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ORIGINAL RESEARCH

Optimal Duration of Monocular Occlusion to Eliminate Fusion Effect in Intermittent Exotropia

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Purpose: To determine the optimal duration of monocular occlusion in patients with intermittent exotropia.

Patients and Methods: This prospective cohort study enrolled 40 patients with intermittent exotropia at Ramathibodi Hospital between May 2023 and September 2023. Angles of deviation at distance (6 m) and near fixation (0.33 m) were measured before and after monocular occlusion for 30, 60, and 90 minutes. All measurements were performed by a single ophthalmologist. The mean angle of deviation was calculated at each time point.

Results: The mean age at presentation was 12.5 years (range, 5–33 years). The mean angles of deviation before monocular occlusion were 27.8 ± 15.1 prism diopters (PD) at distance and 26 ± 13.7 PD at near fixation. At distance, mean angles of deviation after monocular occlusion were 32.2 ± 14.6, 32.9 ± 15.0, and 32.6 ± 14.7 PD at 30, 60, and 90 minutes, respectively. At near fixation, mean angles of deviation after monocular occlusion were 37.4 ± 15.0, 39.8 ±14.3, and 39.5 ± 14.6 PD at 30, 60, and 90 minutes, respectively. All angles significantly differed from the pre-occlusion deviation (all $P < 0.01$). For deviation at distance, there was no statistically significant difference between 60 and 30 minutes of monocular occlusion ($P = 0.48$). For deviation at near fixation, there was a significant difference between 60 and 30 minutes of monocular occlusion ($P = 0.048$), but the difference of 2.5 PD was not clinically significant. There were no statistically significant differences between 90 and 60 minutes of monocular occlusion at distance or near fixation (both $P = 0.82$).

Conclusion: Monocular occlusion is necessary to eliminate the fusion effect in patients with intermittent exotropia; 30 minutes of monocular occlusion is sufficient to achieve the maximum angle of deviation.

Keywords: patch test, intermittent exotropia, tenacious proximal convergence

Introduction

Intermittent exotropia is an occasionally outward deviation of the eye that usually occurs during distance fixation. This condition often affects patients in childhood;[1] it can remain stable, progress, or improve over time.[2] However, most patients show progression and some of them eventually require surgical management, either to maintain binocularity or to address cosmetic concerns.[2,3]

It is challenging to measure the angle of deviation in these patients, especially when surgery is planned. The well-known Burian classification system of intermittent exotropia[4] categorizes patients into three groups based on the difference in angle of deviation between distance and near fixations: basic, divergence excess, and convergence insufficiency. Monocular occlusion is performed to classify divergence excess as true or pseudo subtypes. The type of intermittent exotropia is clarified as some surgeons manage each type differently.[5–7] Moreover, monocular occlusion is used to reveal a patient's maximum angle of deviation,[8] which is the angle at which surgery should be performed, according to Kushner.[9]

Various durations of monocular occlusion have been proposed in the literature. Scobee[10] suggested 24 hours of monocular occlusion to eliminate the fusion effect, whereas Burian[4] recommended a shorter duration of 30–45 minutes, and Kushner[8] proposed 60 minutes. To our knowledge, only a few studies have investigated the most effective duration

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of monocular occlusion.[11,12] Gurlu and Erda[11] compared angles of deviation after monocular patching for 1, 3, and 24 hours; they found that 1 hour of monocular occlusion was sufficient to remove the fusion effect in a clinical setting.

In our hospital, we have performed monocular occlusion for 30–60 minutes before measuring the angle of deviation in patients with intermittent exotropia. We have not found clear evidence regarding whether 30 minutes of occlusion is sufficient to achieve the maximum angle of deviation needed for successful surgery, or whether a longer duration of patching results in a significant difference regarding the angle of deviation. Therefore, we conducted this study to explore the optimal duration of monocular occlusion in real-world clinical practice, aiming to achieve the maximum angle of deviation with the least amount of time that patients have to spend in the hospital. This study compares angles of deviation before and after monocular occlusion for 30, 60, and 90 minutes. The findings may help to improve the accuracies of examinations and surgeries, while reducing the length of time patients must remain in the hospital. Ophthalmologists can use these results to guide the management of patients with intermittent exotropia.

Materials and Methods

Study Population

This prospective cohort study enrolled 40 consecutive patients with intermittent exotropia at Ramathibodi Hospital between May 2023 and September 2023. The inclusion criteria were diagnosis of intermittent exotropia, presence of full duction and version movements of extraocular muscles, ability to cooperate during all measurements, no history of strabismus surgery, and no other ocular diseases or trauma.

