ORIGINAL ARTICLE

Surgical Outcomes for Intermittent Exotropia in a Tertiary Hospital in Manila, Philippines

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ABSTRACT

Background. Spontaneous resolution is infrequent, and surgery remains the mainstay for management of intermittent exotropia [X(T)]. Commonly performed procedures to address the exodeviation are (1) bilateral lateral rectus muscle recessions (BLR), (2) unilateral lateral rectus recession with medial rectus resection (monocular R&R), and three- or four-muscle surgery. Despite the different surgical options available, there is still debate as to the most effective surgical treatment for X(T).

Objective. We are interested in describing the outcomes of various strabismus surgeries for X(T) from a local tertiary hospital perspective in the Philippines.

Methods. This is a single-center retrospective chart review study conducted at the Department of Ophthalmology and Visual Sciences of the Philippine General Hospital.

Results. A total of 25 patients were included in the study, with ages ranging from 4 to 49 years, averaging 5 ± 7.5 years at deviation onset in a predominantly female population (n = 17, 68%). Basic exotropia was the most common type (n = 23, 92%). Surgical outcomes were success (n = 15, 60 %), recurrence (n = 9, 36%), and overcorrection (n = 1, 4%). The most commonly performed procedure was unilateral medial rectus resection-lateral rectus recession (monocular R & R) (n = 11, 44%). Generally, the choice of procedure did not influence success (p-value = 0.968).

Conclusion. In summary, our study demonstrated that surgical interventions for X(T), primarily lateral rectus muscle recessions and medial rectus muscle resections, showed variable success rates, with recurrences observable beginning at 3 months post-operatively. The study acknowledged limitations, particularly a small sample size and challenges with follow-up, cautioning against overgeneralizing results. Despite these limitations, the research contributes to understanding local trends in X(T) surgical outcomes.

Keywords: intermittent exotropia, strabismus, basic exotropia, monocular resection and recession, bilateral medial recession

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INTRODUCTION

Intermittent exotropia [X(T)], characterized by intermittent outward deviation of either eye, remains the most prevalent exodeviation, especially in Asians, with approximately 2% prevalence before the age of 3.[1,2] Spontaneous resolution is uncommon, thereby making surgery the mainstay for definitive management of these cases. Treatment may also involve use of over-minus spectacles and patching.[2] Commonly performed procedures to address exotropia are (1) bilateral lateral rectus muscle recessions (BLR), (2) unilateral lateral rectus recession with medial rectus resection (monocular R&R), three-muscle surgery which includes resection or recession of three muscles, and lastly, four-muscle

surgery usually performed for larger angle exodeviations. With the different surgical options feasible in these cases, there is still debate as to the most effective surgical treatment for X(T). This is because surgical success is largely dependent on the surgeon's preferences and skills, on patient ethnicity, variable classifications of X(T), control of X(T), and surgical doses.

Surgical treatment of X(T) varies depending on its types.[2] Historically, the types of exotropia are basic exotropia, true and pseudo-divergence excess, and convergence insufficiency. Burian proposed a classification system for X(T) that is based on measurements of the deviations at distance and near, as well as its underlying fusional convergence and divergence mechanisms.[3] Basic exotropia (XT) is diagnosed when the distance deviation is within 10 prism diopters (PD) of the near deviation. Divergence excess occurs when the distance deviation exceeds the near deviation by 10 prism diopters or greater. Convergence insufficiency is seen when the near deviation is 10 prism diopters greater than the distance deviation. Pseudo-divergence excess occurs when the distance deviation is greater than near deviation initially, but near deviation increases to within 10 prism diopters of distance deviation after prolonged monocular occlusion, sometimes as short as 30-60 seconds but can be longer.[2]

BLR and monocular R&R are the most common procedures done for the basic type X(T). BLR rather than monocular R&R is favored in divergence excess and pseudo-divergence excess patterns because of the higher overcorrection rate for monocular R&R in these types of cases.[2,3] For convergence insufficiency, a variety of surgical procedures may be performed, such as monocular R&R and bilateral medial rectus resections (BMRs) with or without adjustable sutures and medial rectus plication.[2] The success rates varied widely and ranged from 18% to 92%. Given the different surgical techniques depending on the type of exotropia, reports on surgical outcomes widely vary in different countries. In this research, therefore, the authors wanted to demonstrate the outcomes of various strabismus surgeries for X(T) from a local tertiary hospital perspective in the Philippines.

