ORIGINAL ARTICLE

Factors determining the outcome of paediatric exotropia surgery

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ABSTRACT

Objective: To determine the socio-demographic and clinical profile of exotropia surgery outcomes amongst paediatric patients.

Methods: This is a descriptive, retrospective, clinical study of surgeries performed between 2014 and 2016 at the Sarawak Heart Centre, Malaysia. Medical records of patients with primary and secondary exotropia were reviewed. The following factors that affected the surgical outcomes were collected: onset age of squint, age at the time of surgery, the interval between diagnosis and surgery, the type of exotropia, visual acuity, presence of amblyopia, previous patching, anisometropia, refractive error, type of surgery, preoperative and postoperative deviation, pre-existing ocular comorbidity and systemic illness.

Result: A total of 15 patients were studied with more than two thirds being females. Seven patients had primary exotropia while eight patients had secondary exotropia. Average interval between diagnosis and surgery was 1.3 years (±0.82) for primary exotropia and 1.2 years (±0.84) for secondary exotropia. Average pre-operative angle for primary exotropia was 50.57PD (±10.83) whereas secondary exotropia was 39.38PD (±8.63). Seven patients had successful surgical outcomes of within 10 prism dioptres, five for primary exotropia and two for secondary exotropia. The response to surgery was 3.0PD/mm (±0.59) for primary exotropia and 2.2PD/mm (±0.74) for secondary exotropia.

Conclusion: In our study, primary exotropia had larger preoperative angle than secondary exotropia. The response to surgery was positively correlated with the preoperative angle of deviation. Primary exotropia showed better surgical outcome.

KEY WORDS:
exotropia, surgery outcome

INTRODUCTION

Exotropia is an ocular alignment disorder characterised by an outward deviation of the eyes. Incidence of childhood exotropia is estimated to affect approximately 1.0% of children younger than 11 years of age in countries like the United States of America and Iran.[1] In Malaysia, one cross-sectional study carried out in 1982 reported the incidence of exotropia of 1.8%.[2]

Amongst the benefits of exotropia correction include the development of binocular single vision, elimination of diplopia and creation of a normal appearance especially for young children. This is of great importance as studies have demonstrated lower self-esteem and poorer quality of life in individuals affected by strabismus.[3] If uncorrected, individuals with exotropia were also found to have significantly higher numbers of mental health disorders by early adulthood.[4]

Exotropia can be classified as either primary or secondary. Primary exotropia can be further sub-classified as either intermittent or constant based on clinical assessment. Secondary exotropia can be sub-classified as sensory or consecutive based on ocular pathology or overcorrection of esotropia respectively.[5]

In previous studies, amongst the several factors identified to influence the response to surgery, of utmost importance was the preoperative angle of deviation. The larger the pre-operative angle of deviation, the better the surgical response.[6,7]

Older age at time of surgery, better average corrected visual acuity, higher average spherical equivalent and anisometropia were found to be negatively correlated with the surgical response.[6] This suggested a better surgical response with younger age, poorer visual acuity, less myopic refraction and less anisometropia.

The objective of this study was to determine post-operative outcomes of primary and secondary exotropia. As the majority of earlier articles focussed on primary exotropia; this study can also contribute by providing insights into secondary exotropia outcomes. This study also documents for the first time exotropia surgery outcomes in Sarawak.

MATERIALS AND METHODS

This was a descriptive retrospective clinical study. Case records of patients who had exotropia surgery at the Pusat

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Jantung Hospital Umum Sarawak (Sarawak Heart Centre) between 2014 and 2016 were reviewed. Socio-demographic data included gender, age of onset, age at the time of surgery, duration between diagnosis and surgery, type of exotropia, AV pattern, dissociated vertical deviation (DVD), visual acuity, refractive error, amblyopia, previous patching, anisometropia, pre-operative and post-operative angle, type of surgery performed, amount of muscle recessed/resected, pre-existing ocular comorbidity and systemic illnesses were recorded. Postoperative follow-up was then scheduled up to four months. Patients older than 18 years of age and incomitant strabismus were excluded.

