

## Original article

### Outcome of horizontal strabismus surgery and parents' satisfaction

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#### Abstract

**Introduction:** A clinical audit of strabismus surgery in children in terms of functional and cosmetic outcomes helps improve the quality of services in pediatric ophthalmology. **Objective:** To evaluate the outcome of strabismus surgery and assess the satisfaction of the patients' parents with respect to the surgery outcome. **Subjects and methods:** A study of an interventional series of cases that included 60 strabismic subjects was carried out. The bilateral strabismus surgery under general anesthesia was performed on all subjects using the fornix approach. The parents' understanding about strabismus and the cosmetic outcome was assessed through a set of interview questionnaires. The main outcome measures were the amount of deviation, the parents' knowledge about strabismus and their satisfaction after the intervention. **Results:** Of the 60 subjects, 32 (53.3%) were esotropic and 28 (46.7%) exotropic. The male to female ratio was 1:1. The mean age with standard deviation was  $16.6 \pm 8.5$  years, with a range of 3 to 35 years. The pre-operative mean esotropia with standard deviation was  $48.2 \pm 14.8$  pd, with a range of 22 to 114 pd). The pre-operative mean exotropia was  $57.8 \pm 14.2$  pd, with a range of 25 to 90 pd). In 93.47% of the subjects, the ocular deviation after surgery reduced significantly ( $p < 0.00$ ). After the strabismus surgery, orthophoria was achieved in 15 (25%) subjects, and with excellent cosmetics. After surgery, gross binocular single vision was attained in 39.3% of the exotropes and in 17.9% of the esotropes. Only 30% of the parents were aware about the strabismus and the treatment modalities. Nearly 90% of the parents were satisfied with the cosmetic outcome. **Conclusion:** Horizontal and bilateral strabismus has good surgical outcome with improved cosmetic acceptance.

**Keywords:** Exotropia, esotropia, strabismus surgery, parental understanding

#### Introduction

Strabismus, which is present in approximately 4% of the population (Coats et al, 2005), represents a complex problem of eye alignment, binocularity and cosmetics. If strabismus occurs before visual maturity, abnormal binocular interaction that alters the binocular depth perception resulting in amblyopia, suppression

and anomalous retinal correspondence develops. And if strabismus occurs after visual maturity, functional problem such as diplopia becomes markedly predominant (Dumian et al, 2011).

Strabismus presents a detrimental effect to the patients' quality of life (Beauchamp et al, 2006). The literature shows that strabismus is associated not only with functional effects but with negative psychological changes affecting all aspects of life as well. Negative attitudes of children to a strabismic peer are evident from the age of five (Koklanis et al, 2006).

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Patching regimes have also been shown to have a negative impact on a child's psychosocial well-being, increasing bullying and stigmatization (Menon et al, 2002; Bhandari et al, 2012), which can continue into adulthood (Kothari et al, 2009). Negative psychological effects of strabismus in adults include a negative self-image such as a lack of confidence and a low self-esteem and negatively affect job prospects, relationships, education and sports (Kothari et al, 2009; Burke et al, 1997; Hatt et al, 2007; Nelson et al 2008; Jakson et al, 2006; Durmian et al, 2009; Bez et al 2009). These difficulties have been reported to worsen both with increasing age and the severity of the strabismus (Durmian et al, 2009).

Strabismus surgery is performed to re-establish normal structural and functional relationships. The objective of treatment of strabismus in patients with potential for binocularity is to restore normal binocular vision and stereopsis (Durmian et al, 2011). The published reports in this regard support the psychosocial benefits (Durmian et al, 2011) and improvement of interpersonal interactions after strabismus surgery (Burke et al, 1997). Reports on the clinical outcomes of strabismus surgery in the Nepalese population are scarce.

The present study was carried out to evaluate the outcomes of strabismus surgery in terms of alignment, cosmetics, binocularity and also to assess parental understanding related to the strabismus and the satisfaction of the strabismus surgery.

