | 19.05 | 9 | 42.86 | 4 | 20 | 10 | 50 |
| **Poor** | 3 | 13.04 | 6 | 26.09 | 1 | 4.35 | 4 | 17.39 | 0 | 0.00 | 1 | 4.76 | 0 | 0 | 0 | 0 |
| $X^2$ | a= 1.141, b=6.200, c=2.945, d=7.490, e=2.804, f=8.796, g= 2.007, h=1.077 | | | | | | | | | | | | | | | |
| ***P*** | P1= 0.565, P2=**0.045*,** P3=0.229, P4=**0.024***, P5=0.246, P6=**0.012***P7= 0.367, P8=0.584 | | | | | | | | | | | | | | | |
| **0** | 8 | 34.78 | 0 | 0.00 | 12 | 52.17 | 1 | 4.35 | 10 | 47.62 | 0 | 0.00 | 10 | 50.00 | 1 | 5.00 |
| **1** | 7 | 30.43 | 5 | 21.74 | 7 | 30.43 | 11 | 47.83 | 9 | 42.86 | 17 | 80.95 | 10 | 50.00 | 15 | 75.00 |
| **2** | 6 | 26.09 | 13 | 56.52 | 3 | 13.04 | 7 | 30.44 | 2 | 9.52 | 3 | 14.29 | 0 | 0.00 | 4 | 20.00 |
| **3** | 1 | 4.35 | 1 | 4.35 | 0 | 0.00 | 3 | 13.04 | 0 | 0.00 | 1 | 4.76 | 0 | 0.00 | 0 | 0.00 |
| **4** | 1 | 4.35 | 3 | 13.04 | 1 | 4.35 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| **5** | 0 | 0.00 | 1 | 4.35 | 0 | 0.00 | 1 | 4.35 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| $X^2$ | a= 2.800, b=9.050, c=5.262, d=40.150, e=4.584, f=23.447, g= 5.607, h=2.245 | | | | | | | | | | | | | | | |
| ***P*** | P1= 0.592, P2=**0.048*,** P3=0.409, P4<**0.001***, P5=0.115, P6=**0.009*** P7= 0.214, P8=0.523 | | | | | | | | | | | | | | | |

**$X^2$:** Chi square

**a, $P_1$:** Pretreatment compared 3 months (near)

**b, $P_2$:** Pretreatment compared 3 months (Far),

**c, $P_3$:** Pretreatment compared 6 months (near),

**d, $P_4$:** Pretreatment compared 6 months (Far),

**e, $P_5$:** Pretreatment compared 9 months (near),

**f, $P_6$:** Pretreatment compared 9 months (far),

**g, $P_7$:** 3 months compared 6 months (Far),

**h, $P_8$:** 6 months compared 9 months (Far),

**Table 4.** Near and far exotropia angle at different visits among the studied patients (N=23).

| **Exotropia angle** | **Cases (N=23)** | |
|---|---|---|
| | **Near** | **Far** |
| **Pretreatment** | | |
| Mean ±SD | 21.50±4.56 | 21.78±4.78 |
| Median (Range) | 20 (16.57-25) | 21.5 (17.6-30) |
| **At 3 months** | | |
| Mean ±SD | 17.25±4.97 | 18.60±3.44 |
| Median (Range) | 17 (14.08-22.12) | 18.4 (14.8-29.4) |
| **At6 months** | | |
| Mean ±SD | 15.56±5.02 | 17.88±4.10 |
| Median (Range) | 15.08 (11.24-19.87) | 17.9 (13.7-30.6) |
| **At 9 months** | | |
| Mean ±SD | 13.02±5.06 | 16.92±3.63 |
| Median (Range) | 13.15 (8.79-17.65) | 16.9 (12.3-28.2) |

**t**: Paired t-test, ***:** Significant.

**Table 5.** Mean change of near and far exotropia angle Pretreatment, 3, 6 and 9 months among the studied patients (N=23).