All respondents underwent ophthalmological examination prior and subsequent to surgery. Examination included visual acuity testing by age group, either by Kay test, Cardiff cards or Snellen chart. Refraction was performed on all patients. The spherical equivalent was subsequently calculated for refractive error. Anterior and posterior segments were examined fully and any abnormalities noted. Extraocular motility was assessed in the nine cardinal positions. The angle of deviation was then evaluated using the prism cover test both pre-operatively and post-operatively for near and distance vision. The preoperative angle of deviation was defined as the last recorded angle for distance before the operation. The postoperative angle was defined as the last recorded angle for distance during the follow-up period. The A or V pattern and DVD were assessed as well.[5]

Amblyopia was defined as a difference of two of more lines on a Snellen chart between both eyes without any detectable ocular pathology.[6] Anisometropia was defined as the difference of two dioptres or more between the refractive errors of two eyes.[5]

The type of surgery and laterality performed was recorded. Type of surgery was either bilateral lateral rectus recession or unilateral medial rectus resection and lateral rectus recession. The dose of surgery was recorded in millimetres as the total amount of muscle recessed or resected.

Formulated by von Graefe in 1857, response to surgery was defined as the difference between the preoperative and postoperative angle of deviation for distance per total amount of recessed and/or resected muscle surgery in millimetres.[5] Patients with postoperative deviation within 10 prism dioptres of orthophoria were considered as successful.[7] Data analysis was then performed with SPSS software version 22.0. The continuous variables in the study were expressed as their mean and standard deviation.

RESULTS

A total of 21 patients underwent exotropia surgery at Pusat Jantung Hospital Umum Sarawak (Sarawak Heart Center) between 2014 and 2016. Five patients with missing records and one patient with incomitant exotropia were excluded. The remaining 15 patients were divided into the primary exotropia and the secondary exotropia groups. Out of the 15, seven were in the primary exotropia group and eight in the secondary exotropia group (Table I). The mean age of exotropia onset was 1.1 years (±1.21) for the primary group, and 2.2 years (±1.80) of age for the secondary group. Primary exotropia had earlier average age of surgery of 6.9 years (±3.13) compared to the secondary exotropia group of 8.6 years (±1.95). The mean interval between diagnosis and surgery was comparable between both groups at 1.3 years (±0.82) for primary exotropia and 1.2 years (±0.84) for secondary exotropia.

In the primary exotropia group, five patients had constant exotropia while two had intermittent exotropia. Three patients from the primary exotropia group had V pattern while one patient had DVD. Average visual acuity was 0.67 (±0.25), ranging from 6/6 to 6/19. None of the patients had amblyopia, anisometropia or history of previous patching. The average refractive error in spherical equivalent was -0.5DS (±2.35). Average pre-operative angle was 50.57PD (±10.83) while the average post-operative angle was 8.57PD (±8.52). Five patients had successful surgical outcome (71.4%). All seven patients underwent bilateral lateral rectus recession. Average response to surgery was 3.0mm/PD (±0.59). None of the patients had ocular pathology while three of them had systemic illnesses. None of the patients underwent a repeat or secondary procedure.

All eight patients from the secondary exotropia group had sensory exotropia. One patient from the secondary exotropia group had V pattern. DVD was present in one patient as well. Average visual acuity was 0.39 (±0.35), ranging from 6/12 to 1/60. One patient had amblyopia while four patients had anisometropia. Five patients had history of previous patching. The average refractive error in spherical equivalent was -5.81DS (±8.74). Pre-operative angle averaged 39.38PD (±8.63), while average post-operative angle was 15.0PD (±3.78). Only two patients (25%) had successful outcome based on the criteria mentioned. For surgical procedures, two patients underwent bilateral lateral rectus recession while six patients had unilateral lateral rectus recession and medial rectus resection. Average response to surgery was 2.2PD/mm (±0.74). All eight patients had previous ocular pathology while five of them had systemic illness.

Overall the response to surgery was found to be positively correlated with the preoperative angle of deviation (r=0.596, p=0.019) (Figure 1).

In the secondary exotropia group, the types of previous ocular pathology included lasered Retinopathy of Prematurity, history of congenital cataract, astigmatism amblyopia, ectopia lentis, temporal disc pallor, macular scar, prior trauma with corneal laceration and salt and pepper retinopathy.

The systemic illnesses in the primary exotropia group included Ehler Danlos Syndrome, congenital hydrocephalus and a subdural haemorrhage for which a decompressive craniotomy was done. The systemic illnesses in the secondary exotropia group included global developmental delay, schizencephaly, parietal encephalocele, rheumatic heart disease and congenital rubella syndrome.

