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Review Article

The Incidence of Consecutive Exotropia Following Surgical Correction of Childhood Esotropia, and Associated Risk Factors in St John Eye Hospital

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Abstract

Background/Aims: Consecutive exotropia is a manifest that develops in a formerly esotropic patient either spontaneously or after optical or surgical treatment for esotropia. It has been reported in 3-29% of patients. Consecutive deviations are generally considered as complications of strabismus surgery. The purpose of this study is to determine the incidence of consecutive exotropia following successful surgical correction of childhood esotropia and identify factors associated with its development.

Methods: A descriptive, retrospective study was carried out through review of 117 cases (55 males, 62 females) having age variation from 1-18 years, who were operated on for congenital esotropia between March 2010 and November 2017 and had follow-up for a period of 3 years. Variables used were: age at surgery, patient sex, bilateral medial rectus recession, length of recession, degree of preoperative deviation, presence of inferior oblique over-action and post-op assessments.

Result: The Incidence of Consecutive Exotropia following surgical correction of childhood Esotropia was found to be 13.7 (16/117), which is correlated with previous studies. Among risk factors, the Length was the only significant factor that decreased the risk of developing consecutive Exotropia by 0.254 (P = 0.017). Age at surgery, Pre-operation Angle and Bilateral IO recession didn't show any association with the risk of developing consecutive Exotropia.

Conclusion: There was a statistical significance of consecutive exotropia development in patients in regard to length of medial rectus muscle recession, while age at surgery, gender, preop angle prism diopter and inferior oblique overaction had no role in affecting the occurrence of consecutive exotropia.

Keywords: Consecutive Exotropia; Infantile Esotropia; BMR

Introduction

Infantile esotropia is a form of ocular motility disorder presents as inward turning of one or both eyes which appears during the first six months of life [1]. Manifested by affecting muscle structure and physiology, retinal relations and neural integration phenomena, as well as the relation of the eyes with the environment [2]. Amblyopia develops in 30% of those affected. Timely surgery is effective in most cases [3].

Consecutive exotropia is a manifest that occurs in a formerly esotropic patient either spontaneously or after optical or surgical treatment for esotropia [4]. It has been reported in 3-29% of patients [5]. Risk factors responsible for the overcorrection of esotropia include presence of preoperative inferior oblique over-action, length of medial rectus recession, amblyopia, high hyperopia, and failure to recognise the patient and evaluate his condition preoperatively [6].

Understanding which factors are associated with Congenital esotropia at diagnosis and the relative importance of delayed diagnosis and treatment is important, because this clearly informs our understanding of the disease and helps us to enhance the development of professional and population-based interventions to estimate the risk of consecutive exotropia early on and to reduce the proportion of children may show this kind of post-operative complication.

The aim of this study is to measure the incidence and analyse risk factors of consecutive exotropia, through studying the cases of infantile esotropia that were treated in the Pediatric Ophthalmology and Strabismus Service of St John Eye Hospital in Jerusalem between March 2010 and November 2017.

This study is the first of its kind done in Palestine to establish the incidence and risk factors of consecutive exotropia.

Materials and Methods

Data used in this study was gathered from St John Eye Hospital in Jerusalem, which is considered the only specialized referral hospital in Ophthalmology in Palestine, as it has 49 beds.

With the aim to find the incidence of consecutive exotropia following surgical correction of infantile esotropia, this descriptive retrospective cross-sectional study was performed on sample of 104 patients (55 males and 62 females) having age variation from 1–18 years. this study was conducted by reviewing the medical record of the patients who underwent esotropia correction surgery between March 2010 to November 2017, and had follow-up for a period of 3 years.

Subjects enrolled in this study were male and female Palestinian patients with age ranges of 1-18 years, with minimum follow up period of 3 years. Cases related other kinds of esotropia other than infantile esotropia or patient who are older than 18 years were not included in the study.

A data abstraction sheet (Annex 1) was constructed by the researchers based on national standards, which included essential variables in the files of all infantile esotropia patients, which includes: Demographic information, age at the time of diagnosis, gender, findings at diagnosis and date of surgery.