METHODS

This is a single-center retrospective chart review conducted at the Department of Ophthalmology and Visual Sciences, University of the Philippines - Philippine General Hospital. The study was approved by the Institutional Research Ethics Board of the same institution prior to the conduct of the review. It included all patients who underwent surgical correction for X(T) in a span of 5 years (1 January 2015 to 15 March 2020), with at least 6 weeks of follow-up. Patients with co-existing co-morbidities and syndromes associated with the X(T) were also included. Total sampling was performed. The hospital charts of 25 patients operated on for X(T) were retrieved, with 23 patients satisfying the inclusion criteria. One patient was excluded due to lost medical records. Patients diagnosed as "intermittent exotropia or X(T)" alone were further classified into their respective subtypes (i.e., basic, or pseudo-divergence excess, convergence insufficiency, and divergence excess), based on the data gathered from the chart. The primary outcome investigated was the effect of surgery on the X(T), where the angles of deviation pre-operatively and post-operatively at day 1, 6 weeks, 3 months, 6 months, one year, and the subsequent year/s post-operatively were collected as far as available. Data such as age at deviation onset, age at surgery, interval between deviation onset and surgery, pre-operative deviation at distance and near in prism diopters, type of X(T), and presence of associated strabismus were determined. The outcomes obtained at the latest follow-up time interval were classified as follows:

1. **Success:** defined as distance alignment in primary position, within ±8 prism diopters of orthotropia, with appropriate refractive correction.
2. **Recurrence:** defined as a final alignment of 9 or more prism diopters of exotropia. Patients who underwent reoperation for a recurrent exodeviation were automatically counted as a recurrence.
3. **Overcorrection:** defined as 9 or more prism diopters of esotropia.

Statistical Considerations

The clinicodemographic profile and outcomes of the patients included were summarized by descriptive statistics. Numerical variables such as pre-operative deviation and post-operative deviation at last known follow-up were described as median and interquartile range. Categorical variables such as age group, sex, etiology, and type of intermittent exotropia, associated strabismus, and treatment outcomes were described as frequency and percentages. The association of time from deviation onset to surgery, pre-operative deviation at distance and at near, and surgical treatment with successful alignment were determined by Cox multivariate survival analysis for numerical variables, and chi-square test of association for categorical variables. Kaplan-Meier curves were also constructed to visualize the difference in the post-operative success survival curves between the two surgical techniques.

RESULTS

A total of 25 patients were included in the study, with ages ranging from 4 to 49, and an average age of 5 ± 7.5 years at deviation onset. The sample population was predominantly female (n = 17, 68%). A diagnosis of basic exotropia was the most common (n = 23, 92%); one subject had convergence insufficiency exotropia, and another one had true divergence excess exotropia. The demographic characteristics are shown in Table 1.

Table 2 shows the surgical outcomes where 15 patients (60 %) had a successful outcome, 9 patients (36%) had recurrence, and 1 patient (4%) had overcorrection at the

Table 1. Demographics of Patients with Intermittent Exotropia Necessitating Surgical Correction

Demographic/Ocular Characteristic	Statistic
Age at surgery (years)	
Mean (SD)	15.4 (11.93)
Median (Minimum, Maximum)	12 (4, 49)
Mode	7
Age at deviation onset (years)	
Mean (SD)	5.2 (7.53)
Median (Minimum, Maximum)	3 (0, 28)
Mode	5
Age at surgery	
<6 months	0 (0%)
6 months – 2 years	0 (0%)
2 - 10 years	11 (47%)
10 - 18 years	6 (26%)
19 - 50 years	6 (26%)
Age of deviation onset	
<6 months	4 (17.39%)
6 months – 2 years	7 (30.43%)
2 – 10 years	9 (43.47%)
11 – 18 years	0 (0%)
19 – 50 years	3 (13.04%)
Duration of deviation (months)	
Mean (SD)	77.9 (136.54)
Median (Minimum, Maximum)	36 (1, 625)
Mode	60
Sex	
Female	17 (68%)
Male	8 (32%)
Diagnosis / Etiology of Exotropia	
Basic exotropia	23 (92%)
Convergence insufficiency exotropia	1 (4%)
True Divergence Excess exotropia	1 (4%)
Pseudo-Divergence Excess exotropia	0 (0%)
Surgery Performed	
Bilateral lateral rectus recession (BLR)	4 (16%)
Monocular R and R (MRR)	11 (16%)
Three muscle surgery (BLR recession, unilateral MR resection)	9 (32%)
Four-muscle surgery (BLR recession, BMR resection)	1 (4%)
Surgeon	
Resident	8 (32%)
Fellow	15 (60%)
Consultant	2 (8%)
Pre-operative deviation at distance (prism diopters)	
Mean (SD)	49.3 (10.87)
Median (Minimum, Maximum)	45 (35, 80)
Mode	45
Pre-operative deviation at near (prism diopters)	
Mean (SD)	48.3 (12.42)
Median (Minimum, Maximum)	45 (25, 80)
Mode	45
Associated strabismus	
None	15 (45%)
Bilateral superior oblique overaction	2 (6%)
Bilateral inferior oblique overaction	4 (12%)
Dissociated vertical deviation	5 (15%)
V-pattern strabismus	3 (9%)
A-pattern strabismus	2 (6%)
X-pattern strabismus	2 (6%)

