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Control Scoring in Intermittent Exotropia: A Descriptive Pediatric Study

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ABSTRACT

Background: Intermittent exotropia (IXT) is a condition characterized by fluctuating control, and the optimal approach for monitoring it is a subject of continual discussion.

Purpose: The aim of this study is to assess the reliability of repeated measurements of the Office Control Score (OCS) and its correlation with distance stereopsis in children diagnosed with intermittent exotropia (IXT).

Methods: This prospective study involved 98 children, who were cate-gorized according to deviation angle (<20 PD and ≥20 PD). OCS was assessed at three time points, and stereopsis was evaluated through the Titmus and Distance Randot tests.

Results: Results indicate that both groups exhibited statistically significant improvements in OCS across visits, with Group A showing superior control and stereopsis outcomes at the third visit ($P < 0.05$). Children with smaller deviation angles exhibited significantly improved distance stereopsis.

Conclusions: Multiple OCS measurements, as opposed to a single-point assessment, offer a more stable and reliable approach for monitoring control in IXT. This method may facilitate prompt surgical referrals and enhance clinical outcomes.

1. Introduction

Intermittent exotropia (IXT) is the most common type of strabismus (Jung *et al.*, 2010, Wang *et al.*, 2021, Gore *et al.*, and Oh *et al.*, 2023) in children. Several authors have assessed the progression and severity of IXT using the control score, angle of deviation, and stereoacuity (Wang *et al.,* 2020; Kaur *et al.,* 2024; Lim *et al.,* 2015). The prevalent assumption (Stathacopoulos *et al.,* 1993) is that poor control and decreased distant stereoacuity are components of IXT progress. Mohney (2006) invented the office control score (OCS), a simple-to-use clinical tool that assesses the range of IXT from small to large angles. The repeated OCS measurements are crucial for enhancing assessment and management strategies in children with IXT. In children with IXT, poor control signifies the need for surgery (Kumar *et al.*, 2024). Distance stereoacuity presents an effective method for evaluating distance sensory-visual abilities with IXT (Hatt *et al.*, 2007). This study examines the relationship among the angle of deviation, office control score (OCS), and stereopsis in children with IXT. Additionally, repeated assessments of the OCS may provide a more reliable evaluation compared to a single measurement.

2. Methodology

The biomedical research ethics committee at our institute reviewed and approved the study. The study involved 98 IXT participants, aged between 6 and 16 years, who visited the Regional Institute of Ophthalmology from October 2023 to July 2024. Participants were included if they had a best corrected visual acuity of 6/6 in each eye. The exodeviation at both near and distance was measured, ranging from 10 to 40 prism diopters (PD), using a prism bar and the alternate cover test. Exclusion criteria included convergence insufficiency-type exotropia (near deviation ≥ 10 PD than distance deviation), any history of strabismus and ocular surgery, vertical strabismus, vision therapy, ocular and systemic disorders, amblyopia, nystagmus, anisometropia equal to or greater than four diopters, and any non-surgical treatment. Participants were divided into two groups based on the degree of deviation: Group A, with deviations of less than 20 PD, and Group B, with deviations of 20 PD or

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more. This threshold was chosen because deviations of 20 PD or greater are more likely to impact binocular control and stereopsis, allowing us to assess whether larger deviations are associated with poorer functional outcomes.

2.1. Study Design

The study had a prospective design, and all participants provided written informed consent before enrollmen. A comprehensive orthoptic evaluation was conducted on each participant, which included testing their best-corrected visual acuity, near-point of convergence motility, and the anterior segment of their eyes. The angle of deviation, near- and distance stereopsis, and OCS were measured. An alternate cover test was employed to evaluate the strabismus. The angle of deviation was measured using the Prism Bar Cover Test, with an accommodative target set at 6 meters and 33 centimeters (cm) for near vision. According to prior research, the estimated prevalence rate of IXT in children is 3.24%, or the proportion of the population believed to have the disorder. A key factor in determining sample size (Pan *et al.*, 2016) is prevalence, which indicates the probability of detecting the condition in the chosen sample.