The only dependent variable in this study was postoperative assessment, while independent variables included gender, age at date of surgery, presence of preoperative inferior oblique over-action, length of medial rectus recession (<6mm or >= 6mm), bilateral inferior oblique recession and degree of preoperative deviation

The analysis was done using SPSS (version 21.0). Frequency tables were computed to describe the continuous variables. Chi square test, t- test, ANOVA tests were used to compare between different groups. A P-value of <0.05 was considered to be significant.

The privacy of the information of the patients was taken into account, and the information was kept confidential.

Institutional Review Board (IRB) and the institution's approval were obtained to preserve the ethical aspect of the study. A consent form was not needed for this study as the gathering of the data was retrospective.

Results

These results represent the outcomes of analyzing data abstraction sheet for a total 117 patients (55= males, 62= females) and determining the relation and correlation of each variable with the risk of developing consecutive exotropia.

The incidence of consecutive exotropia following surgical correction of infantile esotropia was found to be 13.7%,

Table 1 compares between consecutive exotropia and residual esotropia in relation to gender. As in males, 85.5% developed residual esotropia and 14.5% developed consecutive exotropia, while in females, 87.1% developed residual esotropia and 12.9% developed consecutive exotropia. However, Testing the significance of these differences using the Chi-Square Tests yielded that the differences between males and females are statistically insignificant at all with consecutive exotropia and residual esotropia (P values = 0.796).

Residual Eso / Consecutive Exo			EXTROPIA		Total
Gender	Male	Count	47	8	55
		% within Gender	85.5%	14.5%	100.0%
		% within EXTROPIA	46.5%	50.0%	47.0%
	Female	Count	54	8	62
		% within Gender	87.1%	12.9%	100.0%
		% within EXTROPIA	53.5%	50.0%	53.0%

Total	Count	101	16	117
% within Gender	86.3%	13.7%	100.0%	
% within EXTROPIA	100.0%	100.0%	100.0%	

Table 1: Crosstabulation between Gender and Exotropia.

Table 2 presents the crosstabulation between consecutive exotropia and several conditions, such as bilateral inferior oblique overaction, Lt Brown's syndrome and Right Brown syndrome. But the main focus was on bilateral inferior oblique overaction (BIOOA). As 9.1% of patients with BIOOA developed consecutive exotropia, while 14.7% of other conditions developed consecutive exotropia. However, Testing the significance of these differences using the Chi-Square Tests yielded that the differences between BIOOA and other conditions are statistically insignificant with consecutive exotropia (P values = 0.487).

Residual Eso / Consecutive Exo			EXTROPIA		Total
Association 1	OTHER	Count	81	14	95
		% within assoiation 1	85.3%	14.7%	100.0%
		% within EXTROPIA	80.2%	87.5%	81.2%
	BIOOA	Count	20	2	22
		% within assoiation 1	90.9%	9.1%	100.0%
		% within EXTROPIA	19.8%	12.5%	18.8%
Total		Count	101	16	117
% within assoiation 1		86.3%	13.7%	100.0%	
% within EXTROPIA		100.0%	100.0%	100.0%	

Table 2: Crosstabulation between variable conditions and exotropia.

Table 3 shows crosstabulation between bilateral inferior oblique recession with postoperative assessment in relation to consecutive exotropia and residual esotropia. As 90.5% of patients who underwent Bilateral IO recession developed residual esotropia, while 9.5% developed consecutive exotropia. And in patients who didn't undergo Bilateral IO recession, 85.4% developed residual esotropia, while 14.6% developed consecutive exotropia. Testing the significance of these differences using the Chi-Square Tests yielded that the differences between bilateral inferior oblique recession with postoperative assessment are statistically insignificant (P values = 0.541).