## **Materials and methods**

### ***Subjects and sample size***

An interventional study was carried out among patients having strabismus of constant and bilateral deviation of more than 20 PD who presented to the Pediatric Eye Clinic, BP Koirala Lion's Centre for Ophthalmic Studies (BPKLCOS) from December 2006 to June 2008. Informed consent was obtained from all the parents and/or the subjects for inclusion in the

study, possible surgical intervention and photographic documentation. A total of 143 strabismic subjects were evaluated in the clinic during the 18 months. However, only 60 subjects consented to participate in the study; and cases having vertical deviations and paralytic strabismus were excluded.

### ***Assessment***

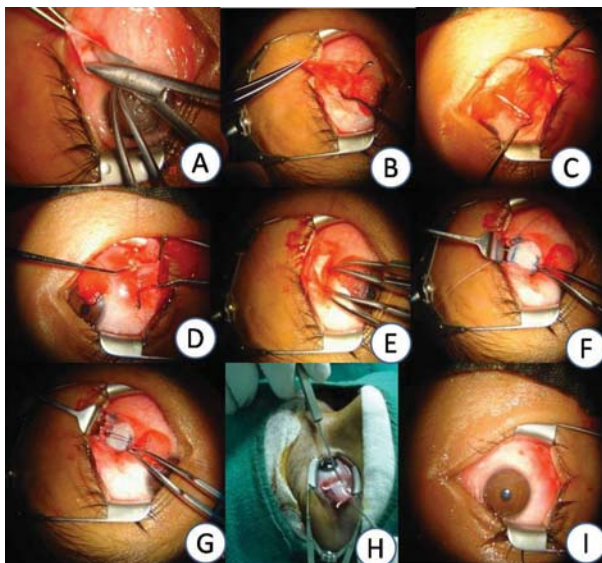
Every patient underwent a detailed ocular examination including visual acuity assessment, orthoptics evaluation, slit-lamp biomicroscopy, cycloplegic refraction and a dilated fundus examination before being subjected to the strabismus surgery.

Visual acuity (V/A) was assessed by using the Snellen's chart in adults and a Catford drum or Lea Symbols in children. Ocular motility examination was carried out with the help of a torch light in all positions of gaze. The cover test was performed using near and far fixation targets and the amount of deviation was measured in the primary gaze by the prism cover test or the Krimsky loose prism test after appropriate correction of refractive error. The Worth-four-dot test (WFD) was performed in each subject to rule out suppression in the strabismic eye. If the suppression was absent, the possibility of a presence of fusion was assessed with a second degree fusion target in the synaptophore and the presence of the stereopsis was measured with the Titmus stereo test. Detailed ocular examinations were performed with indirect ophthalmoscopy, slit-lamp bio-microscopy and cycloplegic refraction after pupil dilatation with cyclopentolate HCL 1.0% instilled three times at a 5-minutes-interval.

### ***Surgical intervention and post-operative evaluation***

After pre-anesthetic work-up, strabismus surgery was planned according to the angle of deviation, following Marshall Park's formula. The strabismus surgery in all subjects using the fornix

approach under general anesthesia was performed by a single surgeon (AS) (Figure 1).



**Figure 1: Surgery for horizontal strabismus** (A: Conjunctival incision and Tenon's excision; B: Identification and hooking of the muscles C: Jameson's muscle hook insertion and septa excision; D: Suturing and securing of muscle with a double-armed 6.0 Vicryl suture; E: Muscle disinsertion with Westcott scissors; F: Measurements and markings of sclera with dye for recession; G: Muscle recession completed; H: Resection of Muscle; I: Closure of conjunctiva with 8.0 Vicryl sutures)

