Outcome of Horizontal Strabismus Surgery and Factors Influencing Surgical Success

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ABSTRACT

Introduction: Strabismus is a complex problem of eye alignment, binocularity, and cosmetics that affect vision and quality of life. Strabismus surgery helps to establish binocular fusion, expand the field of binocular vision, eliminate diplopia, correct a compensatory head posture, and improve cosmetic appearance. The outcomes of horizontal strabismus surgery range from 56.3-86.5%. It depends on different factors such as the type of strabismus, accurate measurement of pre-operative deviation, age at which strabismus surgery was performed for the first time, type of strabismus surgery, postoperative alignment, and binocularity.

Regrettably, there is insufficient data regarding the prevalence of strabismus and the outcomes of surgical interventions in Nepal. This study addresses the outcome of strabismus surgery and the factors influencing surgical success conducted at a tertiary hospital.

Objective: To evaluate the outcome of horizontal strabismus surgery and factors influencing surgical success.

Methodology: The medical records of 206 patients who had undergone their first horizontal strabismus surgery at Tilganga Institute of Ophthalmology (TIO) from 2017 to 2020 were reviewed retrospectively. Those who completed a follow-up period for at least 3 months were included. Patients with restrictive, paralytic, and vertical strabismus were excluded from the study. The success of the surgery was defined by achieving an eye deviation of less than 10 prism diopters (PD) six weeks post-surgery. The influencing factors for surgical success (diagnosis, age group, visual acuity, binocular function, and pre-operative angle of deviations) were analyzed.

Result: Complete data of 194 patients with follow-up periods of 6 weeks to 3 months were retrieved from the electronic medical record. The majority 116(59.8%) of the patients were between 6-18 years >18-53years 40.2% (78) with male to female ratio of 0.96:1. Majority of the participants had exotropia 124(63.9%) and mean pre-operative angle of deviation was 48.9±14.7PD (Range 10- 90). A good motor alignment (total success rate) was 44.3 %(86); the success rate for esotropia was 36(41.9%) and for exotropia was 50(58.1%). Both fusion and stereopsis were significantly improved after surgery (P<0.001). The patient who had a smaller deviation in the preoperative period had good surgical success in the postoperative period.(P <0.001). The type of deviation, age, gender, pre-operative amblyopia, and binocular vision were not related to the surgical success.

Conclusion: In cases of horizontal concomitant strabismus, the preoperative amount of deviation is the paramount factor influencing surgical success. Notably, surgical success is low in patients with large preoperative deviation.

Key words: Influencing factors; outcomes; strabismus surgery; success rate.

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INTRODUCTION

The prevalence of strabismus ranges from 3% to 5% in the population (Arora et al., 2005; Graham et at., 1947; Preslan et al., 1996; Abrahamsson et al., 2002). Strabismus poses a complex challenge involving eye alignment, binocularity, and cosmetics that affect vision and quality of life. Strabismus surgery plays a crucial role in establishing binocular fusion, expanding the field of binocular vision, eliminating diplopia, correcting a compensatory head posture, and improving cosmetic appearance (Simonsz et al., 2011). The outcomes of strabismus surgery range from 56.3-86.5% (Kampanartsanyakorn et al., 2005; Segal et al., 2000; Ganguly et al., 2011; Gogate et al., 2010; Sharma et al., 2014). It depends on different factors such as the type of strabismus, accurate measurement of pre-operative deviation, age at which strabismus surgery was performed for the first time, type of strabismus surgery, postoperative alignment, and binocularity (Thomas et al., 2010; Keenan et al., 1994; Chatzistefanou et al., 2013).

In developing countries, the collective magnitude of amblyopia and strabismus was 2.0% and 6.9% respectively (Saxena et al., 2016).

Despite the significance of the surgery, the outcome of strabismus surgery has been poorly reported. There is inadequate information about the prevalence of strabismus and the outcome of surgery in Nepal. This study addresses the outcome of strabismus surgery and the factors influencing surgical success conducted at a tertiary hospital.

METHODOLOGY

The medical records of 206 patients who underwent their first horizontal strabismus surgery at Tilganga Institute of Ophthalmology (TIO) from 2017 to 2020 were reviewed retrospectively. The patients who had a follow-up period of at least 3 months were included. Patients with restrictive muscular disease, paralytic squints, and vertical squints were excluded from the study. Ethical approval was obtained from the TIO institutional review committee.

After obtaining the patient's medical history, a detailed ophthalmic examination was performed. Visual acuity was measured by the Snellen chart and LEA symbol. Extra Ocular muscle functions were carefully assessed in all nine cardinal gaze positions. Angles of deviation were evaluated by a prism bar cover test at near and distance with and without glasses. For patients with poor vision, the modified Krimsky test was used to measure the angle of deviations. The Titmus fly test was used for the evaluation of stereopsis and the worth-four dot test for binocular vision. Glasses were prescribed according to refractive error and type of strabismus. Patching therapy was advised for the amblyopic patient before surgery. A slit lamp examination of the anterior segment and a dilated fundus examination was performed in all patients.