| Exotropia angle (near) | Patients with intermittent exotropia (n=23) | | | | | |
|---|---|---|---|---|---|---|
| | Paired Differences | | | | | |
| | Mean± SD | *t* | *P-value* | Mean diff.± SD | 95% CI | |
| | | | | | Lower | Upper |
| **Pretreatment** | 21.50±4.56 | | | | | |
| at 3 months | 17.25±4.97 | $t_1$=10.661 | **$P_1$<0.001*** | 4.25±0.41 | 3.42 | 5.08 |
| at 6 months | 15.56±5.02 | $t_2$=14.807 | **$P_2$<0.001*** | 5.94±0.46 | 5.11 | 6.77 |
| at 9 months | 13.02±5.06 | $t_3$=11.455 | **$P_3$<0.001*** | 8.48±0.50 | 6.94 | 10.01 |
| **at 3 months** | | | | | | |
| at 6 months | 15.56±5.02 | $t_4$=3.042 | **$P_4$=0.006*** | 1.69±0.05 | 0.54 | 2.85 |
| at 9 months | 13.02±5.06 | $t_5$=6.542 | **$P_5$<0.001*** | 4.23±0.09 | 2.89 | 5.57 |
| **at 6 months** | | | | | | |
| at 9 months | 13.02±5.06 | $t_6$=3.594 | **$P_6$=0.002*** | 2.54±0.04 | 1.07 | 4.00 |
| **Exotropia angle (far)** | | | | | | |
| **Pretreatment** | 21.78±4.78 | | | | | |
| at 3 months | 18.60±3.44 | $t_1$=3.079 | **$P_1$=0.005*** | 3.18±1.34 | 1.04 | 5.31 |
| at 6 months | 17.88±4.10 | $t_2$=4.286 | **$P_2$<0.001*** | 3.90±0.68 | 2.01 | 5.79 |
| at 9 months | 16.92±3.63 | $t_3$=4.586 | **$P_3$<0.001*** | 4.85±1.15 | 2.66 | 7.05 |
| **at 3 months** | | | | | | |
| at 6 months | 17.88±4.10 | $t_4$=0.644 | $P_4$=0.526 | 0.73±0.66 | -1.61 | 3.07 |
| at 9 months | 16.92±3.63 | $t_5$=2.530 | **$P_5$=0.019*** | 1.68±0.19 | 0.30 | 3.05 |
| **at 6 months** | | | | | | |
| at 9 months | 16.92±3.63 | $t_6$=0.821 | $P_6$=0.420 | 0.95±0.47 | -1.45 | 3.35 |

**t**: paired t-test, **C I:** Confidence interval, P value ≤ 0 .05 is significant, P value ≤ 0 .001 is highly significant

**$t_1$, $P_1$:** Pretreatment compared 3 months

**$t_2$, $P_2$:** Pretreatment compared 6 months,

**$t_3$, $P_3$:** Pretreatment compared 9 months,

**$t_4$, $P_4$:** 3 months compared to 6 months,

**$t_5$, $P_5$:** 3 months compared to 9 months,

**$t_6$, $P_6$:** 6 months compared to 9 months,

**Table 6.**Stereopsis at the beginning and the end of the study (N=11).

| | Pre-patching | | Post-patching | | $X^2$ | *P-value* |
|---|---|---|---|---|---|---|
| | N | % | N | % | | |
| **Fine<40** | 6 | 54.55 | 9 | 81.82 | | |
| **200>Moderate>60** | 4 | 36.36 | 2 | 18.18 | 6.19 | **0.012*** |
| **Coarse>200** | 1 | 9.09 | 0 | 0.00 | | |
| $X^2$ | 2.87 | | 4.15 | | | |
| *P-value* | 0.092 | | **0.032*** | | | |

***:** Significant, **$X^2$:** Chi square.

**DISCUSSION**

Exotropia is a common type of strabismus, with intermittent exotropia being the most frequent form observed in children. Treatment options include both surgical and non-surgical methods [14]. A significant concern with surgical intervention in children is the risk of overcorrection, which can result in consecutive esotropia and potential issues with fusion and stereopsis. Advocates for non-surgical methods argue that surgery should be delayed until the child can effectively cooperate with pre-surgical assessments. This study aims to assess the impact of alternate occlusion on intermittent exotropia in children aged 3 to 8 years. To achieve this, a non-randomized, prospective study was carried out on 23 patients with intermittent exotropia who visited the ophthalmology outpatient clinic at Menoufia University from April 2022 to February 2023.