Bilateral symmetrical muscle surgery was done in all the cases with minimal soft-tissue damage using the curved-fixation forceps, muscle hooks and tissue retractors. Post-operatively, the eyes were patched at the recovery room and a combination of topical antibiotics and steroids was started after two hours of the surgery. Besides an oral non-steroidal anti-inflammatory drug, an ophthalmic steroids-antibiotic ointment to be applied at bed time and lubricating eye drops were also prescribed. Post-operative evaluations of the subjects were scheduled for 4, 8 and 12 weeks. The post-operative examination of the eyes included visual acuity measurement,

refraction, ocular alignment, intra-ocular pressure measurement, and parental satisfaction-evaluation for cosmetic appearance. The parents were asked to rate their satisfaction related to the surgical outcome at 8 to 12 weeks after the surgery as excellent, good, satisfactory or poor. An excellent rating meant the parents did not notice any strabismus in the child during the 8 to 12 weeks after surgery. A good rating represented their noticing a slight strabismus occasionally, during any gaze. A satisfactory rating represented a slight strabismus present all of the time. And a poor rating represented their dissatisfaction with the residual amount of deviation noticed.

### Analysis

The parameters of the study were the age of the subjects, pre- and post-operative visual acuity, angle of deviation, binocular vision, surgical outcome including cosmetics, any post-operative complications, re-operative requirement and the parental understanding about the strabismus and the treatment modalities.

### Results

The subjects' characteristics of the strabismus surgery are presented in Table 1. Out of the 60 patients who underwent the strabismus surgery, 32 (53.3%) had esotropia (ET) and 28 (46.7%) exotropia. The majority of the subjects were between 9 to 25 years (66.6%); and the age ranged from 3 to 35 years, with the mean age and standard deviation of  $16.6 \pm 8.5$ . The male to female ratio was 1:1. Esotropia was predominant in those below 15 years of age and exotropia was predominant in those above 15 years ( $p= 0.04$ , OR 3). Esotropia and exotropia greater than 30 PD was present in 28 (87.5%) and 25 subjects (89.3%), respectively.

**Table 1: Characteristics of the strabismus**

Category		No (%)	Esotropia	Exotropia	P*	OR (96% CI)
Age distribution	<15 years	30 (50)	20 (62.5)	10 (35.7)	0.04	3 (1.04-8.60)
	>15 years	30 (50)	12 (37.5)	18 (64.3)		
Sex	Male	30 (50.0)	15 (46.9)	15 (53.6)	0.61	0.7 (0.27-2.11)
	Female	30 (50.0)	17 (53.1)	13 (46.4)		
Laterality (Dominant eye)	Right eye	28 (46.7)	14 (43.7)	14 (50.0)	0.62	0.8 (0.28-2.15)
	Left eye	32 (53.3)	18 (56.3)	14 (50.0)		
Preoperative magnitude	21-30Δ	7 (11.7)	4 (12.5)	3 (10.7)	0.83	1.2 (0.24-5.84)
	31-110Δ	53 (88.3)	28 (87.5)	25 (89.3)		
Total		60 (100)	32 (53.3)	28 (46.7)		

\*Significant at 0.05 by extended Chi-square test within the group; OR= Odds ratio

The distribution of the subjects based on the refractive status is presented in Table 2. Emmetropia was present in 43.3% of the subjects, followed by astigmatism in 26.7% and hypermetropia in 21.7%. The magnitude of the refractive error ranged from +0.50 to +1.50 D for hyperopia, -0.50 to -2.00D

for myopia and 0.50-1.50DC for astigmatism. Emmetropia (43.7%) and hypermetropia (31.2%) were most common in esotropia, while emmetropia (42.9%) and astigmatism (37.7%) were most common in exotropia.

**Table 2: Refractive error in strabismus**

Category		No (%)	Esotropia	Exotropia	P*
Refractive status	Myopia	5 (8.3)	2 (6.3)	3 (10.7)	0.94
	Hyperopia	13 (21.7)	10 (31.2)	3 (10.7)	
	Astigmatism	16 (26.7)	6 (18.8)	10 (37.7)	
	Emmetropia	26 (43.3)	14 (43.7)	12 (42.9)	
	Ametropia				
Total		60 (100)	32 (53.3)	28 (46.7)	

**Figure 2: Pre-operative and post-operative findings of the strabismus surgery**



(A: A 9-year-old female child with RE esotropia; B: A 5-year-old female child with LE esotropia; C: A 19-year-old female with RE exotropia)

