Original Article

Strabismus Measurements Using the Alternating and Simultaneous Prism Cover Tests

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ABSTRACT

Purpose: To compare the angle of deviation by performing simultaneous prism cover test (SPCT) and alternate prism cover test (APCT) at near (33cm) and far (6m).

Study Design: Cross-sectional observational.

Place and Duration of Study: Al-Ibrahim Eye Hospital, Karachi from July 2021 to December 2021.

Methods: This study enrolled 32 participants diagnosed with constant esotropia, aged between 5 and 25 years, comprising 14 males and 18 females. Comprehensive ocular examinations for strabismus were performed, including simultaneous prism cover tests at both distance and near fixation, conducted with and without corrective glasses. Subsequently, an alternate prism cover test was administered at each fixation point, again both with and without glasses. Binocular single vision was evaluated using the Worth Four Dot test and the 10Δ test. Statistical analysis was conducted using SPSS version 20.0.

Results: At distance fixation, the mean deviation angle measured by the simultaneous and alternate prism cover tests exhibited a significant difference of 9.78Δ (p=<.001). Similarly, at near fixation, the mean deviation angle between the simultaneous and alternate prism cover tests showed a significant difference of 10Δ (p=<.001).

Conclusion: This study demonstrates a notable and statistically significant variance in the measured angle of deviation when employing different testing methodologies (SPCT and APCT).

Keywords: Esotropia, Simultaneous prism cover test, Alternate prism cover test, Binocular Single Vision.

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INTRODUCTION

Strabismus or squint is a misalignment of the visual axis and its measurement is an important step in diagnosing and managing ocular misalignment.[1] It helps determine the extent of angle of deviation before surgery, help with identifying the different types of squints and assess any changes in acquired Incomitant squint.[2,3] Angle of deviation can be measured using a variety of techniques, such as the simultaneous prism cover test, Krimsky test and the alternative prism cover test (APCT). The cover-uncover test is the standard procedure for identifying manifest strabismus.[4,5] APCT is considered to be gold standard to measure objective deviation.[6] Furthermore, the prism alternating cover test (PACT) is used to measure total ocular deviation, which includes both apparent and latent deviations when present.[7] While performing PACT, a prism with apex towards deviation is placed over the deviating eye whilst an occluder is simultaneously placed over the fixing eye. The prism's power is increased until no re-fixation movement is noticed behind the prism. Microtropia with latent component is usually measured with simultaneous prism cover test (SPCT).[8,9] The accuracy of the angle of deviation is influenced by measuring technique, staff expertise, and patient compliance. Hirschberg's test is a basic test that uses the position of the corneal light reflex (CLR) in relation to the pupillary or

corneal limbus to estimate the angle of deviation.[10] For strabismus patients who have difficulty in measuring the deviation angle with the APCT, the Krimsky test is anticipated to be more helpful in this regard.[11] When SPCT is not feasible for children, prism under cover test (PUCT) is method of choice to measure manifest deviation and to support the diagnosis of monofixation syndrome.[12,13]

Esotropia (ET) can develop in infancy or be acquired. Infantile ET first appears in the first six months of life, whereas Acquired ET, on the other hand, appears later in life and can be accommodative or non-accommodative.[14,15] The simultaneous prism cover test measures the manifest inward deviation and is utilized by many surgeons as a way to figure out whether strabismus surgery is necessary or not.[16]

The purpose of this study aims to compare the angle of inward deviation by performing two types of tests (simultaneous prism cover test and alternate prism cover test) at close and far distances.

METHODS

From July to December 2021, a hospital-based cross-sectional comparison study was undertaken at the Orthoptics clinic at Al- Ibrahim Eye Hospital, Karachi, utilizing a non-probability convenient sampling technique. The Isra Postgraduate Institute of Ophthalmology's (IPIO) Research Ethical Committee (REC) granted ethical approval.

A sample of 32 was calculated by Rao soft using prevalence of strabismus as 3.1% and estimated population during our study period as 100. Keeping 95% confidence interval and 5% margin of error, 32 patients who visited the Orthoptic clinic throughout the data collecting period were included. Subjects aged 5 to 25 years old with constant comitant esotropia, no prior squint surgery and no other disease and whose guardians were willing to participate were included. Both genders and deviation less than or equal to 45 PD were included.

