Using Hyperopia Measurements to Predict Need for Surgery in Children with Accommodative Esotropia

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Abstract

Background: Esotropic strabismus is a condition in which the eyes are not properly aligned with each other. In children, uncorrected esotropia may result in permanent loss of vision due to amblyopia, a condition where the nonpreferred, crossing eye is suppressed. Early identification and treatment of esotropia in children is critical, as doing so may prevent permanent loss of vision.

Materials and Methods: This is a retrospective review of children between the ages of two and six years who were diagnosed with strabismus between the years of 2008-2010. 350 patient charts were reviewed, of which 238 were excluded due to diagnosis of pseudostrabismus, leaving 112 patients meeting study criteria. Data collected and analyzed included age, degree of hyperopia at initial presentation, misalignment measurements, surgery status, amblyopia treatment duration before surgery, and postsurgical hyperopia and alignment measurements.

Results: Our data suggests that children with strabismus who are four years old or younger have an increased risk of requiring surgery when compared to patients older than four years. The data also indicates that in children with strabismus for every 1.0 increase in hyperopia measurement the likelihood of the child needing surgery decreased by 30% in the right eye (p-value 0.007) and by 25% (p-value 0.019) in the left eye. This data indicates that children with strabismus and lesser degrees of hyperopia are less likely to respond to treatment and more likely to require surgery than children with strabismus who have greater degrees of hyperopia.

Introduction

Esotropia associated with hyperopia is a major cause of childhood strabismus, and few existing studies have attempted to demonstrate a correlation between levels of hyperopia and the need for corrective surgery esotropic patients.

Although some literature suggests children with hyperopia greater than +3.5 diopters may have a higher risk of developing accommodative esotropia, which can generally be controlled with prescription lenses, a great deal of uncertainty remains regarding this exact measurement. A gap in literature also seems to exist in the manner in which severity of hyperopia in esotropic children of this age group may or may not be used to predict the need for correctional surgery. Of the research we found, much of it took place in countries outside the United States, so our research will also attempt to fill this population gap.

Therefore, the goal of this study was to determine whether the initial level of hyperopia is a risk factor for further surgery in intermittent esotropia patients between the ages of 2 to 6 years.

Methods

Retrospective patient data was collected for children between the ages of 2-6 years who were diagnosed with strabismus between the years of 2008-2010. Data collected and analyzed included: age in months, initial vision at presentation, length of time patients diagnosed with amblyopia before surgery, amblyopia treatments and their length of use prior to surgery, preoperative degree of hyperopia and misalignment, most recent hyperopia and alignment measurements and time since surgery of most up to date measurements.

Of the 350 patient charts reviewed, 112 patients met the study criteria.

Odds ratios and 95% confidence intervals were estimated using logistic regression to ascertain associations between selective covariates and surgical status (right eye score, left eye score, age (>4 vs ≤ 4), astigmatism, amblyopia, anisometropia were assessed as covariates).

Results: Demographics

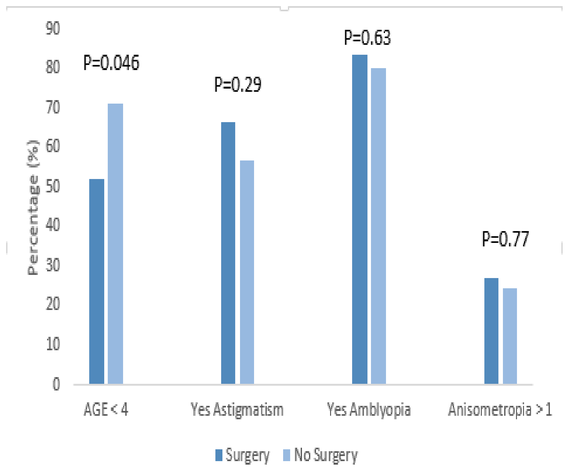

Figure 1. Demographic Characteristics
P-values Calculated using Fisher's Exact.

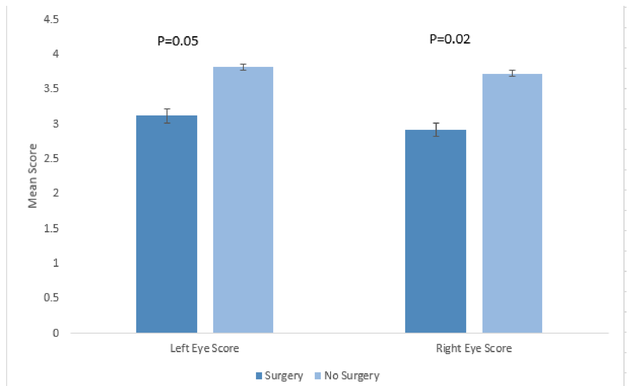

Figure 2. Left and Right Eye Scores
P-values Calculated using Wilcoxon Rank Sum .