The pre- and post-operative strabismus findings are presented in Figure 2 and Table 3. Out of 15 (25.0%) subjects with post-operative orthophoria, seven and eight subjects had pre-operative esotropia and exotropia, respectively. Twelve subjects (20%) with pre-operative esotropia had post-operative residual deviation of less than 10 pd while 13 subjects (21.7%) with pre-operative exotropia had residual deviation of less than 10 pd. Thirteen subjects (21.6%) with pre-operative esotropia had post-operative residual deviation greater than 10" while only seven subjects (11.7%) with preoperative exotropia had residual deviation of greater than 10 pd.

**Table 3: Characteristics of pre-operative and post-operative deviation**

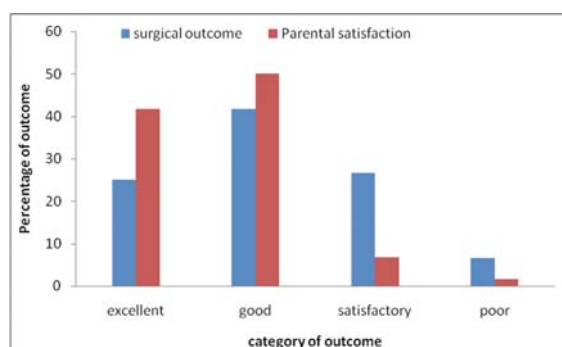
Post-operative	Residual deviation	No (%)	Pre-operative			
			Esotropia		Exotropia	
			21-30Δ No (%)	31-110Δ No (%)	21-30Δ No (%)	31-110Δ No (%)
ET	>21Δ	2 (3.3)	---	2 (7.1)	---	---
	11-20Δ	11 (18.3)	---	11 (39.3)	---	---
	<10Δ	12 (20)	1 (25.0)	11 (39.3)	---	---
OT	0Δ	15 (25)	3 (75.0)	4 (14.3)	3 (100)	5 (20.0)
XT	<10Δ	13 (21.7)	---	---	---	13 (52)
	11-20Δ	5 (8.4)	---	---	---	5 (20.0)
	>21Δ	2 (3.3)	---	---	---	2 (8.0)

ET= esotropia; OT= orthophoria; XT= exotropia

The surgical outcome of the strabismus surgery and the parents' satisfaction is presented in Figure 3. After strabismus surgery, 15 subjects (25%) attained an excellent outcome with the orthophoria; 25 subjects (41.7%) attained a good outcome, with a residual deviation of less than 10 pd, and 16 subjects (26.7%) attained a satisfactory outcome, with a residual deviation between 11 to 20 pd deviation. The surgical outcome was found to be poor in four subjects (6.6%). The pre-operative mean esotropia with standard deviation was  $48.2 \pm 14.8$  pd and the post-operative residual esotropia was  $9.4 \pm 6.1$  pd. The pre-operative mean exotropia was  $57.8 \pm 14.2$  pd and the post-operative residual exotropia was  $8.1 \pm 5.8$  pd. The difference in the magnitude of the strabismus before and after the strabismus surgery was found to be significant for both esotropia (0.00) and exotropia (0.00).

Almost 42% (41.7%) of the parents were satisfied with the excellent result, in 25 subjects, followed by 50% of the parents with the good results, in 30 subjects. Almost 7% parents found the surgical outcome satisfactory and about 2% of the parents found the surgical outcome poor.

**Figure 3:** Surgical outcome and parental satisfaction



for the strabismus surgery

The status of the binocular vision is presented in Table 4. Binocular single vision was absent before strabismus surgery in all the subjects in the study. However, after the strabismus surgery, gross stereopsis of 3000" of arc was present in six subjects (18.7%) with esotropia and in 11 subjects (39.3%) with exotropia. Amblyopia was present in 15 subjects (46.9%) with esotropia and in five subjects (17.9%) with exotropia.

