



Factors Affecting the Surgical Outcome of Primary Exotropia in Children

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: The objective of current study to evaluate the outcome results of the surgical correction and as well as the effects of some factors on the outcome and surgical response of primary exotropia.

Study Design: Retrospective Clinical Study.

Place and Duration of Study: Hamad Medical Corporation –Tertiary Hospital in Qatar, study done over six months.

Methods: Medical records of patients who underwent surgical correction of primary exotropia procedures between the years 2008 and 2013 were retrospectively reviewed. Patients less than 15 years of age were included in the study and the following data were collected: onset age of squint, age at surgery, type of exotropia, visual acuity, presence of amblyopia, anisometropia, refractive error (spherical equivalent), preoperative deviation, AV pattern, stereopsis, type of surgery and analysis using descriptive statistics, unpaired t- and chi-square statistical tests.

Results: Of 74 patients we studied, 30 Male (40.5%), 44 Female (59.5%), 46 patients (62.2%) had successful surgical outcome, and 28 patients (37.8%) had unsuccessful outcome (all under

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correction). The response to surgery correlated mainly to with the preoperative angle. A higher response resulted from larger preoperative deviation and it this was better with lateral plus medial rectus muscle recessions than with bilateral lateral rectus recession.

Conclusions: Preoperative deviation was the most important factor in determining better response to surgical correction of primary exotropia, and accurate measurement of the angle of deviation can improve the outcome and response to surgery.

Keywords: Intermittent exotropia; surgical outcome of exotropia; factors affecting; preoperative deviation.

1. INTRODUCTION

Exotropia is a disorder of ocular alignment characterized by an outward deviation of the eyes. It is considered as a common condition affecting about 1% of all children under the age of 11 years [1]. Exotropia may be classified as primary or secondary. Primary exotropia can be intermittent or constant depending on clinical history and examination. Secondary exotropia, on the other hand, is either consecutive or sensory (paralytic) based on overcorrection of exotropia or fundus pathology respectively. The aim of surgical correction of primary exotropia is to straighten the eye and attain a degree of binocular single vision if possible. Intermittent exotropia is the most common form of childhood exotropia [2-3]. Some patients progress into constant exodeviation, while others remain stable or improve; however, the natural history of this disorder remains obscure [4-6]. Some Patients with intermittent exotropia tend to develop an exotropic drift following surgical correction over time [3].

Many studies have been done to find factors that affect the outcome and response to surgical correction of primary exotropia. Of these factors, the preoperative angle of deviation, visual acuity, refractive error, preoperative stereopsis, type and dose of surgery and age at the time of surgery have been found to have some effects on the surgical outcome and response (response is measured by the amount of corrected deviation from preoperative to postoperative in Prism Diopter per millimeter of surgery).

Patients under 15 years of age, who underwent surgery for primary exotropia were reviewed in this study. The review was to ascertain the outcome of the surgery as well as factors that may affect the postoperative result, during a period of at least six months of follow-up.

The aim of current study to evaluate the outcome results of the surgical correction as well as the

effects of some factors on the outcome and surgical response of primary exotropia.

2. MATERIALS AND METHODS

All records of patients less than 15 years of age in our department who have had surgical treatment for primary exotropia between the years of 2008 and 2013 were reviewed retrospectively. This was done after approval for this study was obtained from the corporation research center. The demographic data that were recorded included age, sex, age of onset. Also, factors that could influence the outcome and response to surgery were recorded and they include type of exotropia (constant or intermittent), visual acuity, amblyopia, stereopsis, AV pattern, type of surgery, age at onset, interval between diagnosis and surgery, preoperative and postoperative angle, period of follow-up. Patients with paralytic or consecutive strabismus, previous squint surgery, and any ophthalmological, or neurological disorder were excluded from the study.

All the patients underwent ophthalmological examination before and after surgery. The examination comprises of the following; visual acuity test, which was done by fixation preference, Cardiff card or Snellen chart depending on the age. We then calculated the mean corrected visual acuity of both eyes. Refraction was done in all patients either by manifest or cycloplegic refraction. Significant refractive error was given to patients during initial visits and the spherical equivalent value was used to analyze refractive error. A negative value represents myopia and positive for hyperopia.