The exclusion criteria were patients with latent and pseudo strabismus or ocular syndromes, vertical deviation, nystagmus, intermittent convergence strabismus, visual acuity less than 6/36, acquired Incomitant deviations and subjects with no true point of reversal on alternate prism cover test (APCT). All the subjects were examined after obtaining informed written consent. The study protocols of the subjects who met the inclusion criteria were evaluated at the Department of Orthopedic Clinic, Al-Ibrahim Eye Hospital. Distance and near visual acuity, with and without glasses using Snellen visual acuity chart and cover uncover were done to assess the presence or absence of manifest and latent deviation. Orthoptic examination included; Hirschberg test, simultaneous prism cover test and alternating prism cover test. The angle of deviation was measured by conducting the Simultaneous prism cover test initially, followed by the Alternate prism cover test after a 20 minutes interval. Evaluation of BSV was done using worth four dot test and 10 Δ Base out prism.

Data analysis was done by using SPSS version 20. All quantitative variables were presented as mean ± standard deviation. To see the significance between SPCT and APCT, independent sample T test and paired t test were applied. A p-value of less than ≤0.05 was taken as statistically significant.

RESULTS

A total of 32 patients were included from Orthoptics Clinic at Al Ibrahim Eye Hospital from July 2021 to December 2021. The age ranged between 5 to 25 years. Participants were divided into four groups according to ages as shown in Table 1. Out of 32 patients, 14 weremalesaccountingfor43.8% and 18 were females making up 56.3%. Unaided Visual acuity in right eye and left eye are shown in Figures1 and 2 respectively.

The data were analyzed to determine the sample mean difference between measurements obtained from the alternate and simultaneous prism cover tests during distance fixation. The calculated value was 9.78Δ ($P < .001$). Similarly, for near fixation, the sample mean difference was found to be 10Δ ($P =< .001$). Table 2 illustrates the significant difference between these measurements ($P = .001$). Among the 32 subjects, 26 (81.3%) exhibited anomalous retinal correspondence (ARC), while suppression was observed in 6 (18.8%), as detailed in Table 3.

Table 1: Age-wise distribution of the sample

Age in Years	Frequency	Percent
5 to 9	21	65.6%
10 to 15	9	28.1%
16 to 20	1	3.1%
21 to 25	1	3.1%
Total	**32**	**100.0%**

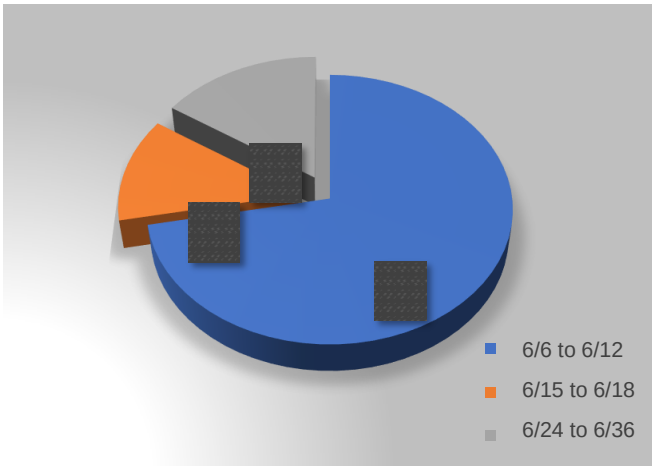

Figure 1: Unaided visual acuity of right eye.

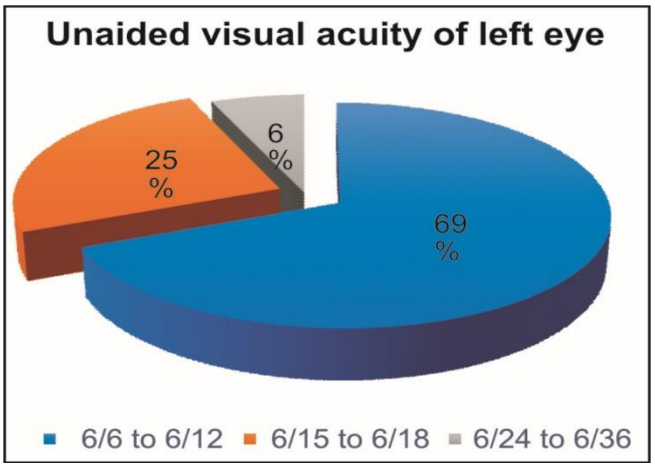

Figure2: Unaided visual acuity of left eye.