Consecutive Exo / Residual Eso			Postop. Assessment		Total
Bilateral IO recession	No	Count	14	82	96
		% within Bilateral IO recession	14.6%	85.4%	100.0%
		% within Postop. Assessment	87.5%	81.2%	82.1%
	Yes	Count	2	19	21
		% within Bilateral IO recession	9.5%	90.5%	100.0%
		% within Postop. Assessment	12.5%	18.8%	17.9%
Total		Count	16	101	117
% within Bilateral IO recession		13.7%	86.3%	100.0%	
% within Postop. Assessment		100.0%	100.0%	100.0%	

Table 3: Crosstabulation between Bilateral IO recession and Postop. Assessment.

Table 4 presents the correlation and the significance between several variables, such as gender, age, length, Bilateral Inferior oblique overaction, Bilateral IO recession, Preoperative angle PDs and Exotropia. As the table shows, there is no association between any of the variables except for 4 correlations. First correlation was found between Bilateral Inferior oblique overaction and Bilateral Inferior oblique recession, as p value = 0. Second correlation was found Preoperative angle prism diopters and length of the recession as p value = 0.031. Third correlation was found between length of the recession and consecutive exotropia, as p value = .013.

Table 5 presents the significance between each variable in relation to consecutive exotropia, as it shows that the only variable that affects the risk of consecutive exotropia is length, as it is statistically significant as p value= .017.

			Gender	Age at Sx	BIOOA	LENGTH mm	Bilateral IO recession	Preop. angle PDs	Exotropia
Kendall's tau_b	Gender	Correlation Coefficient	1	0.02	-0.029	-0.07	-0.05	0.14	-0.024
		Sig. (2-tailed)	.	0.804	0.756	0.407	0.588	0.088	0.797
		N	117	117	117	116	117	115	117
	Age at Sx	Correlation Coefficient	0.02	1	0.082	-0.016	0.071	0.13	-0.112
		Sig. (2-tailed)	0.804	.	0.309	0.825	0.374	0.066	0.162
		N	117	117	117	116	117	115	117
	BIOOA	Correlation Coefficient	-0.029	0.082	1	0.069	.972**	0.119	-0.064
		Sig. (2-tailed)	0.756	0.309	.	0.413	0	0.149	0.489
		N	117	117	117	116	117	115	117
	LENGTH mm	Correlation Coefficient	-0.07	-0.016	0.069	1	0.102	.161*	-.209*
		Sig. (2-tailed)	0.407	0.825	0.413	.	0.226	0.031	0.013
		N	116	116	116	116	116	114	116
	Bilateral IO recession	Correlation Coefficient	-0.05	0.071	.972**	0.102	1	0.104	-0.057
		Sig. (2-tailed)	0.588	0.374	0	0.226	.	0.206	0.543
		N	117	117	117	116	117	115	117
	Preop. angle PDs	Correlation Coefficient	0.14	0.13	0.119	.161*	0.104	1	-0.035
		Sig. (2-tailed)	0.088	0.066	0.149	0.031	0.206	.	0.667
		N	115	115	115	114	115	115	115
	EXTROPIA	Correlation Coefficient	-0.024	-0.112	-0.064	-.209*	-0.057	-0.035	1
		Sig. (2-tailed)	0.797	0.162	0.489	0.013	0.543	0.667	.
		N	117	117	117	116	117	115	117

Table 4: Correlation between several variables: gender, age, length, BIOOA, Bilateral IO recession, Preop. angle PDs and Exotropia.

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1a	Gender	-.404	.650	.387	1	.534	.667	.187	2.388
	Age at Sx	-.400	.219	3.350	1	.067	.670	.436	1.029
	assoiation 1	-.613	2.062	.088	1	.766	.542	.010	30.870
	LENGTH mm	-1.371	.575	5.689	1	.017	.254	.082	.783
	Bilateral IO recession	1.132	2.126	.284	1	.594	3.102	.048	200.088
	Preop. angle PDs	.003	.025	.017	1	.895	1.003	.956	1.053
	Constant	8.045	3.572	5.074	1	.024	3118.683		

Table 5: The significance between each variable in relation to consecutive exotropia.

