Medbiotech Journal

Research Paper

MBTJ, 6(2): 85-90, 2022

Comparison of surgical complications between unilateral or bilateral strabismus surgeries

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Received: 11 March 2022 Accepted: 15 April 2022 Published: 25 July 2022

Abstract

Strabismus is defined by non-coaxial eyes. In bilateral cases, this operation can be done unilaterally or bilaterally. This study evaluated the effectiveness, results, and unilateral or bilateral strabismus surgery complications. This clinical trial was performed in 2021 in Ahwaz, Iran, on 70 patients with bilateral strabismus candidates for surgical treatments. Patients were randomly divided into two groups: patients who underwent surgery in one eye (R&R) and patients who underwent surgery in both eyes (bilateral resection). The deviation before surgery, the first day after surgery, the first week, one month, and six months after surgery were measured. The deviation reduction in the two groups was compared with each other. Also, the rate of postoperative refraction, the need for reoperation, complications of surgery (including red eyes, enophthalmos, limited eye movements, etc.), and patient satisfaction were recorded and compared. 23 patients that underwent unilateral surgery (R&R) and 47 patients that underwent bilateral surgery. The data indicated a significantly higher frequency of red-eye in 1 day and one week after the surgery in the unilateral group (P= 0.02 and P= 0.01 respectively) and substantially higher eye discharges in patients undergoing unilateral surgery (P= 0.04). We also showed that diplopia was more frequent in unilateral group 1 week, one month, and six months after surgeries (p= 0.03, P= 0.04, and P= 0.03 respectively). A significantly higher frequency of restricted eye movement was observed in the unilateral group 1 month after operations (P= 0.03). 80.8% of the bilateral surgery group and 8.7% of patients in the unilateral group were satisfied with their condition (p-value = 0.04). Performing bilateral strabismus surgery could have significantly lower minor complications compared to unilateral approach.

Keywords: strabismus, surgery, unilateral, bilateral, complication.

1. Introduction

Strabismus is defined by non-coaxial eyes, a common disorder with a prevalence of 1 to 4% (1). Strabismus is a type of ophthalmic problem in which the eyes are in a heterogeneous position relative to each other, and they look in different directions. This heterogeneity may be apparent, or it may exist only occasionally (2). While one eye looks straight ahead, the other eye is turned inward, outward, up, or down. The prevalence of strabismus varies in different parts of the world. Studies in African children have reported between 0.5-4.4% and in other parts of the world between 0.9-7.4 percent (3, 4).

Attached to each eye's outer wall are six muscles responsible for controlling eye movements. In each eye, two eye muscles move to the right or left. The other four muscles are responsible for moving the eye up and down or controlling the oblique movements of the eye (5). For both eyes to focus on a specific sign, all the eye muscles must be in harmony with each other and the muscles of the opposite eye (6).

Any cause that interferes with this coordination can lead to strabismus. The controlling role of the male brain in the eye muscles is vital. Therefore, children

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with brain diseases such as cerebral palsy, cerebral palsy, hydrocephalus, and brain tumors are more likely to develop strabismus. Any factor that leads to vision loss, such as refractive error, cataracts, eye injuries, etc., can be a factor for strabismus (7-9, 19).

Types of strabismus include inward deviation of the eye (isotropia), outward deviation of the eye (exotropia), vertical upward departure of the eye (hypertropia), or lower (hypotropia). Also, in another classification, strabismus is divided into two types: comitant and incomitant. In comitant strabismus, the angle of deviation in looking in different directions remains constant and is the most common type of strabismus. In the incomitant type (also called paralytic strabismus), the degree of deviation in looking in different directions varies (10, 11).

Strabismus surgery is corrected by surgery on the extraocular muscles in one or both eyes, which involves weakening or strengthening the muscle as needed (12). The eyes are pulled mechanically. Anesthesia is required for pediatric strabismus surgery, but adult surgery with local anesthesia is also possible. Recovery is rapid, and the patient often returns to normal activities within a few days. After surgery, it is sometimes necessary to wear glasses or a prism. As with any surgery, surgery on the eye muscles is associated with risks. These risks include infection, bleeding, and other rare complications leading to vision loss (13).

This operation can be done on one eye or simultaneously on two eyes in bilateral cases. Different studies have reported different results in terms of efficacy and complications in these patients. This study aimed to evaluate the effectiveness and effects, and complications of strabismus surgery in one eye compared to two eyes and to use the results to decide on an appropriate treatment approach.