**Table 4: Post-operative status of BSV**

Category	Classification	No (%)
BSV in esotropia	Gross	6 (18.7)
	Absent	26 (81.3)
BSV in exotropia	Gross	11 (39.3)
	Absent	17 (60.7)

## Discussion

The outcome of strabismus surgery can be defined by different measures such as the type of strabismus, magnitude of pre-operative deviation, age at the initiation of the strabismus surgery, type of strabismus surgery, post-operative alignment, binocularity and cosmetics (Keenan & Willshaw, 1994; Chatzistefanou et al, 2013; Wang & Nelson, 2010; Maruo et al, 2000; Wong, 2008; Simonsz & Kolling, 2011; Birch, 2006; Thomas, 2010).

In our study, the surgical outcome was accepted as successful in terms of the alignment of the eyes within 20 pd. The parents' satisfaction related to the cosmetics and the binocular vision were also assessed. A successful outcome was found in 56 subjects (93.4%), with a residual deviation of less than 20 pd and in 40 subjects (66.7%) with a residual deviation of less than 10 pd. Currie et al (2003) reported an outcome in 77 % of the cases within 10 pd, and 85% within 15 pd of residual deviation. Ganguly and Pradhan (2011) reported successful monocular surgery of large-angle, horizontal deviations at 81.2% within 10 pd. The difference in the results of success could be related to the different surgical techniques used in the correction of the strabismus, the criteria of the residual strabismus and the age ranges.

In our study, the results were found to be poor in four subjects (6.6%) that required re-operation. Various post-operative complaints such as suture irritation (25%), dry eye (25%) and diplopia (25%) were also reported in the initial period post operatively. One subject had a dellen formation. There was no slipped or lost muscle or globe perforation. These complaints gradually disappeared on subsequent follow-ups.

In the study by Ganguly and Pradhan (2011), the re-operation rate was reported to be 19%, owing to the pre-operative large-angle deviations or post-operative consecutive deviations. In our study, the need for the re-operation was only a pre-operative, large-angle of deviation.

In our study, the majority of subjects (88.3%) presented after the age of eight years. Strabismus of greater than 30 pd was present in 88.3% having hyperopia of less than 1.50 ds, myopia less than 2.00 ds and astigmatism less than 2.00 ds. So, the presence of strabismic amblyopia was quite frequent in our study (33.3%). Binocular single vision was absent before strabismus surgery in all the subjects in the study. However, after strabismus surgery, gross stereopsis of 3000" of arc was present in 17 subjects (28.3%). Fatima et al, (2009) reported true stereopsis after 6 weeks among 33 % of cases with long-standing, large-angle deviations. Keenan and Willshaw (1994) achieved binocular single vision in 39 children (93%) after strabismus surgery for childhood exotropia. Mets et al, (2004) reported improved binocular function in 30 strabismic adults (42%) after surgical correction in strabismus. So, the majority of patients with good vision with non-fusing, large-angle, chronic strabismus can regain fusion and stereopsis after successful visual alignment. However, an early onset and late presentation of strabismus hinders the development of binocular vision and the outcome. The late presentation in our study was attributable to belief in our communities that strabismus is the sign of good luck and they do not want to go for eye check up in hospital. Some parents also believed that surgery should not be performed at an early age.

The level of awareness of the parents regarding the positive effects of strabismus surgery and their satisfaction of the results of the surgery are, naturally, related. Upon asking them questions related to their knowledge on the treatment modality, only 20 parents (33.3%) were aware about the surgical option for strabismus. After surgical intervention, the result surprised many of them when they saw that the post-surgery cosmetic appearance, compared to that of the pre-operative, was so greatly improved.

The limitations of our study included our inability to complete an assessment of the



functional benefit because most of the patients had presented after their visual maturation with compromised binocularity. We also could not subject the parents with standard questionnaires for the assessment of satisfaction. So, in the majority of the cases, the findings are largely limited to the cosmesis, in spite of some cases having gross stereopsis. A post-operative, adequately long-term follow-up to assess the final outcome was also not scheduled.

### Conclusion

Horizontal and bilateral strabismus has excellent surgical outcome with improved cosmetic acceptance and stereopsis.

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