Extraocular motility was evaluated in nine cardinal positions. The angle of deviation was measured using a prism pre- and postoperatively. Also, an alternate cover test was carried out at near and far distance, and with glasses for those using them. These were done during the period of follow-up which was at least

six months. A or V pattern was recorded. Stereopsis was examined when the patient's age allows using fly test before and after surgery. The type of surgery was also recorded which could be only lateral rectus recession or medial rectus resection or a combination of both, and unilateral or bilateral procedure. Anterior and posterior segments were fully examined.

Exotropia was classified as constant or intermittent. Intermittent exotropia can also be divided into divergence excess, convergence insufficiency, and basic. Amblyopia was defined as the difference of 2 lines or more between monocular visual acuity; anisometropia was defined as the difference between the refractive errors of two eyes in diopter (D). Patient's data were analyzed to determine the factors influencing surgical success and response to surgery. Patients with postoperative deviation within 10 prism diopter of orthotropia were considered as successful [7-8].

Response to surgery was defined as the change of deviation from preoperative to postoperative measurement divided by the amount of surgery (sum of millimeters of recession and resection performed), Described by von Graefe in 1857 [9]. We looked at the correlation between the outcome and various variables, including the type of exotropia, age at onset, age at surgery, time between presentation and surgery, type of surgery, average corrected visual acuity, AV pattern, amblyopia, and preoperative stereopsis. We also assessed factors that may influence the response to strabismus surgery, which can affect the predictability of the surgical outcome.

The data were analyzed using SPSS 21.0 statistical package. Mean, standard deviations as well as medians with range, wherever applicable, were calculated for continuous variables whereas; frequency and percentages were calculated for categorical variables. Chi-square tests were applied to see association between successful vs unsuccessful for other independent categorical variables and correlation coefficient were calculated to see association with response to surgery and other continuous variables. Student t tests were performed to see significant difference between success vs unsuccessful events for continuous variables. P value < 0.05 (two-tailed) was used to see statistical significant level.

3. RESULTS

The total number of patients according to our inclusion criteria was 74 patients, 30 (40.5%) were male and 44 (59.5%) were female (M: F, 1:1.5). Constant exotropia was found in 25 patients (33.8 %), and intermittent exotropia in 49 patients (66.2%). The mean and standard deviation values of independent variables used for analysis are listed in Table 1. Amblyopia was present in 6 patients (8.2%), V pattern was present in 8 patients (10.8%) stereopsis was found in 15 patients (32.6%) and 25 patients (33.8%) were unaccessed.

Table 1. Preoperative baseline parameters-descriptive statistics

Independent variable	Mean±SD
Age at onset (years)	3.6±3.04
Age at surgery (years)	9.1±3.8
Interval between onset & surgery (years)	5.3±3.5
Preoperative angle deviation PD	35.9±12.02
Visual acuity	0.9±0.6
Refractive error in PD	-0.47±3.3
Anisometropia in PD	0.27±1.04

The successful surgical outcome which is within 10 PD of orthotropia was achieved in 46 patients (62.2%), and the unsuccessful outcome was 28 patients (37.8%) All of them were under corrected group. Secondary procedure was done in 3 patients (4.1%). There was no significant effect of our study factors on the outcome, as we can see from Table 2. Patients that underwent bilateral lateral rectus recession were 42 (56.8%), unilateral lateral rectus recession and medial rectus resection 27 patients (36.5%), unilateral lateral rectus recession 4 patients (5.4%), bilateral lateral rectus recession and medial rectus resection 1 patient (1.4%). The overall response to surgery was 2.1 PD/mm (SD 0.81). The average response to bilateral lateral rectus recession surgery was 2.0 PD/mm (SD=0.5) and the average response to unilateral lateral rectus recession and medial rectus resection was 2.4 PD/mm (SD=1.1) (p=0.02). There was a significant difference in the response between two types of surgery.

