Comparing Nearpoint Up Gaze Measures with Far Gaze: Alternate Exotropia

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Abstract

Strabismus is a common problem encountered by eye and vision care professionals and alternating exotropia is a common diagnosis of patients with strabismus. When measuring the deviation it is often easier to elicit consistent near fixation than at distance, particularly with children and special populations. The purpose of this study was to investigate the existence of a correlation between far gaze measurements with 10° or 25° of upward gaze at near with alternating exotropia. The sample was a cross-sectional pilot study of 41 patients with a definite diagnosis of basic alternating exotropia, either intermittent or constant. The deviation was first measured at far gaze and then in an up gaze position with neck flexion of 10° and 25°, respectively. The outcome measures were correlations between exotropia measurements in far gaze and both the 10° and 25° upward near gaze measures. Measuring exotropia in upward gaze instead of far gaze offers the possibility of a more reliable method of measurement with children and noncooperative patients.

Mosallaei M, Attarzadeh A, Fattahi F, Farvardin M, Talebnejad MR, Attarzadeh A, Alipour A. Comparing Near Point Up Gaze Measures with Far Gaze: Alternate Exotropia J Behav Optom 2010;21:150-153.

Key Words

cover test neutralization, far gaze, intermittent exotropia, true gaze

INTRODUCTION

Comitant primary exotropia (XT) is either intermittent or constant.[1] The XT may also show a vertical incomitance that may vary from the primary position to either up-gaze and down-gaze ("A" or "V" pattern) or a horizontal incomitance in right and left gaze.[2,3] The measurement of ductions and versions often reveals inferior and/or superior oblique muscle dysfunctions. Measurements of all diagnostic gaze positions are typically recorded at distance, while at near only the primary position is generally recorded. The near measurement is necessary to differentiate various types of XT, including basic XT, true divergence excess and simulated divergence excess.[4,5]

Accurate measurement of the maximum exodeviation to document XT is critical if one is planning surgical management. The measure is obtained with prism neutralization and an alternate cover test.[6] Continued effort with a rapid but prolonged alternate cover test is usually conducted to disrupt both vergence and fusion. Control of accommodation at distance is necessary to insure a true measurement and patient cooperation is therefore required. The control of accommodation in children is an obstacle that affects the diagnosis and surgical correction.[6,7] In addition, the design of some examination rooms (length less than 6 meters) is not suitable to encourage attention at far. It is therefore reasonable to consider other ways to facilitate the control of accommodation in these patients. It is more convenient for children to gaze upward rather than to attend a far target. Far gaze is considered necessary to encourage the relaxation of accommodation. Blumenthal, based on observation, claimed that when looking downward one has a tendency to focus closer and the stimulation for convergence exists even without a specific visual target. Upward gaze therefore favors a tendency toward relaxation of the accommodative mechanism.[8] This fact generated the idea of using an upward rather than far gaze to overcome accommodation. To our knowledge, the present study is the first investigation on the existence of any correlation between measurements in the far gaze and at 10° or 25° of near upward gaze.

METHODS

This cross-sectional study included 41 patients with a definite diagnosis of either intermittant or constant alternate XT. The near deviation was always within 10 prism diopters of the distance deviation. Exclusion criteria were: amblyopia, noncooperative patients, a history of previous strabismus surgeries, presence of either vertical or horizontal incomitance, craniofacial or spinal problems. Diagnosis for inclusion was based on two measurements either by a resident or a professor employing an alternate prism cover test at 6 m. Deviations were measured twice in separate sessions to insure a proper diagnosis for inclusion in the study. The deviation was consistently measured first at far gaze and then at the near (76 cm) up gaze position with neck flexion of 10° and 25°, respectively. A Welch-Allyn Professional Penlight was used as the target and the alternate prism test was accomplished for a minimum of 1 minute to insure the disruption of fusion. A manual goniometer was used to measure proper neck flexion. The

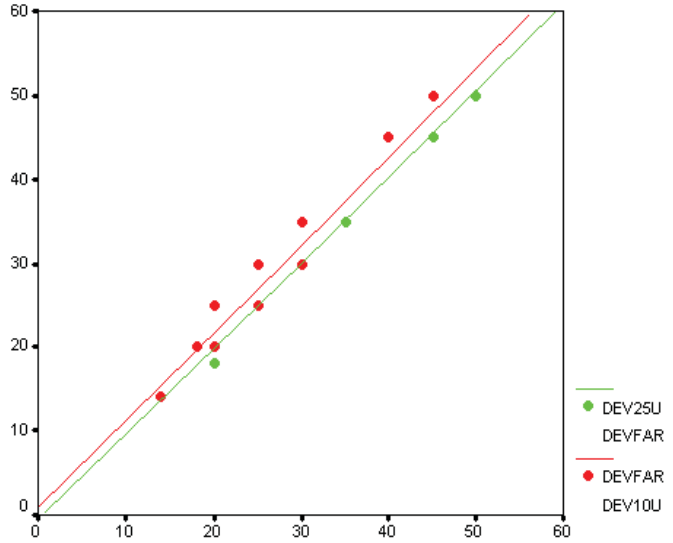

Figure 1. Scatter plot of the amount of XT at far against both 10 and 25 degrees of up gaze in intermittent deviation group and fit linear regression line (every marker may show several identical conditions)