The success criterion of the surgery was defined by achieving an eye deviation of less than 10 prism diopters six weeks after surgery. The surgical procedures were conducted under general and local anesthesia. Guidelines in planning surgical measurement for esotropia and exotropia were based on Marshall Park's

formula. The influencing factors for surgical success (diagnosis, age group, visual acuity, binocular function, and pre-operative angle deviations) were analyzed in the study.

The choice of surgical method depended on the type of deviation, presence of amblyopia, and age of the patient. In younger children aged 2-16 (excluding amblyopic eyes) and those with an alternating squint, bilateral surgery was performed while in older patients aged>16, monocular surgery was done. The majority of the surgery was done under local anesthesia while younger patients underwent general anesthesia. All patients and parents of children were explained about the surgical procedure. Written informed consent was taken before surgery from patients and parents of minors. A fornix-based conjunctival incision was made, horizontal muscles (Lateral Rectus or Medial Rectus) were grabbed using a muscle hook, Tenon's capsule was identified, cleaned by blunt dissection, and recession and resection surgery was performed based on the type of strabismus. For suturing the muscle to the sclera 6.0 absorbable vicryl suture with a double spatula needle was used. Conjunctival closure was done by 8.0 vicryl suture.

Patients were examined on the first day, one week, and six weeks to three months after surgery. They were advised to apply an eye drop combination of dexamethasone and chloramphenicol six times a day for one week and ointment chloramphenicol at bedtime for 1 week. The dose of the medication was tapered over one month. An orthoptic evaluation was done on the last follow-up visit of the patient.

Data retrieved from electronic medical records were cleaned in Microsoft Excel. Cleaned data was Transported to Statistical Package for The Social Science (SPSS) version 20. For the association Of the categorical data, Chi-Square test was used. For numerical normally distributed data,

An Independent t-test was used otherwise Mann-Whitney U test was used. A p-value less than 0.05was considered statistical significance.

RESULT

A total of 206 patients were included in the study, with complete information available for 194 individuals. Among 194 patients, the median age was 17.00, a minimum of 6 years, and a maximum of 53 years.

The pre-operative mean angle of deviation ± SD was 48.7 ±14.7 (minimum 10, maximum 90), and SD was 14.7

Total success was seen in 44.3 % (86). In the success group, the median deviation was 45PD, the minimum was 10PD, and the maximum was 87.50PD. In the failure group (109 patients) median was 50, the minimum was 20, the maximum was 90, and the p-value was 0.005

Following surgery, fusion improved by 30.6% and stereopsis increased by 26.5%. Both fusion and stereopsis demonstrated significant improvement after surgery (P<0.001). Surgical success increased significantly (P <0.001) among those patients who had less pre-operative deviation.

The type of deviation, age, gender, pre-operative amblyopia, and binocular vision were not significantly related to the surgical success.

90 patients (46.4%) had LR Recession with MR Resection. 34 patients (17.5%) underwent MR Recession with LR Resection. Both eye LR Recession were done in 31 patients (16%), and both eye MR Recession was done in 30 patients (15.5%). MR Recession was done in 6 patients (3.1%) and LR Recession was done in 3 patients (1.5%)

The details of the demographic profile are shown in Table 1. The majority (59.8%) of the patients were between 6-18 years (median age: 17), while the male-to-female ratio was 0.96:1.

Table 1 Demographics of patients

Characteristics	Categories	Number (%)
Age	6-18yrs	116 (59.8%)
	>18-yrs	78 (40.2%)
Gender	Female	99(51.0%)
	Male	95(49.0%)
Residence	Kathmandu	88(45.4%)
	Outside Kathmandu	106(54.6%)

Table 2 Pre-operative clinical parameters of the patients (n=194)

Variables	Number (%)
Type of refractive error	
Myopia	18 (9.3%)
Hypermetropia	25 (12.9%)
Astigmatism	68 (35.1%)
Emmetropia	83 (42.8%)
Diagnosis	
Esotropia	70 (36.1%)
Exotropia	124 (63.9%)
Eyes	
Right	65 (33.5%)
Left	69 (35.6%)
Both	60 (30.9%)
Pre-operative angle of deviation(PD)	
Mean (SD)	48.7(14.7), (Min 10, Max 90)

Table 3: Success rate according to pre-operative deviation

The success rate was highest at 58.8 %, among the patients who had 30-39PD preoperative deviation

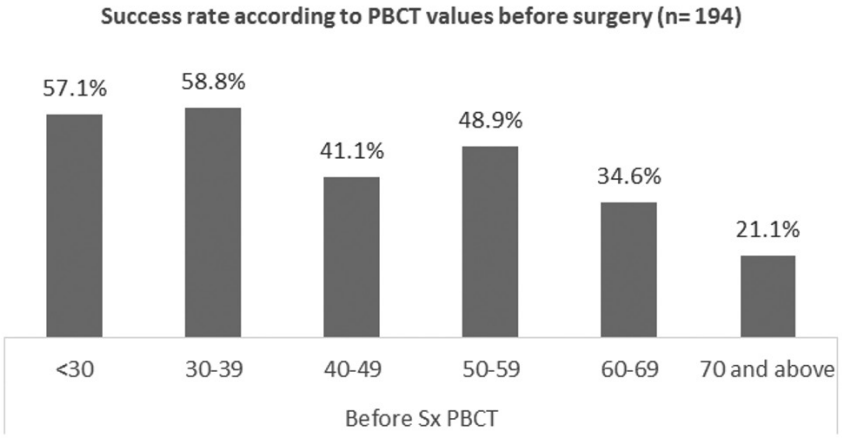

Table 4: Analysis of influencing factors and surgical success

Pre-operative deviations were found to be significantly related to surgical success (p= 0.005)

