RESEARCH ARTICLE

COMPARISON OF KRIMSKY AND HIRSCHBERG METHODS IN THE MEASUREMENT OF ANGLE OF STRABISMUS

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Manuscript Info

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Abstract

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Strabismus is a condition in which the eyes do not properly align with each other when looking at an object. This study compared the Krimsky and Hirschberg methods in measuring angle of strabismus. This study was carried out in Owerri municipal. The study adopted a prospective study design. In this study, 21 strabismus subjects aged 16-45 years, were examined with exclusion to subjects without strabismus, 12 males and 9 females with strabismus were drawn through random selection from the study area age 30 years. The major instrument used to carry out this research are prism bar, pen torch and millimeter rule. The angle of strabismus was first measured using Krimsky method and repeated with Hirschberg method. The result of Hirschberg was converted to prism diopter for comparative analysis and results were tabulated. Statistical Analysis using T-test showed no statistical significance difference in the values of angle of strabismus measured with Krimsky and Hirschberg methods ($p<0.05$). Therefore, it is recommended that any of the methods can be used when measuring angle of strabismus.

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Introduction:-

Eyes are well aligned, so the foveal are aimed at the same visual target; this is termed as orthophoria [1-3]. Due to different factors, eyes are deviated from its normal position, alternatively termed as strabismus, squint or heterotropia. These terms come from the fact that strabismic patients often squint one eye to block out one of the two images that they see [4-7]. Therefore, strabismus, is a condition in which the eyes do not properly align with each other when looking at an object (NIH 2010). Strabismus is also a manifest deviation from the orthophoric position that cannot be overcome by the fusional reflex.The condition may be present occasionally or constantly. If present during a large part of childhood, it may result inamblyopiaor lazy eyes and loss ofdepth perception.

Risk factors includepremature birth,cerebral palsyand a family history of the condition. Types includeesotropia, where the eyes are crossed ("cross eyed");exotropia, where the eyes diverge ("lazy eyed" or "wall eyed"); andhypertropiaor hypotropia where they are vertically misaligned. They can also be classified by whether the problem is present in all directions a person looks (comitant) or varies by direction (incomitant). Diagnosis may be made by observing the light reflecting from the person's eyes and finding that it is not centered on thepupil[8]. This is known as the Hirschberg reflex.

Treatment depends on the type of strabismus and the underlying cause. This may include the use ofglassesand possiblysurgery. Some types benefit from early surgery. Strabismus occurs in about 2% of children [8].

Methodology:-

Study area
This study was done within Owerri municipal of Imo State.

Ethical clearance
A permission letter from the Head of Department of Optometry was obtained to enable me carry out the tests. Oral informed concept was also performed on each subject.

Research design
This study was a prospective study on the comparison of krimsky and Hirschberg method in the measurement of angle of strabismus.

Population of the study
The population of study comprised of young adults with strabismus of age ranging from 18-45 years residing in Owerri Municipal of Imo State.

Sample and sampling technique
A sample size of 21 strabismic subjects residing in Owerri municipal were chosen randomly for the purpose of the research. The sampling technique used for this research is the convenience sampling to avoid bias.

Exclusion criteria
Those excluded from this research were those not proven to have strabismus, those strabismic young subjects who could not cooperate in the procedure and those not within the age range 18-45.

Inclusion Criteria
Those included in this research are strabismic subjects aged 18 – 45 years.

Procedure for data collection
Oral interview was performed on each strabismus patient concerning the history of the development of strabismus, previous ocular or medical condition and any family related health abnormality.