Discussion and Conclusion

This study was conducted to determine the incidence and the risk factors of consecutive exotropia following initial successful surgical alignment of childhood esotropia in a patient who had undergone Bilateral medial rectus muscle recession surgery.

The incidence of consecutive exotropia following surgical correction of infantile esotropia was found to be 13.7%, which is correlated with previous studies, as it has been reported to be 3-29% [7,8].

Several risk factors for consecutive exotropia caused by surgical correction have been proposed and discussed in different previous studies. This study allowed highlighting some of them, such as the gender and age of the patients, length of medial rectus muscle recession, bilateral Inferior oblique overaction, bilateral inferior oblique recession and preoperative angle prism diopter.

The difference between incidences of developing consecutive exotropia in males and females is noted. But, after measuring the statistical significance of this variance using the Chi- square test we conclude that no statistical significance is present in regard to gender.

In this study, the amount of BMR was significantly correlated to the incidence of consecutive exotropia. As it is shown that the large recession of the medial rectus muscle (≥6mm) increases the risk of developing consecutive exotropia, as other studies have illustrated. Like, Qianwen Gong found that the length of the recession affects the incidence of limitation of adduction and medial muscle slippage which leads to consecutive exotropia [9]. And R Beneish found that adduction deficit leads to limitation of the convergence ability which plays a role in progressive evolution towards exotropia [5]. While Demer found that small BMR recession might play a role is medial rectus slippage and limited adduction [10].

In another study, Ganesh., *et al*. found that children who underwent multiple surgeries and who had medial rectus recession more than 6 mm, had higher tendency of developing consecutive exotropia.

Qianwen Gong proposed that postoperative oblique overaction is affects the long-term alignment and may even accelerate the development of misalignment, that leads to exotropia [9]. However, another study made by Young Han., *et al*. showed that there is no statistically significance between inferior oblique overaction and consecutive exotropia [11], which is similar to the result of our research.

Other study by Hande Taylan Sekeroglu, showed that patients who has a concomitant neurological disease, such as cerebral palsy, epilepsy, and mental retardation, had significant higher risk of developing consecutive exotropia following esotropia surgery [12]. Postoperative outcome was significantly affected by patient's neurological impairment. However, our study had couldn't test the relation between neurological disease and consecutive exotropia, because there was no long-term follow-up of the patients.

In conclusion, this study coincides with almost all articles that the incidence of consecutive exotropia showed gradual increase with time after surgery, which points out to the necessity of considering the long-term follow up of consecutive exotropia development after surgery.

There was a statistical significance of consecutive exotropia development in patients in regard to length of medial rectus muscle recession, while age at surgery, gender, preop angle prism diopter and inferior oblique overaction had no role in affecting the occurrence of consecutive exotropia.

The limitations of this study were that it is a retrospective study, with a small sample size and short term follow up period.

Consecutive exotropia is a type of strabismus in which there is an outward deviation of the eye. It occurs in patients with previous esotropia in that eye either spontaneously [8] or after surgical interference to treat an existing esotropia. The prevalence has been reported to be between 4% and 27% [4]. Infantile esotropia, also known as congenital esotropia, is an inward turning of one or both eyes which begins at birth or during the first year of life. Its cause is unknown and it is usually treated with strabismus surgery. Many factors have been suggested that could influence the surgical treatment of infantile esotropia and which could possibly result in consecutive exotropia. Some of these factors are: general health of the patient, history of multiple eye surgeries, age at onset of esotropia, duration of esotropia till surgery, age at surgery, presence of hypertropia, amblyopia, refractive index, amount of bilateral medial rectus recession, type of surgery (symmetrical or asymmetri-

cal), degree of preoperative deviation (at near and at distance) and presence of inferior oblique over-action.

Because of the high prevalence of consecutive exotropia and the fact that it usually occurs as a complication of strabismus eye surgery, it is very important to address this problem and try to find the factors that play a role in its occurrence after eye surgery. Several articles relevant to this topic have been published that study each of these possible risk factors; therefore we will mention and discuss some of them and their results about the relevance of the risk factors to the development of consecutive exotropia.

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