latest documented clinic visit. With regard to the surgical procedure done, 6 (24%) patients underwent bilateral lateral rectus recessions, 11 (44%) unilateral medial rectus resection-lateral rectus recession (monocular R & R), and 8 (32%) underwent three-muscle surgery. Generally, the choice of procedure did not influence success (p-value = 0.968). Comparison of the frequencies of their surgical outcomes resulted in no statistically significant difference. The experience level of the surgeon resulted in different surgical outcome distributions: 100% success for consultants, 50% success and 50% recurrence for residents, and 60% success, 33% recurrence, 17% overcorrection for fellows. However, there was insufficient evidence to conclude a statistically significant difference. Similarly, there was insufficient evidence to indicate significant differences in outcome distribution based on sex or associated strabismus. Mean pre-operative deviation, both at distance and at near, was similar (within 5 PD) for patients with a successful outcome and patients with recurrence, and no significant difference was found between the outcomes. The mean age for patients with a successful outcome or overcorrection was lower compared to the patients with recurrence; however, the differences were not found to be significant.

The results of the univariate analyses were further confirmed by the Cox multivariate survival analysis in Table 3. Of the pre-operative variables investigated, none was found to be significantly associated with surgical outcome.

For the three procedures under consideration, it was observed that the likelihood of success reached 100% within the initial three months (Figures 1 to 3). Subsequently, however, recurrence became apparent. Bilateral lateral rectus recession (BLR) exhibited a stabilization of outcomes following the initial three-month period (Figure 1), while both monocular R&R and the three-muscle surgery demonstrated a decline, resulting in a 60% success rate after the same timeframe (Figures 2 and 3). Despite the declining trends observed in the success rates of the three procedures, it is noteworthy that no statistically significant correlation was identified.

DISCUSSION

Intermittent exotropia is reported as the most common type of manifest exodeviation. It usually occurs before 5 years of age and is more prevalent in females.[2] This study agrees with these observations, with a higher number of X(T) patients being less than 5 years of age and predominantly female (n = 17, 68%). The deviation usually manifests during periods of visual inattention, fatigue, stress, or illness.[4] Both conservative management and surgery can be used to address X(T). The etiology of X(T) remains unknown.[5] However, there are multiple theories suggested, such as defective fusion, mechanical and innervational factors, abnormal accommodative convergence to accommodation (AC/A) ratio, and even genetics.[6] Uncorrected refractive errors are

Table 2. Surgical Outcomes by Category

Category	Success (±8 PD XT)	Recurrence (≥9 PD XT)	Overcorrection (≥9 PD ET)	*p*-value
Age, mean (SD)	13.6 (9.54)	19.1 (15.52)	9 (NA)	0.6601
Surgery Performed, n (%)				0.4225
Bilateral lateral rectus recession (N = 6)	4 (66.7%)	1 (16.7%)	1 (16.7%)	
Monocular R and R (N = 11)	6 (55.0%)	5 (45.0%)	-	
Three muscle surgery (N = 8)	5 (62.5%)	3 (37.5%)	-	
Surgeon, n (%)				
Resident (N = 8)	4 (50.0%)	4 (50.0%)	-	0.7428
Fellow (N = 15)	9 (60.0%)	5 (33.3%)	1 (6.7%)	
Consultant (N = 2)	2 (100.0%)	-	-	
Sex				0.2352
Female (N = 17)	8 (47.1%)	8 (47.1%)	1 (5.8%)	
Male (N = 8)	7 (87.5%)	1 (12.5%)	-	
Associated Strabismus				0.2816
None (N = 15)	7 (46.7%)	7 (46.7%)	1 (6.7%)	
Yes (N = 18)	14 (80.0%)	4 (20.0%)	-	
Pre-operative deviation at distance, mean (SD)	46.9 (6.82)	50.0 (11.99)	80 (NA)	0.1683
Pre-operative deviation at near, mean (SD)	45.9 (9.13)	48.9 (13.41)	80 (NA)	0.2304