2. Methods and Material

This clinical trial was performed in 2021 in Imam-Khomeini hospital affiliated with Ahwaz University of Medical Sciences. The current study was conducted on patients with bilateral strabismus candidates for surgical treatments. The study was accepted by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.HGOLESTAN.REC.1399.101).

The inclusion criteria were diagnosing bilateral strabismus by expert ophthalmologists, candidates for surgical interventions, and signing the written informed consent to participate in this study. The exclusion criteria were follow-up time less than six months, deviation more significant than 50-45 diopter prisms, incomplete data in patient's medical documents, and patient's will to exit this study.

Patients entered the study based on the inclusion and exclusion criteria. Demographic data of patients such as age, gender, type of strabismus, and preoperative deviation angle were collected. Patients were then divided into isotropic and exotropic groups based on the type of strabismus. Then, in each group, patients were randomly divided into two groups using Random Allocation software: patients who underwent surgery in one eye (R&R) and patients who underwent surgery in both eyes (bilateral resection). A surgeon under general anesthesia operated on all patients, and other information such as age, sex, and preoperative vision was evaluated and standardized between groups of patients. The amount of deviation was measured using the prism bar and the cover test both at close range and near, and the amount of resection of the extraocular muscles was determined based on the calculated amount of deviation.

In each group, the amount of deviation before surgery, the first day after surgery, the first week, one month, and six months after surgery were measured. The deviation reduction in the two groups was compared with each other. Also, the rate of postoperative refraction, the need for reoperation, complications of surgery (including red eyes, enophthalmos, limited eye movements, etc.), and patient satisfaction were recorded and compared.

The obtained data were entered into the Statistical Package for Social Sciences (SPSS) version 24. Independent t-test, one-way ANOVA, chi-square, and Spearman and Pearson correlation test were used to examine the relationship between variables. P-value< 0.05 was considered as a significance threshold.

3. Results

In the present study, data of 70 patients were analyzed. Our study population consisted of 23 patients that underwent unilateral surgery (R&R) and 47 patients that underwent bilateral surgery (Bilateral Recess). The primary analysis of demographic data showed no significant differences between the two groups regarding age and gender (P= 0.23 and P= 0.35, respectively). These data are indicated in Table 1.

Table 1. Analysis of demographic data of patients.

Variable	Unilateral group (N= 23)	Bilateral group (N= 47)	P-value

Age (years) (mean± SD)		18.2± 13.0	19.3± 12.0	0.23
Gender (n (%))	Male	9 (39.2%)	19 (40.5%)	0.35
	Female	14 (60.8%)	28 (59.5%)	

Further assessments indicated a significantly higher frequency of red-eye in 1 day and one week after the surgery in the unilateral group (P= 0.02 and P= 0.01 respectively) and considerably higher eye discharges in patients undergoing unilateral surgery (P= 0.04). We also showed that diplopia was more frequent in unilateral group 1 week, one month, and six months after surgeries (p= 0.03, P= 0.04, and P= 0.03 respectively). A significantly higher frequency of restricted eye movement was observed in the unilateral group 1 month after operations (P= 0.03). These data are indicated in Table 2.

We found no significant differences between patients regarding Visual acuity. We observed the visual acuity of the right eye was 4.4± 3.3 in the unilateral group and 4.1± 3.4 in the bilateral group (P= 0.65). The visual acuity of the left eye was 4.5± 3.5 in the unilateral group and 4.3± 3.6 in the bilateral group (P= 0.75). No significant differences were observed between patients regarding other complications (Table 3).