Hirschberg test
This was performed by shining a light in the person'seyesand observing where the light reflects off thecorneas. In a person with normal ocular alignment the light reflex lies slightly nasal from the center of the cornea (approximately 11 prism diopters—or 0.5mm from the pupillary axis), as a result of the cornea acting as a temporally-turned convex mirror to the observer. Then the test, the light reflexes of both eyes are compared, and will be symmetrical in an individual with normal fixation. For an abnormal result, based on where the light lands on the cornea, the examiner can detect if there is anexotropia(abnormal eye is turned out),esotropia(abnormal eye is turned in),hypertropia(abnormal eye higher than the normal one) orhypotropia(abnormal eye is lower than the normal one). 1mm displacement of corneal reflex is equivalent to 7° of 15PD.
That is 1mm = 7° =15PD

2.Krimsky Test
The Krimskytest is essentially the Hirschberg test, but with prisms was employed to quantitate deviation of ocular misalignment by determining how much prism is required to centre the reflex, the Krimsky test is advisably used for patients with tropias, but not with phorias. The amount of prism that was able to bring alignment was recorded and multiplies with 7 to convert to degree of misalignment.

Statistical analysis
Statistical analysis was performed with T-test statistics.

Results:-

The table below shows the age distribution of study subjects. The age range of the subjects that participated in the study was 16 – 45 years with mean age of 30 years and standard deviation of 1.83. the age group of 40 – 45 years had the highest number of subjects representing 33.3%, followed by age group of 34 – 39 years with 23.8%, 28 – 33 years had 19.1%, 16 – 21 years with 14.3 and the least 22 – 27 years with 9.5%.

Table 1:- Age distribution of study subjects.

Age	Frequency	%Frequency
16 – 21	3	14.3
22 – 27	2	9.5
28 – 33	4	19.1
34 – 39	5	23.8
40 – 45	7	33.3
Total	21	100

The table below shows gender distribution of study subjects. A total of 12 males representing 57.1% participated in the study, while 9 females or 42.9% were used for the study.

Table 2:- Gender distribution of study subjects.

Gender	Frequency	%Frequency
Male	12	57.1
Female	9	42.9
Total	21	100

The table below shows the distribution of subjects based on the type of strabismus. 17 or 81% of subjects has exotropia, 3 or 14.2% of the subjects had esotropia while only one person had alternate strabismus representing 4.8%.

Table 3:- Distribution of subjects based on the type of strabismus.

Type	Frequency	%Frequency
Exotropia	17	81.0
Esotropia	3	14.2
Alternate	1	4.8
Total	21	100

The table below shows the distribution of mean results of Hirschberg test in PD with respect to age. Hirschberg recorded average mean values of 15PD with standard deviation of 1.45 and standard error of 1.89. Krimsky test recorded average mean value of 13.2PD with SD and SE of 1.87 and 1.25 respectively.

In various age groups, the mean difference between Hirschberg and Krimsky for age group of 16 – 21 years was 0.5PD with SD and SE of 0.35 and 0.25 respectively. Age group of 22 – 27 years had no mean PD difference with SD and SE, while 2.5PD with SD and SE of 2.48 and 1.75 were recorded respectively. Age group of 34 – 39 years had mean difference of 3.0PD with SD of 2.12 and SE of 1.50, and the last 40 – 45 years had mean value of 2.0PD with SD and SE of 1.41and 1.00 respectively.

Table 4:- Distribution of mean results of Hirschberg and Krimsky tests in prism diopter (PD) with respect to age.

Age	Mean Hirschberg(PD)	Mean Krimsky(PD)	SD	SE
16 – 21	10.5	10.0	0.3	0.25
22 – 27	6.0	6.0	0.00	0.00
28 –33	19.5	16.0	2.48	1.75
34 –39	21.0	18.0	2.12	1.50
40 – 45	18.0	16.0	1.41	1.00

Average mean	15.0	13.2
SD	1.45	1.87
SE	1.89	1.25

*PD = prismdiopter. mm=millimeter.

The table below shows the distribution of mean results of Hirschberg and Krimsky tests in prism diopter (PD) with respect to gender. The average mean values for Hirschberg and Krimsky tests obtained were 19.5PD and 16PD respectively giving SD of 2.47 and SE of 1.75. Females recorded 21PD and 18PD for Hirschberg and Krimsky tests with SD of 2.12 and SE of 1.50.