NA: Not applicable

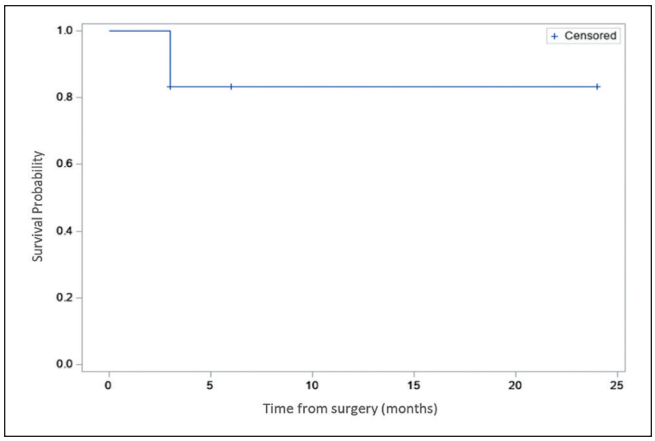

Figure 1. ***Bilateral lateral rectus recession:*** Survival curves as a function of time after surgery.

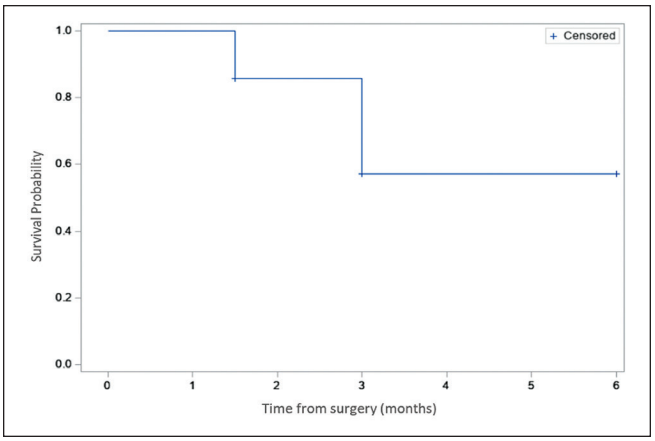

Figure 2. ***Monocular R & R:*** Survival curves as a function of time after surgery.

Table 3. Cox Multivariate Survival Analysis

Variable	*p*-value
Global test (model)	0.7988
Associated Strabismus	1.0000
Sex	0.9964
Age	1.0000
Pre-operative deviation at distance	1.0000
Pre-operative deviation at near	1.0000
Surgery Performed	1.0000
Surgeon	1.0000

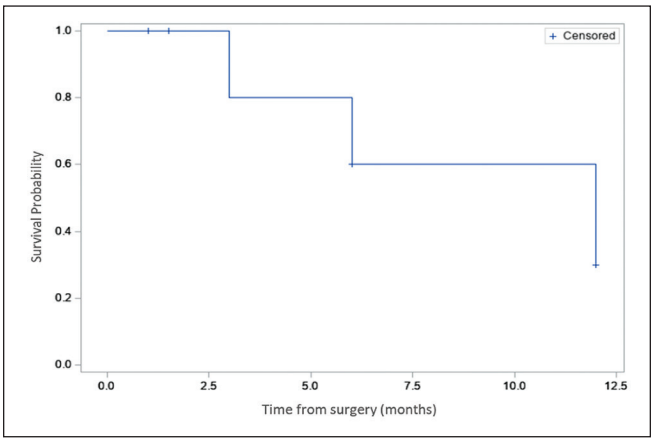

Figure 3. ***Three-muscle surgery:*** Survival curves as a function of time after surgery.

also theorized to cause constant under-stimulation of convergence, leading to the development of an exodeviation.[6]

The management of X(T) varies from observation, nonsurgical and surgical interventions with the goal of restoring alignment and preserving binocular function. The choice mainly depends on the extent and control of the deviation. Nonsurgical management includes correction of refractive errors, over-minus lenses, patching or occlusion of the nondeviating eye, and prism therapy using base-in prisms.[6] In terms of timing of surgery, it was observed in our study that the majority of patients were operated on at a mean age of 5 years. Optimal time for surgery in patients with X(T) is when the patient is cooperative enough for a complete ophthalmologic assessment.[7] The mean time of 5 years in our study was the period in which nonsurgical options have been maximized prior to doing surgery. In cases where X(T) worsens even after nonsurgical intervention has been optimized, surgery was recommended.