Table I: Comparison between primary and secondary exotropia (n=15)

Variable	Primary exotropia (n=7)	Secondary exotropia (n=8)
Gender Male Female	 3 4	 6
Average age of onset (years) Mean (±SD)	1.1 (±1.21)	2.2 (±1.80)
Average age of surgery (years) Mean (±SD)	6.9 (±3.13)	8.6 (±1.95)
Average time between diagnosis and surgery (years) Mean (±SD)	1.3 (±0.82)	1.2 (±0.84)
Type of exotropia	Constant = 5 Intermittent = 2	Sensory = 8 Consecutive = 0
AV pattern (n)	3	1
DVD (n)	1	1
Visual acuity Average Range	 0.67 (±0.25) 6/6 to 6/19	 0.39 (±0.35) 6/12 to 1/60
Amblyopia (n)	0	1
Anisometropia (n)	0	4
Previous patching (n)	0	5
Average refractive error in spherical equivalent (DS) Mean ± SD	-0.5DS (±2.35)	-5.8DS (±8.74)
Average pre-operative angle (PD)	50.57 (±10.83)	39.38 (±8.63)
Average post-operative angle (PD)	8.57 (±8.52)	15 (±3.78)
Successful outcome (%)	71.43	25
Type of surgery Bilateral lateral rectus recession Unilateral lateral rectus recession and medial rectus resection Response to surgery (mm) Mean (±SD)	 7 0 3.0 (±0.59)	 2 6 2.2 (±0.74)
Ocular pathology (n)	0	8
Systemic illness (n)	3	5

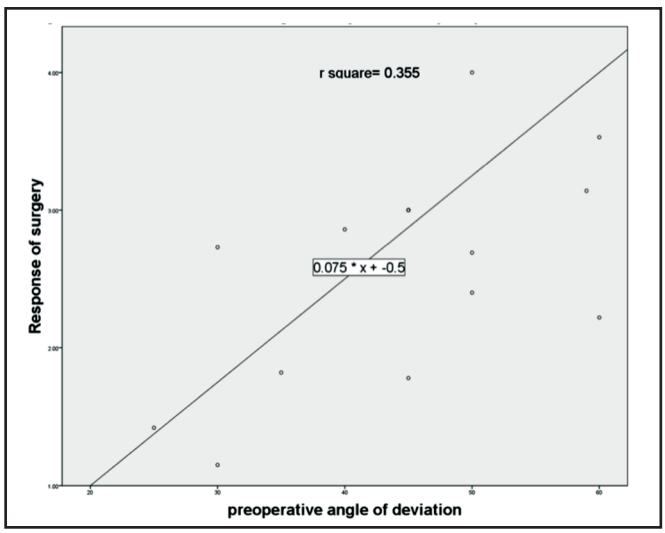

Fig. 1: Association between surgical response and pre-operative deviation

DISCUSSION

Our study had comparable rates of surgical success for primary exotropia (71.4%) to other studies, with their rates being 62.2%,[5] 67%6 and 76.4%.[8] However, it is difficult to compare directly success rates as surgical procedures and definition of success differ amongst studies.

The response to surgery was found to be positively correlated with the pre-operative angle of deviation (r=0.596, p=0.019). A higher surgical response was directly correlated with larger pre-operative angles as a larger amount of surgery was performed.

Our study showed that primary exotropia had larger preoperative angles of deviation compared to secondary exotropia and had higher surgical success rates (71.4% vs 25.0%). Where bilateral lateral rectus recessions had good surgical outcomes in the primary group, both bilateral lateral rectus recessions had unsuccessful outcomes in the secondary group. Most earlier studies compared between unilateral recession-resection and bilateral lateral rectus recession procedures for primary exotropia, with scant amount on secondary exotropia outcomes. Thus, this study adds knowledge on bilateral lateral rectus recession outcomes for secondary exotropia.

Primary exotropia had earlier ages of diagnosis compared to secondary exotropia likely due to later age of disease onset. This also led to earlier surgical timings for primary exotropia. However, this did not lead to longer surgical waiting times for secondary exotropia as their average interval between diagnosis and surgery was shorter than the primary group (1.3 years vs 1.2 years).