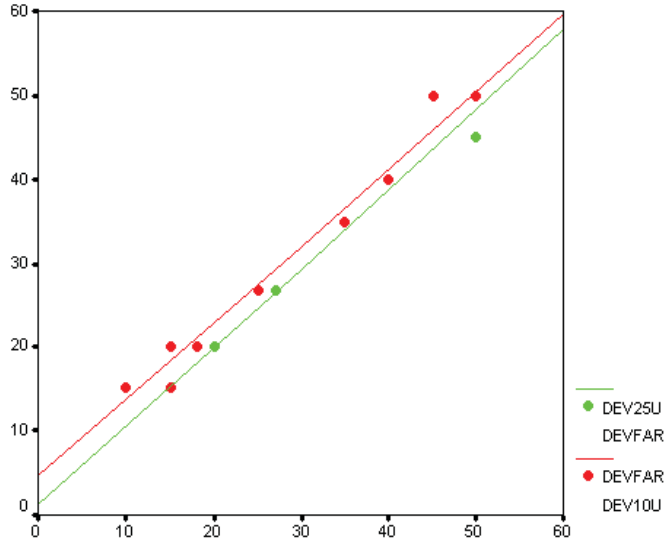

Figure 2. Scatter plot of the amount of XT at far against both 10 and 25 degrees of up gaze in constant deviation group and fit linear regression line (every marker may show several identical conditions

correlation between fixation measurements at far and then at both 10° and 25° of upward gaze at near were calculated.

Statistical Analysis

The data were statistically analyzed using a student t-test and either the Chi-Square or Fisher Exact test, where applicable. A pretest probability of p=/<.05 was accepted considering variance equality with the Leven test. Experimental results were presented as an arithmetic mean, with a plus or minus standard deviation (± SD) for age and for gender. Normality of parameters distribution was evaluated with a Kolmogrov-Smirnov test. Evaluation of validity between the amount of XT at far and 10° and 25° of up gaze were assessed with both indices and graphical approaches. Linear regression coefficients, linear regression (with intercept = 0 and regression coefficient = 1) and coefficient of variability were used to assess the variables.[9-12] In addition, Bland-Altman plots were created for the amount of XT at 10° and 25° of up gaze versus the amount of XT at far gaze.[12-14] SPSS software (Version 16) was used for analysis.

RESULTS

Table 1 contains the comparison of the intermittent and constant XT's by age and gender. Females were predominant in the intermittent group while males were more frequent with constant XT. (p=.005) Means and standard deviations for both the constant and intermittent XT's for the different measurement variables are found in Table 2. None of the measures were significantly different from one another. Partial correlations (controlling for gender) between the amount of XT at far and at 10° and 25° up gaze at near is found in Table 3 and Figures 1 & 2. The correlations are statistically the same. Linear regression models for assessment of validity between the amount of XT at far and 10° and 25° of up gaze at near for the two groups were also compared. (Table 4) This calculation indicated that the numerical variables between the regression of two lines were highly correlated. The one exception was the difference of intercepts with zero between the amount of XT at far and 10° at near in the constant XT subgroup and the whole sample. In the same manner, Bland and Altman plots demonstrated that the amounts of XT at far, 10° and 25° near up gaze were equivalent measures of the same parameter in both

Table 1. Characteristics of Subjects in Two Groups of Exotropia

	Intermittent XT (n=26)	Constant XT (n= 15)	P value
Age(Mean ± SD)	14.92 ± 7.99	16.27 ± 7	0.5911
Sex (Female/Male)	17/9	3/12	0.0052

[1]two sample t test
[2]chi-square test

Table 2. Exotropic Deviation in Patients with both Intermittant or Constant Type

The mean deviation in two groups in either gaze was not statistically different. Groups were matched in terms of amount of deviation.

Group Statistics					
	Type of deviation	N	Mean	Std. Deviation	P value
Far gaze	Intermittent	26	27.27	7.713	0.399
	Constant	15	30.47	13.109	
Near gaze	Intermittent	26	23.92	6.711	0.598
	Constant	15	26.40	14.396	
10° of upgaze	Intermittent	26	25.23	7.044	0.809
	Constant	15	26.23	13.779	
25° of upgaze	Intermittent	26	27.38	7.930	0.455
	Constant	15	30.13	12.631	
Down gaze	Intermittent	26	23.96	6.660	0.544
	Constant	15	26.40	14.396	

Table 3. Partial Correlations (Controlling for Gender) between the Amount of XT at Far and 10°, 25° of Up Gaze in Two Groups of Exotropia

	Group of exotropia	Amount of XT at 10° of up gaze	Amount of XT at 25° of up gaze
Amount of XT at far	Intermittent	0.937*	0.988*
	Constant	0.991*	0.997*
	All subjects	0.972*	0.993*

**PV < 0.0001*

Table 4. Relationship between Amount of XT at Far (Dependent Variable) with Amount of XT at 10°, 25° of Up Gaze (Independent Variables) in Simple Regression Models