In our study, using the 3-point control scale, far control of deviation at 3-, 6-, and 9-months post-intervention showed significant improvement compared to pre-intervention levels ($p=0.045$, $p=0.024$, and $p=0.012$, respectively). There was no significant difference in far control of deviation between 6 and 3 months, and between 9 and 6 months ($p=0.367$ and $p=0.584$, respectively). Near control of deviation did not show significant differences before and after the intervention at any visit ($p=0.565$ for 3 months, $p=0.229$ for 6 months, and $p=0.246$ for 9 months). Additionally, according to the 6-point control scale, there was a significant improvement in far control at 3-, 6-, and 9-months post-intervention compared to pre-intervention ($p=0.048$, $p<0.001$, and $p=0.009$, respectively). No significant differences were found in far control between 6 and 3 months, and between 9 and 6 months ($p=0.214$ and $p=0.523$, respectively). Near control showed no significant differences before and after the intervention at any visit ($p=0.592$ for 3 months, $p=0.409$ for 6 months, and $p=0.115$ for 9 months).

In a study by Akbari et al., [15] it was found that far deviation control improved significantly over three 3-month periods based on the office control 3-point scale and 6-point scale, with the most significant improvements occurring within the first 3 months post-treatment. Near control did not show improvement after 9 months based on the 3-point scale, likely because baseline near control was already good in most cases of intermittent exotropia. However, the 6-point control scale showed significant improvement in near control at 3-, 6-, and 9-months post-treatment, suggesting that the 6-point scale may be more effective for evaluating near control in these cases. In a study by Song et al., [16] results indicated that far deviation control in patients with intermittent exotropia (IXT) aged 5 to 7 years improved significantly over 12-week periods in both the alternate occlusion group and the pencil push-ups group, while no improvement was seen in the observation group. Combining observation with other interventions may be more effective than using it as a sole treatment method. Additionally, in the study by Freeman and Isenberg, [17] 27% of patients became orthophoric, and 45.5% had asymptomatic exophoria at the final examination.

The current study demonstrated that the near exotropia angle, initially measuring 21.50±4.56 before treatment, progressively decreased to 17.25±4.97 after 3 months, 15.56±5.02 after 6 months, and 13.02±5.06 after 9 months. Similarly, the far exotropia angle, which was 21.78±4.78 pre-treatment, reduced to 18.60±3.44 after 3 months, 17.88±4.10 after 6 months, and 16.92±3.63 after 9 months. These findings align with the results reported by Suh et al. [18], who observed a significant reduction in deviating angles at distance following part-time occlusion therapy. Abdel-Rehim et al. [19] noted that the mean near angle of intermittent exotropia (IXT) in patients undergoing convergence exercises improved from 26.83 PD to 15.0 PD over 12 months. In their study, the mean distance angle of IXT improved from 20.167 PD to 14.167 PD after 12 months of treatment, which showed a lower success rate compared to our method due to poor compliance with the convergence exercises. Additionally, the findings of AlKahmous and Al-Saleh et al. [20] are consistent with those of Reynolds and Wackerhagen [21], who reported that 6% of their patients achieved a lasting reduction in angle size with occlusion therapy.

In this study, among patients with intermittent exotropia, the mean change in the near exotropia angle showed a significant improvement post-treatment compared to pre-treatment ($P<0.001$). The most substantial improvement was observed after 9 months (8.48±0.50), compared to 6 months (5.94±0.46) and 3 months (4.25±0.41). Similarly, the mean change in the far exotropia angle significantly improved post-treatment

compared to pre-treatment (P<0.05), with the greatest improvement seen after 9 months (4.85±1.15) compared to 6 months (3.90±0.68) and 3 months (3.18±1.34). Moreover, Spoor and Hiles [22] reported a 54% improvement in the deviation angle at distance and concluded that occlusion therapy effectively reduces the size of the deviation. Berg et al. [23] found that occlusion therapy decreased the deviation angle at near (77%) and distance (56%). Newman and Mazow [24] reported that 87% of their subjects treated with occlusion therapy experienced a decrease in the deviation size or converted to phoria.