The data were recorded in a standardized manner using a data collection sheet that protected patient autonomy and confidentiality.

The study protocol was approved by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (COA. MURA2023/73). The study conformed to the principles of the Declaration of Helsinki. Written informed consent for inclusion in the study was obtained from all participants aged 18 and over, or from the legal guardian if the patient is under 18 years old.

Procedures

All patients underwent routine ophthalmic examinations, including visual acuity assessment and fundoscopy using a slit-lamp biomicroscope. Best-corrected visual acuity was recorded, and ocular movement was evaluated. Titmus tests were conducted to confirm the presence of binocularity.

Orthoptic examinations were performed using the alternate prism cover test with each patient's best-corrected visual acuity at distance (6 m) and near fixation (0.33 m). Angles of deviation were measured before monocular occlusion. Subsequently, one eye was covered with surgical tape for 30 minutes. Angles of deviation were reevaluated immediately after patch removal. The angle of deviation was initially measured at near fixation, then at distance. This process was repeated in each patient after monocular occlusion for 60 and 90 minutes. All measurements were performed by a single ophthalmologist.

Outcomes

This study explored the most effective duration of monocular occlusion, which can give the maximum angle of deviation, in patients with intermittent exotropia by comparing mean angles of deviation before and after monocular occlusion for 30, 60, and 90 minutes.

Statistical Analysis

Data were analyzed using STATA software version 17 (StataCorp LP, College Station, TX, USA). Descriptive statistics were calculated, including means with standard deviations (SD), medians with interquartile ranges (IQR), and frequencies.

Mean angles of deviation were calculated before and after monocular occlusion for 30, 60, and 90 minutes. Angles of deviation at each time point were compared using mixed-effects linear regression. P-values < 0.05 were considered statistically significant. Data were reported as means with standard deviations (SD).

Results

In total, 40 patients were enrolled in this study (mean age at presentation: 12.5 years [range, 5–33 years]; 47.5% male patients and 52.5% female patients). The median logarithm of the minimum angle of resolution (logMAR) visual acuities was 0.06 (IQR, 0.02–0.16) in right eyes and 0.04 (IQR, 0.02–0.16) in left eyes. Types of intermittent exotropia were as follow: 35% basic, 40% convergence insufficiency, 22.5% pseudo-divergence excess, and 2.5% true divergence excess. All patients had some degree of stereopsis, confirming binocularity. Demographic and baseline data of the patients are shown in Table 1.

The mean angles of deviation before monocular occlusion were 27.8 ± 15.1 prism diopters (PD) at distance and 26 ± 13.7 PD at near fixation. At distance, the mean angles of deviation after monocular occlusion were 32.2 ± 14.6, 32.9 ± 15.0, and 32.6 ± 14.7 PD at 30 minutes, 60 minutes, and 90 minutes, respectively. All angles significantly differed from the pre-occlusion deviation (all P < 0.01). However, there was no statistically significant difference between 60 and 30 minutes of monocular occlusion (P = 0.48) or between 90 and 60 minutes of monocular occlusion (P = 0.82).

Findings were similar regarding the mean angles of deviation at near fixation. All mean angles of deviation at 30, 60, and 90 minutes after monocular occlusion—37.4 ± 15.0, 39.8 ±14.3, and 39.5 ± 14.6 PD, respectively—differed from the pre-occlusion deviation (all P < 0.01). The difference between 60 and 30 minutes of monocular occlusion was 2.5 PD (P = 0.048). There was no statistically significant difference between 90 and 60 minutes of monocular occlusion (P = 0.82). The detailed data are shown in Table 2.

Table 1 Demographic and Baseline Characteristics of Patients

Variables	n (%)
Age (years old)	
Mean (SD)	12.5 (5.7-19.3)
5–9	15 (37.5)
10–19	19 (47.5)
20–29	4 (10.0)
30–35	2 (5.0)
Sex	
Male	19 (47.5)
Female	21 (52.5)
Types of intermittent exotropia	
Basic	14 (35)
Convergence insufficiency	16 (40)
True divergence excess	1 (2.5)
Pseudo-divergence excess	9 (22.5)
Duration (years)	
Mean (SD)	5.5 (1.6-9.4)
Visual acuity (logMAR)	
Median (IQR)	
Right eye	0.06 (0.02-0.16)
Left eye	0.04 (0.02-0.16)