2.2. Testing Sets

Near stereopsis was assessed using the Titmus circles test (Vision Assessment Co., Inc., IL, USA) at a 40 cm distance with polarized glasses. The parallaxes of the Titmus circle test were 400, 200, 160, 100, 63, 50, 40, 32, 25, and 20 seconds of arc. The Distance Randot Stereo test (Stereo Optical Co., Inc., IL, USA) measured distance stereopsis at a distance of three meters using polarized glasses. Participants view matching cards (circle, star, triangle, and square) of each shape and confirm their ability to recognize each shape by pointing to the corresponding shapes on the matching card. The "400A" picture initiates the testing, followed by the "400B" picture. If the subject correctly matches both shapes at the 400-second arc level, proceed to the 200-, 100-, and 60-second arc levels.

The Distance Randot Stereo test had a parallax of 400A, 400B, 200A, 200B, 100A, 100B, 60A, and 60B seconds. The categories consisted of ≤200A, ≤200B, >200A, and >200B. For statistical analysis, 800 seconds of arc were used when stereopsis was absent at both near and distance. The angle of deviation and near- and distance stereopsis were measured in each group.

To examine the control of exodeviation, the OCS (0-5 control scale) was used. The control of exodeviation was assessed using best-corrected visual acuity at both a six-meter distance and a near distance of 33 cm. The assessment of the OCS took place over three visits. The patient arrived for the first visit, and the same examiner repeated the test two to four hours later at the second visit and again 24 hours later at the third visit. Each visit did not include a review of the previous record. Each visit involved three assessments of OCS. The examiner graded the OCS at the clinic by assessing the break in fusion and observing the recovery of alignment in both eyes to maintain binocular vision. The OCS grades three to five were determined through a preliminary evaluation lasting 30 seconds at both distance and near ranges. The fixation targets were standardized: a Snellen chart was used for distance fixation at 6 meters, and a Lang sticks accommodative target was used at a distance of 33 centimeters. Participants exhibiting constant exotropia received a grade of five. Those with more than 50% exotropia were assigned a grade of four, while participants with less than 50% exotropia received a grade of three. If the examiner did not observe any exotropia during the initial 30-second observation, grades from zero to two were assigned based on how long it took to re-establish fusion in the eyes. The recovery times were categorized as follows: a recovery of fusion within five seconds was designated as grade two, a recovery time between one and five seconds was assigned grade one, and a recovery within one second was classified as grade zero.

2.3. Statistical Analysis

Quantitative variables were presented as means and standard deviations; categorical variables were presented as proportions and percentages. A t-test was used to compare the mean OCS between group A and group B. The ANOVA statistics were used to compare the mean OCS between the three patient visits. The level of significance was set at 5%, and significance was considered if the p-value was less than 0.05. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 26) and Microsoft Excel software.

3. Results

The mean age of the 98 participants was 10.97 ± 3.1 years (range, 6 to 16 years), with 47 participants in Group A and 51 participants in Group B. The groups consisted of 27 males (57.5%) and 20 females (42.5%) in Group A and 22 males (43.2%) and 29 females (56.8%) in Group B. The mean age of each group was 10.7 ± 3.34 years in Group A and 11.22 ± 2.91 years in Group B, with no significant difference between the two groups. The mean OCS data for near and distant were obtained from the first, second, and third visits. Groups A and B exhibited notable differences in the OCS during each visit. In Group A, the mean scores for near decreased from 2.489 ± 1.214 at the first visit to 2.064 ± 0.818 at the second visit to 1.617 ± 0.898 at the third visit (ANOVA 7.071, *P* = 0.002). Similarly, distance scores declined from 2.404 ± 1.1 at the first visit to 2.234 ± 1.127 at the second and 1.298 ± 1.159 at the third visit (ANOVA = 13.11, *P* < 0.0001). Group B also showed near scores decreasing from 2.882 ± 0.791, 2.333 ± 0.973, and 2.118 ± 1.423 at the first, second, and third visits, respectively (ANOVA = 6.61, *P* = 0.002), and distance scores from 2.961 ± 0.799, 2.51 ± 1.155, and 2.177 ± 1.466 at the first, second, and third visits, respectively (ANOVA = 5.752, *P* = 0.004). Notably, both groups show similar trends, providing robustness to the findings (Table 1).