A parallel older cohort study by Cotter et al. [25] identified a slightly smaller mean distance exodeviation at the 6-month follow-up examination among those who were patched compared to those who were observed (22.2 D vs. 23.8 D; P = 0.01), with no statistical difference in the mean near exodeviation (15.4 D vs. 17.6 D; P = 0.11). The present study found that only 11 patients were able to complete the Titmus test, with stereoacuity measurements ranging from 40 to 200 arc/sec. A significant improvement was observed between pre-patching and post-patching results, with a p-value of 0.012. Prior to patching, 54.55% of patients had fine stereopsis (<40), 36.36% had moderate stereopsis (60-200), and 9.09% had coarse stereopsis (>200). After patching, the distribution shifted to 81.82% with fine stereopsis (<40), 18.18% with moderate stereopsis (60-200), and none with coarse stereopsis (>200).

In a previous study by Cooper [26], occlusion therapy was shown to effectively reduce suppression, with 63% of participants demonstrating fair to good outcomes in terms of deviation angle, stereopsis, and fusional amplitudes. This aligns partly with the findings of AlKahmous and Al-Saleh [20], who reported a 94% success rate in improving stereopsis, with 17 out of 18 cases achieving normal stereoacuity after occlusion for 50% of waking hours over 4 months. Akbari et al. [15] also documented significant enhancements in near stereopsis. Similarly, Shin et al. [27] indicated that patients who adhered well to part-time occlusion therapy exhibited superior stereopsis compared to those with poor compliance.

**CONCLUSIONS**

Despite concerns that occlusion might disrupt fusion and reduce control, our findings demonstrate that a 9-month period of alternate occlusion therapy improves deviation angle, control, and stereopsis. This low-cost, non-invasive treatment with minimal side effects can enhance control and delay the need for surgical intervention.

## References:

1. McKean-Cowdin R, Cotter SA, Tarczy-Hornoch K, Wen G, Kim J, Borchert M, Varma R, Multi-Ethnic Pediatric Eye Disease Study Group. Prevalence of amblyopia or strabismus in asian and non-Hispanic white preschool children: multi-ethnic pediatric eye disease study. Ophthalmology. 2013 Oct 1; 120(10):2117-24.
2. Alastair DKO, Philip MI. Strabismus.Oxford handbook of ophthalmology. 3rd ed. Oxford city UK: Oxford University Press2014;1(1):750–751
3. Govindan M, Mohney BG, Diehl NN, Burke JP. Incidence and types of childhood exotropia: a population-based study. Ophthalmology. 2005; 112(2):104-8.
4. Economides JR, Dilbeck MD, Gentry TN, Horton JC. Ambulatory Monitoring with Eye Tracking Glasses to Assess the Severity of Intermittent Exotropia. American Journal of Ophthalmology. 2023 Jan 18.
5. Wright KW, Strube YNJ. Pediatric Ophthalmology and Strabismus (3rd ed). New York: Oxford University Press. 2012; 1(1):64-66.
6. Scheiman M, Wick B. Clinical Management of Binocular Vision.Heterophoric, Accommodative and Eye Movement Disorders (4thed). Philadelphia: Lippincott Williams and Wilkins. 2014; 3(2):47-50
7. Kang H, Shin HJ, Lee AG. Risk of consecutive esotropia after surgery for intermittent exotropia according to passive duction force. PloS one. 2023 Feb 16;18(2): e0281392.
8. Ansons AM, Davis H. Diagnosis and management of ocular motility disorders. John Wiley & Sons. 2008; 3(1):10-12.
9. Shen T, Chen J, Kang Y, Deng D, Lin X, Wu H, Li J, Wang Z, Qiu X, Jin L, Yan J. Surgical treatment versus observation in moderate intermittent exotropia (SOMIX): study protocol for a randomized controlled trial. Trials. 2023 Mar 1; 24 (1):153.
10. Boichuk IM, Tarak A. Efficacy of conservative treatment of children with exotropia depending of the baseline status of visual and binocular functions. 2023.