The response of surgery was found also to be positively correlated with the preoperative angle of deviation. The greater the preoperative angle, the better the surgical response (this is as a result of a larger amount of surgery) (p=0.001, r = 0.48) as shown in Fig. 1. No significant

Table 2. The characteristics of various factors in relation to outcome*

Variables	Successful	Unsuccessful	P value
Age of onset (years)	3.6±3	3.64±2.9	0.92
Vision BE	0.94±0.73	0.74±0.26	0.16
Pre op Dev distant	33±10	38±14	0.08
Refraction -SE	-0.91±3.5	0.25±3.1	0.15
Anisometropia	0.58±1.14	0.40±0.50	0.42
Time between onset and surgery	5.3±3.3	5.7±3.6	0.64
Age at surgery	8.8±3.7	9.5±4.0	0.50
Intermittent XT	27 (58.7)	21 (75)	
Constant XT	19 (41.3)	7 (25)	0.15
Stereopsis			
Yes	15 (32.6)	8 (28.6)	
No	31 (67.4)	20 (71.4)	0.72
Amblyopia	4 (8.7)	2 (7.1)	0.81

*Figures are frequencies and percentages in parenthesis otherwise in means and standard deviations

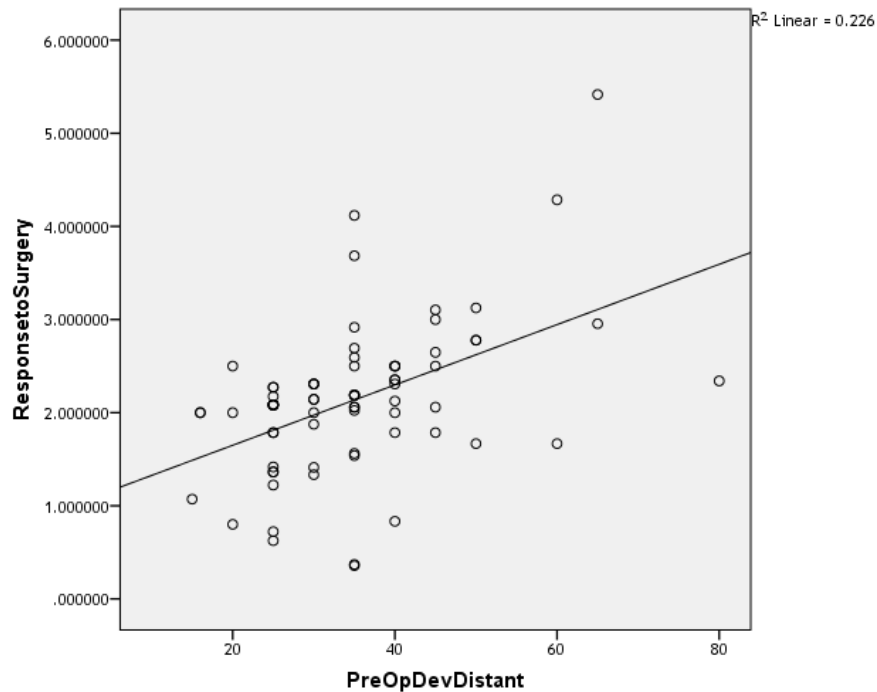


Fig. 1. Association between surgical response and preoperative deviation

correlation was observed with refractive error, visual acuity or age at surgery ($r= 0.06, 0.009, 0.04$ respectively), and other variables. The median postoperative follow-up period was 16 months with a range of 8 months to 96 months.

4. DISCUSSION

Surgical success rate in this study was 62.2%. Other studies have reported a success rate of 76.4% [10], 67% [11], 49% [12]. However, direct

comparison of success rates is difficult as surgical procedure, definition of success of surgery differs among studies. In our study, we found that preoperative deviation is observationally less in successful outcome compared to that of less successful (33 ± 10 vs 38 ± 14 ; $p=0.08$). Although it is not statically significant because of the number of patients but it would suggest a better outcome with smaller preoperative angle, like the result found by Gezer et al. [11], who reported that preoperative

deviation significantly influenced a favorable outcome in patients with surgically treated exotropia.

Visual acuity, refraction error, age at onset, age at surgery, interval between onset and surgery, amblyopia, anisometropia and type of surgery were found not to influence the surgical outcome. A similar finding was reported by Keenan et al. [8] regarding the effect of these factors on the outcome except, that visual acuity was not involved in his analysis. Although other studies found that visual acuity [9] and refractive error [12] affect surgical outcome, patients with higher myopic refractive errors tend to have less favorable outcome (larger postoperative deviation). A study by Yoo and Kim [13] revealed that the postoperative surgical outcome was influenced by the duration of the misalignment, rather than the age at surgery. Surgery within 24 months of misalignment favourably affected the percentage of patients who achieved successful outcome in the treatment of infantile exotropia.