Table 1: One-Way Analysis of Variance (ANOVA) was used to compare Group A and Group B Three-Visit Near- and Distance-Office Control Scores

Variables		First Visit (Mean ± SD)	Second Visit (Mean ± SD)	Third Visit (Mean ± SD)	ANOVA	P – Value
Group A	**Near**	2.489 ± 1.214	2.064 ± 0.818	1.617 ± 0.898	7.071	0.002
	Distance	2.404 ± 1.1	2.234 ± 1.127	1.298 ± 1.159	13.11	0.00001
Group B	**Near**	2.882 ± 0.791	2.333 ± 0.973	2.118 ± 1.423	6.61	0.002
	Distance	2.961 ± 0.799	2.51 ± 1.155	2.177 ± 1.466	5.752	0.004.

Data are presented as mean ± standard deviation (SD), with P-values indicating significant changes over time (P < 0.05)

Table 2 compares the OCS between Groups A and B. The analysis showed no statistically significant difference in near and distance OCS between the first and second visits for both groups. For Group A, the near-OCS values were 2.489 ± 1.214 at the first visit and 2.064 ± 0.181 at the second visit. In Group B, the near-OCS values were 2.882 ± 0.791 at the first visit and 2.333 ± 0.793 at the second visit. The near OCS p-values for the first and second visits were 0.063 and 0.141, respectively.

Table 2: Group A and Group B Near and Distance Office Control Ratings were Compared over Three Visits using an Independent T-Test

Variable		Group A (Mean ± SD)	Group B (Mean ± SD)	t-test	P-value
Near	**First Visit**	2.489 ± 1.214	2.882 ± 0.791	-1.882	0.063
	Second Visit	2.064 ± 0.818	2.333 ± 0.973	-1.488	0.141
	Third Visit	1.617 ± 0.898	2.118 ± 1.423	-2.099	0.039
Distance	**First Visit**	2.404 ± 1.1	2.961 ± 0.799	-1.851	0.068
	Second Visit	2.234 ± 1.127	2.51 ± 1.155	-1.196	0.235
	Third Visit	1.298 ± 1.159	2.177 ± 1.466	-3.304	0.002

Only at the third visit (P < 0.05) were significant differences observed in the scores, which are presented as the mean ± standard deviation (SD).

For Group A, the distance-OCS values were 2.404 ± 1.1 at the first visit and 2.234 ± 1.127 at the second visit. In Group B, the distance-OCS values were 2.961 ± 0.799 at the first visit and 2.51 ± 1.155 at the second visit. The p-values for the distance-OCS at the first and second visits were 0.068 and 0.235, respectively. During the third visit, group A exhibited a near mean of 1.617 ± 0.898, whereas group B had a mean of 2.118 ± 1.423. The distances were 1.298 ± 1.159 for group A and 2.177 ± 1.466 for group B. During the third visit, the OCS values exhibited statistically significant differences (P = 0.039 for near and P = 0.002 for distance), with t-test values of -2.099 for near and -3.304 for distance. Notable differences in distance stereopsis were identified between Group A and Group B (χ^2 = 13.58, P = 0.004). Group A exhibited more participants with good stereopsis (13 compared to 2). Conversely, Group B had a higher incidence of participants with no measurable stereopsis (7 compared to 1), suggesting superior stereopsis outcomes in Group A (Table 3). All groups showed no significant differences in near stereopsis (P = 0.82), as indicated by a t-test value of -0.24.

Table 3: Analysis of Distance Stereopsis in Group A versus Group B Utilizing the Chi-Square Test (χ^2).