Table 5:- Distribution of mean results of Hirschberg and Krimsky tests in prism diopter (PD) with respect to gender.

Gender	Mean Hirschbeg(PD)	Mean Kirmsky(PD)		SD SE
Male	19.5	16.0		2.47 1.75
Female	21.0	18.0		2.12 1.50

The table below shows the distribution of mean results of Hirschberg and
Krimsky tests in prism diopter (PD) with respect to type of strabismus. Exotropia recorded the mean results for

Hirschberg and Krimsky as 16.5 PD and 16PD respectively with SD of 0.35 and SE of 0.25. Esotropia had 17.5PD and 18PD respectively with SD of 0.57 and SE of 0.40. Exotropia and esotropia had the same mean value of 0.5PD when measured with Hirschberg and Krimsky tests. No result was obtainable with both tests in alternate strabismus.

Table 6:- Distribution of mean results of Hirschberg and Krimsky tests in prism diopter (PD) with respect to type of strabismus

Type	Mean Hirschberg	Mean Krimsky	SD	SE
Exoptropia	16.5	16.0	0.35	0.25
Esotropia	17.5	18.0	0.57	0.40
Alternate	-	-	-	-

Discussion:-

In this prospective study, 21 strabismus patients within the age range of 16 to 45 years were tested in the clinic; their mean age of 30 years and standard deviation of 1.83. The age group with the highest number was 40 – 45 years representing 33.3% 34 – 39 years with 23.8%, 28 – 33 years age group had 19.1%, age group of16 – 21 years had 14.3 and the least 22 – 27 years with 9.5%. A total of 12 males representing 57.1% participated in the study, while 9 females or 42.9% were used for the study.

The distribution of subjects based on the type of strabismus showed that 17 of the subjects representing 81% had exotropia, 3 subjects or 14.2% had esotropia while only one person had alternate strabismus representing 4.8%.

The mean results of Hirschberg test in PD with respect to age showed that Hirschberg recorded average mean values of 15PD with standard deviation of 1.45 and standard error of 1.89, and Krimsky test recorded average mean value of 13.2PD with SD and SE of 1.87 and 1.25 respectively. In various age groups, the mean difference between Hirschberg and Krimsky for age group of 16 – 21 years was 0.5PD with SD and SE of 0.35 and 0.25 respectively. Age group of

22 – 27 years had no mean PD difference with SD and SE, while 2.5PD with
SD and SE of 2.48 and 1.75 were recorded respectively. Age group of 34 – 39 years had mean difference of 3.0PD with SD of 2.12 and SE of 1.50, and the last 40 – 45 years had mean value of 2.0PD with SD and SE of 1.41 and 1.00 respectively.

Statistical analysis showed no significant difference in the values measured with Hirschberg and Krimsky tests. In support of my findings no previous studies have been specific on the differences in their test values, however, Cho et al. [9] upon carrying out various tests for measuring angle of strabismus for surgery observed that both the Hirschberg and Krimsky tests require correction of angle kappa, which is largely subjective and, therefore, can lead to interobserver errors and they concluded that methods available for measuring the angle of ocular deviation include the alternate prism cover test (APCT), Hirschberg test, and Krimsky test. No previous studies or available literature have indicated the superiority of each of the two tests in measuring angle of strabismus [10].

My findings showed that age and gender did not have statistically significant effect on the difference in the results of Krimsky and Hirschberg methods in the measurement of angle of strabismus based on gender [11]. No previous study or available literature has on age and gender effect on the result of Hirschberg and Krimsky methods in the measurement of angle of strabismus.

Conclusion:-
There is no statistically significant difference in the values of angle of strabismus measured with Krimsky and Hirschberg methods.

Age and gender do not have any influence on the results of angle of strabismus measured through Hirschberg and Krimsky methods.

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