Variables	Surgical success	Surgical failure	P value
Gender			
Male, n (%)	45(52.3%)	50(46.3%)	0.404
Female, n (%)	41(47.7%)	58(53.7%)	
Diagnosis			
Esotropia, n (%)	36(41.9%)	34(31.5%)	0.135
Exotropia, n (%)	50(58.1%)	74(68.5%)	
Binocular vision			
Present, n (%)	12(14.0%)	11(10.2%)	0.42
Absent, n (%)	74(86%)	97(89.8%)	
Amblyopia (Before surgery)			
Present, n (%)	30(34.9%)	32(29.6%)	0.436
Absent, n (%)	56(65.1%)	76(70.4%)	
Pre-operative angle of deviation, Median (range)	45(10-87.5)	50(20-90)	0.005
Age, Median (Range)	17 (6-38)	16.5 (6-53)	0.530

DISCUSSION

The good motor outcome of horizontal strabismus surgery in our study was 44.3% (Esotropia 41.9%) and Exotropia (58%), the success rate was higher among the patients with lower pre-operative deviation. The highest success rate (58.8%) was observed among the patients who had pre-operative deviation 30-39PD followed by 57% success in <30PD pre-operative deviation. The pre-operative deviation was 20-30PD in 13% (25), 31-59PD in 64.2% (124), and >60 in 22.8%. Different scientific studies have reported success rates of 30%-80 %.(44) (Pandey et al., 2017). In the present study, we did not include the surgeon factor in the analysis process. However, the study from Eastern Virginia Medical College showed no statistical significance between residents and attending physicians in strabismus surgical success rate (58% and 69% respectively). (Kampanartsanyakorn et al., 2005). The Study done by Kampanartsanyakorn S et al revealed that successful surgery was related to an age younger than 6 years and preoperative deviation of fewer than 30 degrees. In our study age was not the influencing factor for surgical success. The highest success was seen in 30-39 PD and <30PD group patients which were similar to Kampanartsanyakorn S et al study. A study done by Min Yang et al showed a lower surgical success for patients undergoing 2 muscles (30%) and 3 muscles (26.7%) surgery for large-angle intermittent exotropia. In a study done by Uzun A et al the surgical success was 83.92% in all patients, 87.13% in esotropic patients, and 76.19% in exotropia patients but in our study, the success is lower than this study, they had shown the highest success in esotropia but in this study, success was highest in exotropia patients, this might be because in our study exotropia patients were more in number. The lower success rate in our study in comparison to this study might be due to large preoperative deviation and the other factor is that the patient did not come for a follow-up for second eye surgery, in Uzun A et al additional surgery was performed in 8 patients with >20PD residual strabismus.

Different surgical techniques, the number of muscles operated on, the criteria of the residual strabismus, influencing factors, follow-up period, and experience of the surgeon could be the cause for the difference in the success results. (Pandey et al., 2017).

In this study the pre-operative angle of deviation is the most crucial influencing factor for the surgical outcome, the larger the pre-operative deviation lesser the success rate. Small angle deviation measurements may be more accurate than large angle deviations, the surgeon had to do more millimeters in extra ocular muscle surgery in large angle deviation patients, which may violate muscle pulleys, and orbital fat in resection and cause errors in curved and linear measurements along the sclera in recession. The exact cause of strabismus and its pathophysiology is still not clear. Although strabismus surgery does not cure the primary cause, it does alleviate motor function and affects the development of sensory function, especially in younger children. (Kampanartsanyakorn et al., 2005).

A study by Pandey S et al shows a success of 38.2 %.(49% for ET, 26% for XT). 74% failure in XT, and our study›s success rate is comparable to this study. (Pandey et al., 2017).

The binocular vision significantly improved after surgery, and fusion and stereopsis improved in 52(30.6%) and 45(26.5%) respectively (<0.001). There are several studies in which stereopsis was improved after surgery. (Segal et al., 2000; Gogate et al., 2010). The limitations of this study are: it was a retrospective study and only those patients who underwent surgery only in one eye even for the larger deviation were taken.

CONCLUSION

In horizontal concomitant strabismus, the preoperative amount of deviation emerges as the pivotal determinant of surgical success. Surgical success is lower in patients with large preoperative deviation. Careful measurement of the angle of deviation before surgery can increase the success rate. Patients and their parents should be informed about the possibility of residual deviation and the potential need for another surgery.

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