The study done by Jeoung et al. [7] found significantly higher surgical success in patients with unilateral recess/resect procedure than those having bilateral lateral rectus recession. The same result was also found by Millan et al. [13] but preoperative deviation was up to 60 PD. However, it did not result in successful outcomes for deviations of over 65 PD [14]. Other of studies have evaluated the effect of these factors on the response of surgery, we found that the response of surgery was only positively correlated with preoperative angle of deviation in which the response of surgery increased as the preoperative angle increases as you are doing more amount of surgery, this has been demonstrated in previously studies [9-12,15-16].

We found also that the response to unilateral lateral rectus recession plus medial rectus resection was significantly better than bilateral lateral rectus recession ($p=0.02$). Similar finding was reported by Faridi et al. [11], while Scott et al. [16] reported in his study that response to surgery was similar in both procedures for large preoperative angle of deviation but more with RR compare to BLR for small angle. We found no correlation between surgical response, visual acuity, and average spherical equivalent, although Faridi et al. [10] reported that the response to surgery was negatively correlated with the average corrected visual acuity, and Gordon & Bachar et al. [17] found that response to surgery is negatively correlated with average

corrected visual acuity, average spherical equivalent and the degree of anisometropia.

Although there is lack of agreement in these studies regarding the effect of these factors on the outcome and the response to the surgical management of primary exotropia, most of them raised the importance of preoperative angle of deviation, and we found as others the importance of preoperative angle of deviation in determining the postoperative result & response to surgery. So improvement in the method of measuring preoperative angles of deviation would be expected to improve the final result. Some studies suggested measuring the angle of deviation after 30-60 minutes of monocular occlusion [18] or go to the largest measured angle. Delay surgery if possible to get accurate, stable measurement, especially some studies did not show better outcome with early surgery [19]. Most recently, a study by Yam et al. [3] reported that the postoperative exodrift along three years occurs in a majority of patients after bilateral lateral rectus recession for intermittent exotropia. The long-term surgical success is significantly affected by this postoperative exodrift. Larger preoperative deviations are associated with a larger early and late postoperative exodrift. Also other study suggested that a significant refractive error such as high myopia should be taken into consideration when you are planning for surgery as the measured angle may be slightly higher than their true angle of deviation. So the effect of surgery on them would be less than surgery done in hyperopic patients [12]. In conclusion, our study demonstrated the importance of preoperative angle of deviation and it correlates positively with the response to surgery. Therefore accurate measurements are necessary before surgery should be performed.

Controversies still abound in defining successful surgery, but the assertion that absolute orthophoria is necessary for successful surgery seems far from realistic. The criteria for our study are comparable to those of Gezer et al. [12] and Kushner et al. [20] presents the comparisons of the total numbers of subjects, duration of follow-up, and the success rates of previous studies.

The major limitation of this study was retrospective design. Also, the number of patients considered was small. Nevertheless, our cohort has relatively long-term follow-ups which allow determination of the long-term ocular stability of exotropia after unilateral lateral rectus recession and medial rectus resection.

5. CONCLUSION

Preoperative deviation was the most important factor in determining better response to surgical correction of primary exotropia, and accurate measurement of the angle of deviation can improve the outcome and response to surgery. Also under correction result in all our unsuccessful outcome can strongly recommended initial postoperative overcorrection to increase the likelihood of long –term satisfactory alignment.

WHAT THIS STUDY ADDS

Overall, our study demonstrated that the successful outcome and response of surgical correction of exotropia was influenced by preoperative angle of deviation, the greater the preoperative angle, the better the surgical response, which also better with unilateral recess/resect procedure than bilateral lateral rectus recession. We also found that the success rate of surgery decreased over the course of follow-up, therefore, immediate postoperative overcorrection should be seriously considered to maintain a satisfactory postoperative alignment. Age at onset, age of the patient at surgery, interval between onset and surgery, refraction error, amblyopia, anisometropia and type of surgery were found not to influence the surgical outcome and response to surgery.

CONSENT

All authors declare that 'written informed consent was not obtained from the patients as the study was Retrospective and Hamad Medical Corporation Research Center approved it.

ETHICAL APPROVAL

All authors hereby declare that this study has been examined and approved by the Hamad Medical Corporation Research Center and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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