Table 2: *Mean angle of deviation measured by Alternating and simultaneous Prism Cover Test.*

Distance (▲)		Near (▲)		Difference (P)	
APCT	SPCT	APCT	SPCT	Distance	Near
28.81±10.42	19.03±9.1	29.44±11.14	19.44±9.225	9.78(<.001)	10 (<.001)

Probability values are derived from paired t test.

Table 3: *Status of Sensory fusion on Worth four-dot test and motor fusion with 10 ▲ base out prism.*

Worth Four-Dot Test	Frequency	Percent
ARC	26	81.3%
Suppression	6	18.8%
Total	**32**	**100.0%**
Fusion	**Frequency**	**Percent**
Present	26	81.3%
Absent	6	18.8%
Total	32	100.0%

Additionally, fusion was present in 26 subjects (81.3%) and absent in 6 (18.8%) when subjected to a 10Δ base out test.

DISCUSSION

In strabismus measurement techniques, some tests demand a high level of visual acuity while others need patient's co-operation. Clinical skills are required to select the right test for each case in order to obtain the most reliable strabismus measurement and to collect correct longitudinal patient data. This study chose the prism cover test because it is the recommended method to measure angle of deviation in subjects who are willing to co-operate while simultaneous prism cover test was selected for small angle constant esotropia. The findings of study carried by Deacon et al showed that it is important to measure both SPCT and APCT for all types of constant manifest esotropia.[6] However, this is only necessary when there is a noticeable difference in angle during the cover test. The results of the tests reveal that the average difference in the angle of deviation between SPCT and APCT measurements for near was (10Δ) and for far (9.78Δ).

While study conducted in UK showed difference in angle measurements by SPCT and APCT as 7.42 Δ for near and 4.35 Δ for distance. The interval time between PCT and APCT was one hour whereas, in our study we kept 20 minutes interval between both measurements.[7]

In the present study, Binocular Single Vision (BSV) was evaluated through the Worth Four Dot Test (W4DT) and a 10Δ Base Out Prism. In contrast, a separate study focused on individuals undergoing corrective surgery for esotropia. In this study, participants underwent pre-operative sensory assessments utilizing the Titmus Stereo Test and four-dot tests conducted at distances of six meters and 0.33 meters. The findings from this research suggested that both pre- and post-operative sensory and motor functions could serve as predictors for motor outcomes six months following surgery.[18]

The assessment was performed by a single

examiner in the present study, whereas the previous studies used more than two examiners and concluded that inter-examiner variability is likely to be the cause of the variation in the APCT within 10 PD for both close (33cm) and far fixation (6m).[19,20]

Several potential limitations of the study include Small Sample Size, Age Range Disparity as the age range of participants, spanning from 5 to 25 years, is quite wide. Different age groups may exhibit varying responses to ocular examinations and treatments, potentially affecting the consistency and interpretation of results. The study was a cross sectional design, offering insights into the participants' ocular status at a single time point. Longitudinal data tracking changes over time, particularly in response to interventions or natural progression of the condition, could offer deeper insights into the effectiveness of treatments and the stability of ocular measurements.

Addressing these limitations in future research endeavors could enhance the robustness and applicability of findings in the field of esotropia assessment and management.

CONCLUSION

There exists a significant difference in the measured angle of deviation when employing two different tests: the Simultaneous Prism Cover Test (SPCT) and the Alternate Prism Cover Test (APCT). This suggests that the choice of test methodology can impact the assessment of esotropia in individuals, highlighting the importance of selecting appropriate diagnostic techniques in clinical practice.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(REC/IPIO/2021/076-A).**

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Authors Designation and Contribution

Shua Azam; Assistant Professor: *Concepts, Literature search, Data acquisition, Manuscript preparation, Manuscript editing, Manuscript review.*