Independent variables	Group of extropia	Constant coefficient (intercept)			Regression coefficient (slope)		
		B	SE	p value1	B	SE	p value2
Amount of XT at 10° of up gaze	Intermittent	0.884	1.73	0.614	1.046	0.066	0.46
	Constant	4.585	1.27	0.004	0.916	0.043	0.08
	All subjects	3.106	1.05	0.005	0.963	0.038	0.36
Amount of XT at 25° of up gaze	Intermittent	-0.165	0.565	0.772	1.008	0.019	0.2
	Constant	0.875	0.756	0.258	0.964	0.027	0.88
	All subjects	-0.669	0.871	0.456	1.033	0.027	0.6

1comparison with intercept=0

Table 5. Coefficients of Variability (Percent) between the Amount of XT at far and 10°, 25° of Up Gaze in Two Groups of Exotropia

	Group of extropia	Amount of XT at 10° of up gaze	Amount of XT at 25° of up gaze
Amount of XT at far	Intermittent	5.47	0.7
	Constant	8.97	0.2
	All subjects	6.64	0.63

the intermittent, the constant XT group and the entire sample. The relation bias of 10° up gaze was 2.15, whereas for 25° up gaze was .0488. The standard error for 10° up gaze was 2.28, whereas for the 25° of upward gaze was 1.161. Furthermore, coefficients of variability for the amount of XT at far and at 10° and 25° near up gaze of the two groups were calculated. (Table 5) These coefficients showed almost perfect agreement between the amount of XT at far and both the 10° and 25° up gaze.

Discussion

XT is a horizontal form of strabismus where there is a disruption of normal fusional control.[4,5,8] Measurements of the maximum exodeviation are necessary when documenting the XT or considering a surgical correction. This is obtained by alternate cover testing in far gaze to overcome any fusion and/or positive accommodation.[15] Alternating XT is classified as either intermittent or constant. XT was sub classified by Burian and colleagues as basic when near measurements were like the distance measurements; however, the standard introduced for basic type of XT was a near measurement within 10 prism diopters of the distance measurement.

Simulated or pseudo divergence excess was where the amount of deviation at distance is similar to the near deviation after one hour of ocular occlusion. The third of Burian's classifications was true divergence excess diagnosed when distance measurements always exceeded near deviation.[9,16,17]

Subclassification is mainly used when surgery is planned for intermittent XT. The true measurement of XT is a mainstay measure for both the differential diagnosis and planning surgery. Fusional vergence is considered as an obstacle. With pseudo divergence excess, one hour of occlusion disrupts fusional control and leads to equal amounts of near and distance deviation. Accordingly, Burian et al believed that these patients could be treated as those with a basic type of exotropia.[18] However, Kushner claimed that surgical management of basic intermittent exotropia should be associated with a surgical under correction.[19] Kushner's idea was that the patient would have a strong convergence or fusional mechanism holding the eyes straighter at near. He emphasized that, patients with exotropia often excessively accommodated and converged their eyes to decrease the angle of deviation. This fostered better fusion. Measurements should therefore be obtained with a target that demands an accurate accommodative response as well as prolonged alternate cover test.[4]

Indeed, control of accommodation is difficult when measuring strabismus, especially in children who usually refuse or do not have enough patience to hold their gaze on a far target.[15] Likewise, an uncooperative adult patient may lose attention on a far target. Strong fusional convergence may result in an error of measurement of the true angle of deviation.[8,19] One should measure a far gaze deviation while the patient looks toward a distant accommodative target. This helps the examiner measure the maximum deviation and reduces variability.[6,7]

Ten and 25° of upward gaze measures are usually used to find out A or V patterns. There are several previous studies on using extreme upward gaze and downward gaze over 25° for evaluation of exotropia, but multiple controversial results have been reported.[20-22] Procianoy et al discussed the prevalence of horizontal deviation pattern changes with measurements in extreme gazes. They concluded that measurements in extreme upward and downward gazes (25° of up or down gaze) might show an increase in deviation with a significant portion of patients.[23] Accordingly, we sought to compare those measurements in upward gaze with distance measurements. The goal was to detect the angle of deviation in children and uncooperative patients who were verified as basic XT's. We evaluated both intermittent and constant alternate XT's. The number of patients with intermittent XT exceeded the constant type as expected from prevalence data previously reported for this population.[1,2] Correlations between 10° and 25° of upward gaze and far gaze were evaluated using a multiple statistical formula.

Regardless of variability in methods of analysis used for the comparison of the measurements of far gaze and upward gaze, our data showed that there was an acceptable agreement between the mea-

surement of deviation in far gaze and both 10° and 25° upward gaze. Moreover 25° near upward gaze may be considered as a more reliable substitution for far gaze in uncooperative patients.

Conclusion

The measurement of basic XT in near up gaze instead of far gaze in alternate, constant or intermittent XT is a reliable method of measuring XT in children and non co-operative patients. The results of this study support this concept. Statistical analysis showed the correlation of these entities is high. Nevertheless, further studies in larger number of patients will be warranted to better verify this finding.

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Date accepted for publication:
September 28, 2010