The average refractive error of secondary exotropia was -5.8DS (±8.74) as compared to -0.5DS (±2.35) for the primary

exotropia group. This was due to the ocular conditions faced by the patients in the secondary exotropia group as lasered Retinopathy of prematurity is known to be a risk factor for developing high myopia.[9] Conditions such as ectopia lentis, amblyopic astigmatism and corneal laceration also increases the cylindrical refractive error of patients in the secondary exotropia group. Thus, the average refractive error of the secondary exotropia group would be higher than in eyes with no ocular pathology. Higher refractive error is associated with larger postoperative angles of deviation, which is detrimental to surgical success.[6]

Central fusion or stereopsis has been identified to be an important factor in determining postoperative alignment and surgical success.[6] It is assumed that the primary exotropia group would have higher levels of stereopsis as compared to the secondary exotropia group. Patients in the secondary exotropia group have poorer vision which would lead to a lack of development of stereopsis. However, this theory could not be verified as stereopsis was not recorded pre-operatively in this study.

Several limitations have been identified in this study which may affect outcome. The small sample size might not provide a generalization on primary and secondary exotropia surgical outcomes. The orthoptic measurements and surgical procedures were performed by different persons. This was not a blinded study, which may lead to bias. The short duration of follow-up post-surgery makes it difficult to determine postoperative stability of ocular alignment. Postoperative exodrift can occur which would affect the long term surgical success.[10,11]

This article provides some insight into postoperative outcomes of secondary exotropia. Most reports in the literature focus mainly on primary exotropia surgical outcomes with secondary exotropia being largely ignored. With this study, strabismus surgeons have further data on secondary exotropia surgery outcomes which could be of use in their respective clinical settings. This study adds to the current practices, knowledge and aids surgeons in predicting postoperative outcomes.

Surgical outcomes of primary exotropia has a significant postoperative success rate compared to secondary exotropia. This information should told to patients prior to undergoing surgery in view of demands and expectations of parents. Accurate and repeated preoperative deviation should be measured prior to surgery to improve surgical outcomes and response to surgery.

CONCLUSION

In our study, primary exotropia had larger preoperative angles than secondary exotropia. The response to surgery was positively correlated with the preoperative angle of deviation. Primary exotropia showed better surgical outcomes as compared to the secondary exotropia group. A higher degree of refractive error is associated with poorer surgical success. Thorough and repeatable assessments should be carried out preoperatively to improve on the success and outcomes of surgery postoperatively.

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REFERENCES

1. Govindan M, Mohney BG, Diehl NN, Burke JP. Incidence and types of childhood exotropia: a population-based study. Ophthalmology 2005; 112(1): 104-8.
2. Teoh GH, Yow CS. Prevalence of squints and visual defects in Malaysian primary one school children. Med J Malaysia 1982; 37(4): 336-7.
3. Hatt SR, Leske DA, Kirgis PA, Bradley EA, Holmes JM. The effects of strabismus on quality of life in adults. AM J Ophthalmol 2007; 144(5): 643-7.
4. Mohney BG, McKenzie JA, Capo JA, Nusz KJ, Mrazek D, Diehl NN. Mental illness in young adults who had strabismus as children. Pediatrics 2008; 122(5): 1033-8.
5. Huda S, Asim T, Bener A. Factors Affecting the Surgical Outcome of Primary Exotropia in Children. British Journal of Medicine & Medical Research 2016; 16(10): 1-7.
6. Faridi UA, Saleh TA, Ewings P, Twomey JM. Factors affecting the surgical outcome of primary exotropia. Strabismus 2007; 15(3): 127-31.
7. Gezer A, Sezen F, Nasri N, Gozum N. Factors influencing the outcome of strabismus surgery in patients with exotropia. J AAPOS 2004; 8(1): 56-60.
8. Saleem QA, Cheema AM, Tahir MA, Dahri AR, Sabir TM, Niazi JH. Outcome of unilateral lateral rectus recession and medial rectus resection in primary exotropia. BMC research notes 2013; 6: 257.
9. Choi MY, Park IK, Yu YS. Long term refractive outcome in eyes of preterm infants with and without retinopathy of prematurity: comparison of keratometric value, axial length, anterior chamber depth and lens thickness. Br J Ophthalmol 2000; 84(2): 138-143.
10. Yang M, Chen J, Shen T, Kang Y, Deng D, Lin X et al. Clinical characteristics and surgical outcomes in patients with intermittent exotropia: a large sample study in South China. Medicine (Baltimore) 2016; 95(5): e2590.
11. Yam JC, Chong GS, Wu PK, Wong US, Chan CW, Ko ST. Predictive factors affecting the short term and long term exodrift in patients with intermittent exotropia after bilateral rectus muscle recession and its effect on surgical outcome. Biomed Res Int 2014; 2014: 482093.