11. Karlsson V. Does nonsurgical treatment of exodeviations work? American Orthoptic Journal. 2009; 59(1):18-25.
12. Mohney BG, Holmes JM. An office-based scale for assessing control in intermittent exotropia. Strabismus. 2006; 14(3):147-50.
13. Su H, Fu J, Wu X, Sun A, Zhao B, Hong J. Comparison of Botulinum toxin type A with surgery for the treatment of intermittent exotropia in children. BMC ophthalmology. 2022 Feb 4; 22 (1):53.
14. McKean-Cowdin R, Cotter SA, Tarczy-Hornoch K, Wen G, Kim J, Borchert M, Varma R, Multi-Ethnic Pediatric Eye Disease Study Group. Prevalence of amblyopia or strabismus in Asian and non-Hispanic white preschool children: multi-ethnic pediatric eye disease study. Ophthalmology. 2013 Oct 1; 120 (10):2117-24.
15. Akbari MR, Mirzajani A, Moeinitabar MR, Mirmohammadsadeghi A, Khorrami-Nejad M, Sharbatoghli L. The effect of alternate occlusion on control of intermittent exotropia in children. European journal of ophthalmology. 2020 Mar; 30 (2):275-9.
16. Song D, Yin L, Chen D, Qian J, Chen Z. Comparison of alternate part-time patching and pencil push-up training for patients with intermittent exotropia. BMC ophthalmology. 2022 Dec;22(1):1-7.
17. Freeman RS, Isenberg SJ.The use of part-time occlusion for early onset unilateral exotropia. Journal of Pediatric Ophthalmology & Strabismus. 1989 Mar 1;26(2):94-6.
18. Suh YW, Kim SH, Lee JY, Cho YA. Conversion of intermittent exotropia types subsequent to part-time occlusion therapy and its sustainability. Graefe's Archive for Clinical and Experimental Ophthalmology. 2006 Jun;244:705-8.
19. Abdel-Rehim AS, Ali AM, Sadaka AA, Mohamed DH. Management of Intermittent Exotropia in Children. The Egyptian Journal of Hospital Medicine. 2019 Jul 1;76 (1):3282-90.
20. AlKahmous LS, Al-Saleh AA. Does occlusion therapy improve control in intermittent exotropia? Saudi Journal of Ophthalmology. 2016 Oct 1; 30 (4):240-3.
21. Reynolds JD, Wackerhagen M. Early onset exodeviations. American Orthoptic Journal. 1988 Jan 1; 38 (1):94-100.
22. Spoor DK, Hiles DA. Occlusion therapy for exodeviations occurring in infants and young children. Ophthalmology. 1979 Dec 1;86(12):2152-7.
23. Berg PH, Lozano MJ, Isenberg SJ.Long term results of part-time occlusion for intermittent exotropia. American Orthoptic Journal. 1998 Jan 1;48(1):85-9.
24. Newman J, Mazow ML. Intermittent exotropia: is surgery necessary? Ophthalmic Surgery, Lasers, and Imaging Retina. 1981 Mar 1;12(3):199-202.
25. Cotter SA, Mohney BG, Chandler DL, Holmes JM, Repka MX, Melia M, Wallace DK, Beck RW, Birch EE, Kraker RT, Tamkins SM. A randomized trial comparing part-time patching with observation for children 3 to 10 years of age with intermittent exotropia. Ophthalmology. 2014 Dec 1;121(12):2299-310.
26. Cooper J. Major review. Intermittent exotropia. Basic and divergence excess type. Binocular Vision and Eye Muscle Surgery Quarterly. 1993;8:185-216.
27. Shin KH, Kim IN, Paik HJ. The Effect of Preoperative Occlusion Therapy on Long- term Outcome after Surgery for Early-onset Exotropia. Korean J Ophthalmol. 2017 Jun; 31(3): 268-274. doi: 10.3341/ kjo.2015.0168. Epub 2017 May 11..