Results: Logistic Regression

Variables	Model 1	p-value[1]	Model 2	p-value[2]	Model 3	p-value[3]
	OR (95%CI)[1]		OR (95%CI)[2]		OR (95%CI)[2]	
Right Eye Score	0.62 (0.32, 1.20)	0.16	0.70 (0.54, 0.91)	0.007	N/A	---
Left Eye Score	1.14 (0.61, 2.15)	0.67	N/A	---	0.75 (0.59, 0.96)	0.019
Age		0.036		0.034		0.035
>4	Referent		Referent		Referent	
≤ 4	2.61 (1.06, 6.41)		2.64 (1.07, 6.47)		2.60 (1.06, 6.35)	
Astigmatism		0.64		0.65		0.58
No	Referent		Referent		Referent	
Yes	0.80 (0.32, 1.98)		0.81 (0.33, 2.01)		0.78 (0.35, 1.92)	
Amblyopia		0.88		0.92		0.81
No	Referent		Referent		Referent	
Yes	0.92 (0.31, 2.71)		0.95 (0.32, 2.78)		0.88 (0.29, 2.56)	
Anisometropia		0.71		0.64		0.87
< 1	Referent		Referent		Referent	
≥1	0.82 (0.28, 2.36)		0.80 (0.30, 2.10)		1.08 (0.42, 2.80)	

Table 1. Ascertaining the association between selected covariates and Surgery.
[1]OR (95% CI) and p-values calculated using Multiple Logistic Regression adjusting for all other covariates.
[2]OR (95% CI) and p-values calculated using Multiple Logistic Regression excluding the Left eye score adjusting for all other covariates.
[3]OR (95% CI) and p-values calculated using Multiple Logistic Regression excluding the Right Eye Score adjusting for all other covariates.

Variables	Age > 4		Age ≤ 4	
	OR (95% CI)[1]	P-value[1]	OR (95% CI)[1]	P-Value[1]
RIGHT EYE				
Right Eye	0.66 (0.42, 1.03)	0.07	0.67 (0.47, 0.94)	0.022
Astigmatism		0.20		0.11
No	Referent		Referent	
Yes	2.84 (0.57, 14.3)		0.35 (0.09, 1.27)	
Amblyopia		0.04		0.19
No	Referent		Referent	
Yes	0.12 (0.02, 0.91)		2.53 (0.61, 10.4)	
Anisometropia		0.13		0.32
< 1	Referent		Referent	
≥1	3.70 (0.69, 19.8)		0.51 (0.14, 1.89)	
LEFT EYE				
Left Eye	0.68 (0.45, 1.06)	0.088	0.75 (0.55, 1.01)	0.066
Astigmatism		0.28		0.13
No	Referent		Referent	
Yes	2.41 (0.49, 11.9)		0.38 (0.11, 1.33)	
Amblyopia		0.037		0.24
No	Referent		Referent	
Yes	0.12 (0.01, 0.88)		2.27 (0.57, 9.01)	
Anisometropia		0.09		0.52
< 1	Referent		Referent	
≥1	4.31 (0.78, 19.4)		0.67 (0.19, 2.33)	

Table 2. Ascertaining the association between selected covariates and Surgery stratified by Age Categories.
[1]OR (95% CI) and p-values calculated using Multiple Logistic Regression adjusting for all other covariates stratified by age categories.

Variables	No Astigmatism		Astigmatism	
	OR (95% CI)[1]	P-value[1]	OR (95% CI)[1]	P-Value[1]
RIGHT EYE				
Right Eye	0.54 (0.36, 0.82)	0.004	0.89 (0.62, 1.29)	0.55
Age Categories		0.006		0.83
>4	Referent		Referent	
≤ 4	7.56 (1.8, 32.0)		1.15 (0.29, 4.44)	
Amblyopia		0.48		0.22
No	Referent		Referent	
Yes	1.59 (0.43, 5.86)		0.19 (0.01, 2.63)	
Anisometropia		0.67		0.59
< 1	Referent		Referent	
≥1	0.73 (0.17, 3.07)		1.45 (0.37, 5.64)	
LEFT EYE				
Left Eye	0.59 (0.41, 0.87)	0.008	0.94 (0.67, 1.32)	0.71
Age Categories		0.008		0.83
>4	Referent		Referent	
≤ 4	6.4 (1.61, 25.5)		1.15 (0.29, 4.56)	
Amblyopia		0.56		0.21
No	Referent		Referent	
Yes	1.46 (0.41, 5.2)		0.18 (0.01, 2.52)	
Anisometropia		0.75		0.55
< 1	Referent		Referent	
≥1	1.25 (0.30, 5.19)		1.50 (0.38, 5.78)	

Table 3. Ascertaining the association between selected covariates and Surgery stratified by Astigmatism status.
[1]OR (95% CI) and p-values calculated using Multiple Logistic Regression adjusting for all other covariates stratified by Astigmatism status.

Discussion and Conclusions

This small study indicates that patients between the ages of two and six years who have acquired esotropic strabismus are at increased risk of requiring corrective surgery as the measure of hyperopia decreases. The mean measures of hyperopia in our patient population were 3.4 diopters in the right eye and 3.5 diopters in the left eye. Patients who required corrective surgery had mean right and left eye measurements of 2.92 and 3.12 diopters, respectively, while measurements in the non-surgical group were 3.73 (right) and 3.82 (left) diopters. This difference was statistically significant (p-values 0.02 right eye and 0.05 left eye).

Age was also an important indicator for whether or not the patient required corrective surgery. The statistical analysis showed that patients who were four years of age or younger were nearly three times more likely to have surgery compared to patients older than four years. While this is what the data shows, the surgeon's preferences for surgery appropriate age and/or the duration of attempted pre-surgical treatment of the strabismus must be considered along with the data.

It should also be noted that when ascertaining the association between measurements of the degree of astigmatism, amblyopia and anisometropia and surgery, we did not find a statistically significant association.

Limitations

Several limitations existed in this study including a small sample size and the fact that this was a retrospective chart review.

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