Category	Group A	Group B	Chi-square test (χ^2)	P - Value
≤ 200 A	13	2	13.58	0.004
≤ 200 B	7	10		
> 200 A	26	32		
> 200 B	1	7		

The participant counts in each stereopsis category are presented, revealing a significant difference between groups (χ^2 = 13.58, P = 0.004)

4. Discussion

This prospective study demonstrated that the OCS changed at each visit, and during the third visit, significant differences were revealed between the two groups. The distance stereopsis found a considerable difference between the two groups. Hatt *et al.* (2011) noted that examining control deviation at a single interval often effectively represents the severity of IXT in numerous cases. Hatt *et al.* (2008) noted variations in deviation control from one visit to another and suggested that one should not place undue significance on measures from a single visit. The average of three control measures (Hatt *et al.,* 2011) offers a more comprehensive description of control than single or double measurements. Romanchuk *et al.* (2006) demonstrate that variations in the angle and control of exodeviation can occur between visits. Hence, one should not ascribe excessive relevance to findings from a single visit. The research supports the existing literature; near and distance OCS varied with each visit for both groups. Wang *et al.* (2017) utilized both indoor and outdoor far-distance control scales to evaluate the control scores of children with IXT. They discovered that the controls for outdoor far distance and indoor far distance were lower than those for indoor distance. The current study revealed that control of deviation is poorer at larger angles compared to smaller angles during the third visit.

According to Kang *et al.* (2015) and Jin *et al.* (2012), near and distance stereoacuity were not significantly different in the reasonable and fair control groups. Still, in the poor control group, both distances showed statistically significant differences. In the current study, distance stereopsis was found to be inadequate in group B (>200 A). When the two groups were compared, it was found that individuals with large angles of deviation had worse distance stereopsis.

Still, neither small nor large angles of deviation had any effect on their near stereopsis. The study by Hatt *et al.* (2012) demonstrates that conducting the prism and alternate cover tests to measure the angle of strabismus three or four times daily can identify clinically significant changes in children with IXT. The differences in control scores at distance exceeded those at near range, with positive fusional amplitudes significantly contributing to the difference in IXT control scores between near and distance measurements (Ale *et al.,* 2023). Patching therapy yields a more substantial improvement in distance control scores in children (Hatt *et al.,* 2023). The results showed that in group B, the distance control score was higher than the near control score. The current study found that greater deviation angles are associated with poorer control and stereopsis, and repeated OCS assessments enhance the reliability of evaluating control in IXT.

This study has several limitations. Initially, 42 participants were unable to detect the 400 arc seconds of distance stereopsis at 3 meters; it is conceivable that the number of participants for the 800 arc seconds stereopsis may have varied. Second, the sample size of Group A participants was smaller than that of Group B. Third, the grade levels three to five were monitored for 30 seconds at both the near and distant ranges, with the timing initiated and stopped at the starting point of the 30-second interval, leading to variations according to the scale definition. Thus, differences can be expected among grade levels three to five. A one-hour occlusion patch was not utilized to assess the angle of deviation.

5. Conclusion

Children with IXT demonstrate a relationship between the OCS and distance stereopsis, which is a reliable measure for monitoring the progression of exotropia. The OCS indicates considerable variability across several assessments, underscoring the necessity of repeated observations. It is advisable to measure the OCS several times instead of only once.

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Authorship Contribution

Rajesh Kumar, Malhar Vyas, and M.K. Prajapat contributed to the concept and design of the study. All authors performed data acquisition, analysis, and interpretation. The manuscript was drafted by Rajesh Kumar, Malhar Vyas, and Neebha Passi and all authors critically revised it for important intellectual content. Malhar Vyas provided supervision of the study.

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Conflict of Interest

Authors declare that there is no conflict of interest.

Ethical Approvals

Ethical approval for this study was obtained (Ref: BREC/23/448).

Declaration

It is an original article and has been neither sent elsewhere nor published anywhere.

Abbreviations

IXT: Intermittent Exotropia, **OCS:** Office Control Score, **ANOVA:** Analysis of Variance, **SD:** Standard Deviation, **PD:** Prism Diopter

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