This study serves to create a general picture of the outcomes of strabismus surgeries done for X(T) in a large tertiary hospital in the Philippines. There is no single guideline that recommends a definitive surgical technique for X(T) patients.[7] This is precisely because of the various factors and considerations for the technique of choice. Nonetheless, all surgeries aim to restore single binocular vision.[7] There were some recommendations per a particular type of exotropia, namely BLR and monocular R&R for the basic type, BLR for true and pseudo-divergence types, and BMR resection for convergence insufficiency.[2] In our study, a similar pattern was observable where BLR (n = 11, 51%) and monocular R&R (n = 10, 47%) comprised the surgical census for basic exotropia surgeries. There was only one convergence insufficiency reported where a BMR resection was performed, and one true divergence excess where BLR recession was done.

Similar published studies aimed to compare the outcomes between surgeries statistically. In a multi-center randomized clinical trial done by the Pediatric Eye Disease Investigator Group, which involved children with intermittent exotropia aged 3-10 years old, the difference in surgical success between monocular R&R (63%) and BLR recession (54%) was not significant. Jin and Choi evaluated surgical outcomes of two muscle surgeries (BLR or monocular R&R) for children with moderate (20-30 PD) and large (>40 PD) angle X(T).[8] Success rate was defined as alignment between 10 prism diopters of exodeviation and 5 prism diopters of esodeviation for both distance and near after 6 months post-surgery. Large-angle X(T) had a significantly lower surgical success rate of 55% (n = 40) than moderate-angle exodeviation (94%, n = 138), 6 months (range 1 to 24 months) after surgery. Both BLR recession and unilateral R&R groups showed better surgical success rates for moderate angle X(T) in comparison to large angle X(T). The effect/dose ratio, defined as the amount of prism diopters per mm of muscle recession or resection, was greater in large-angle X(T) for both BLR and monocular R&R. A retrospective study by Tibrewal et al. revealed 27 of 157 (17%) patients who underwent BLR or monocular R&R had residual exotropia of more than 10 prism diopters 4-6 weeks after surgery.[9] Ten (10) of 27 (37%) of those with residual exotropia underwent BLR, while 17 of 27 (63%) underwent a unilateral R&R procedure. In addition, they concluded that age and pre-operative deviation for distance and near were good predictors for unsuccessful outcome.[9] They postulated that older age at surgery was attributed to delayed presentation, which subsequently developed into larger pre-operative deviations. Large deviations can also disrupt binocular fusional ability and affect surgical outcomes. Lajmi et al. performed a retrospective study that included 57 cases of X(T) who underwent muscle surgery done by a single surgeon from 1995 to 2015. Amblyopia (26%, 15 of 57) and V-pattern strabismus (14%, 8 of 57) were also seen in these patients.[10] Success rate after a single surgery was 78% (45 of 57), while patients who were reoperated on had an 84.2% success rate.[11,12] He also noted that the mean age at the time of surgery was 14.8 years old.[10] Furthermore, a study of Tibrewal et al. found 17% recurrence, attributed to older age at surgery as well as pre-operative deviation for distance and near.[9] In comparison, our study had a higher recurrence rate of 39% but on a smaller sample size. The mean age at surgery was 15.52 years, which can be considered a relatively older age group. Also, the mean pre-operative deviation from our study is 46 and 49 prism diopters for distance and near, which can also be considered large.

This study has several limitations, most prominent of which is the small sample size. Due to the limited sampling frame, analysis of potential confounding variables was impracticable; thus, the authors chose to focus on the surgical outcomes exclusively. To strengthen the findings, increasing the number of subjects across a broader timeframe is recommended. Additionally, the retrospective design resulted in patients not being randomly allocated. The follow-up periods were also a challenge. Six weeks minimum time for post-operative monitoring was chosen due to the availability of records and compliance of patients with prescribed clinic visits. Employing a more standardized approach to monitoring should enhance the quality of the data. Due to insufficient sample size for robust statistical calculations, the authors suggest exercising caution with interpreting results.

CONCLUSION

This study aligns with existing literature regarding age and gender distribution of intermittent exotropia. Surgical interventions, primarily lateral rectus muscle recessions and medial rectus muscle resections, showed variable success rates, with recurrences observable 3 months post-operatively. The study acknowledges limitations, particularly a small sample size and challenges with follow-up, cautioning against overgeneralizing results. Despite these limitations, the research contributes to understanding local trends in intermittent exotropia outcomes.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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