Abbreviations: SD, standard deviation; logMAR, logarithm of the minimum angle of resolution; IQR, interquartile range

Table 2 Mean Angles of Deviation at Distance and Near Fixation Before and After Monocular Occlusion for 30, 60, and 90 Minutes

Deviation (XT (PD)) / Monocular Occlusion	Distance Mean (SD)	P-value		Near Mean (SD)	P-value	
Before	27.8 (12.7-42.9)			26 (12.3-39.7)		
30 minutes	32.2 (17.6-46.8)	< 0.01*		37.4 (22.4-52.4)	< 0.01*	
60 minutes	32.9 (17.9-47.9)	< 0.01*	0.480[a]	39.8 (25.5-54.1)	< 0.01*	0.048[a]
90 minutes	32.6 (17.9-47.3)	< 0.01*	0.821[b]	39.5 (24.9-54.1)	< 0.01*	0.822[b]

Notes: *P-value for indicated deviation vs pre-occlusion deviation. [a]P-value for deviation after 60 minutes of monocular occlusion vs 30 minutes of monocular occlusion. [b]P-value for deviation after 90 minutes of monocular occlusion vs 60 minutes of monocular occlusion.
Abbreviations: XT, exotropia; PD, prism diopters; SD, standard deviation.

Discussion

Monocular occlusion is an essential assessment for patients with intermittent exotropia. It is important to identify the type of intermittent exotropia because this information guides the treatment approach. In terms of surgery, bilateral lateral rectus recession is recommended for patients with true divergence excess intermittent exotropia, whereas bilateral medial rectus resection is commonly used for patients with convergence insufficiency intermittent exotropia. Many other surgical techniques have been developed for the management of convergence insufficiency, including improved R and R (extent of medial rectus resection based on near deviation and extent of lateral rectus recession based on distance deviation), slanted bilateral medial rectus resection, and slanted bilateral lateral rectus recession. Monocular occlusion also provides information regarding the maximum angle of deviation, which is the angle that determines the extent of surgical management. The rate of surgical success is higher when the procedure is based on the largest angle of deviation[9] because it helps minimize residual exotropia. Where there is concern about overcorrection from this surgical dosage, it is actually rare. However, the optimal duration of monocular occlusion has not been clearly established. In the present study, we explored the most effective duration of monocular occlusion for patients with intermittent exotropia.

Our results showed that there were no statistically significant differences among monocular occlusion for 30, 60, and 90 minutes with respect to the angle of deviation at distance. The results for angle of deviation at near fixation were similar, except for the statistically significant difference between 60 and 30 minutes of monocular occlusion. However, the difference of 2.5 PD is not clinically significant. This result is consistent with the work of Gurlu and Erda,[11] who reported that a longer duration of occlusion did not lead to a larger angle of deviation. They found a statistically significant difference after 1 hour of monocular occlusion, but an additional time (3 or 24 hours) did not lead to a larger difference at distance or near fixation. However, Gurlu and Erda did not perform 30 minutes of monocular occlusion, whereas we did. Our rationale for utilizing a 30-minute duration of monocular occlusion was that this interval is implemented in our hospital. Moreover, if we found that a shorter duration of monocular occlusion was effective, we expected that it would help to reduce the amount of time patients must remain in the hospital. To our knowledge, no previous studies explored 30 minutes of monocular occlusion. Therefore, this is the first study to confirm the effectiveness of a 30-minute duration of monocular occlusion.

The strengths of our study include its prospective design and reasonable number of patients. Moreover, it is among the first to utilize a 30-minute duration of monocular occlusion, and angle of deviation measurements were performed by a single ophthalmologist to eliminate variations related to measurement technique. However, this study did not evaluate surgical outcomes according to the extent of recession or resection, considering the angles of deviation measured in these patients. Such outcomes should be explored in future research.

Conclusion

This study showed that monocular occlusion is necessary to eliminate the fusion effect in patients with intermittent exotropia; 30 minutes of monocular occlusion was sufficient to achieve the maximum angle of deviation in these patients. There were no clinical differences between 30 minutes and 60 or 90 minutes of monocular occlusion. Therefore, we recommend 30 minutes of monocular occlusion for patients with intermittent exotropia. This approach will allow patients to spend less time in the hospital, compared with the use of longer monocular occlusion. Ophthalmologists can use these results to guide the management of patients with intermittent exotropia.

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Disclosure

The authors report no conflicts of interest in this work.

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