Table 2. Comparison of various surgical complications between two groups

Variable	Group	Before	1 day	1 week	1 month	6 months
Deviation at far (mean± SD)	Unilateral	49.3± 17.6		15.5± 15.6	12.4± 15.1	9.0± 13.6
	Bilateral	51.8± 23.4		9.8± 9.6	12.4± 11.9	10.8± 12.4
	P-value	0.96		0.29	0.55	0.26
Deviation at near (mean± SD)	Unilateral	50.1± 19.1		15.8± 15.6	12.8± 15.9	11.4± 13.7
	Bilateral	51.0± 24.1		10.1± 9.4	12.9± 13.1	9.5± 13.6
	P-value	0.54		0.29	0.05	0.22
Red eye (n (%))	Unilateral	1 (4.3%)	23 (100%)	21 (91.3%)	0	0
	Bilateral	2 (4.2%)	42 (89.3%)	24 (51.1%)	6 (12.7%)	4 (5.8%)
	P-value	0.32	0.02	0.01	0.56	0.21
Eye discharge (n (%))	Unilateral	0	5 (21.7%)	4 (17.4%)	0	0
	Bilateral	1 (2.1%)	0	6 (12.7%)	0	0
	P-value	0.56	0.04	0.25	-	-
Diplopia (n (%))	Unilateral	3 (13%)	13 (56.5%)	13 (56.5%)	8 (34.7%)	6 (26.1%)
	Bilateral	3 (6.3%)	6 (12.7%)	4 (8.5%)	2 (4.2%)	2 (4.2%)
	P-value	0.35	0.58	0.03	0.04	0.03
Restricted eye movement (n (%))	Unilateral	3 (13%)	13 (56.5%)	13 (56.5%)	8 (34.7%)	6 (26.1%)
	Bilateral	3 (6.3%)	6 (12.7%)	4 (8.5%)	2 (4.2%)	2 (4.2%)
	P-value	0.56	0.48	0.69	0.03	0.21
Enophthalmos (n (%))	Unilateral	0	0	0	2 (8.7%)	3 (13%)
	Bilateral	0	0	0	0	0
	P-value	-	-	-	0.23	0.11
Repeated surgery (n (%))	Unilateral	0		9 (39.1%)	9 (39.1%)	7 (30.4%)
	Bilateral	0		14 (29.7%)	13 (27.6%)	14 (29.7%)
	P-value	-	-	0.74	0.23	0.71

Table 3. Comparison of other complications between patients

Complication	Group	1 day	1 week	1 month	6 months	p-value
Corneal epithelial defect (CEC)	Unilateral	0	1	1	0	0.62
	Bilateral	1	2	0	0	
Dellen ulcer	Unilateral	0	0	0	0	0.45
	Bilateral	0	2	2	2	
Conj suture removal	Unilateral	0	2	2	2	0.23
	Bilateral	0	0	0	0	
Conj Cyst formation	Unilateral	0	0	0	0	0.21
	Bilateral	2	2	1	0	
Head turn	Unilateral	0	0	0	0	0.13
	Bilateral	0	0	0	1	
Bare sclera	Unilateral	0	0	0	0	0.65
	Bilateral	0	1	0	0	
Without complications	Unilateral	23	20	20	20	0.22
	Bilateral	44	40	44	44	

Figure 1 shows the patient's satisfaction with the type of surgery. 80.8% of the patients in the bilateral surgery group and 8.7% of patients in the unilateral group were satisfied with their condition,

and the rest of the patients were dissatisfied with surgery. The Chi-square test with an error rate of 0.05 and confidence of 95 showed a significant difference in patient satisfaction between the two study groups (p-value = 0.04).

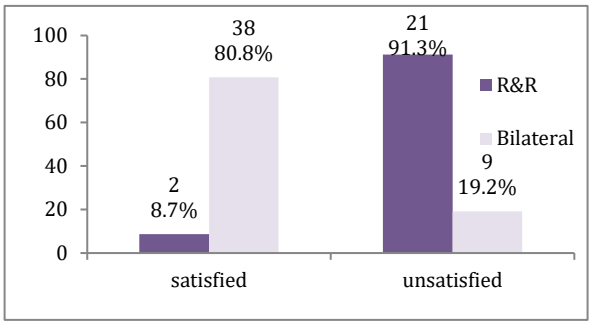

Figure 1: Comparison of patient's satisfaction based on treatment group.

4. Discussion

In the present study, we investigated the effectiveness and complications of unilateral vs. bilateral strabismus surgery. Based on our findings, patients that underwent unilateral strabismus surgery had a significantly higher frequency of red-eye, eye discharges, diplopia, and restricted eye movement. On the other hand, patients that underwent bilateral surgeries had significantly higher satisfaction rates. These data show that bilateral surgical operations have higher effectiveness and lower complications compared to the unilateral approach.

Few previous studies have evaluated the complications of these two approaches. In 2020, Bommireddy and colleagues explored the importance of strabismus surgery in the United Kingdom. They reported that the prevalence of strabismus in children was 2.1%, and many children required surgical approaches. Examining the methods for assessing strabismus in these children, they stated that performing surgery simultaneously can reduce complications such as redness, diplopia, and limited eye movements for children with both eyes with strabismus. This issue should be further investigated (14). Another study in 2020 by Riddering and others studied 36 patients with strabismus, reporting that 19 patients underwent bilateral surgery and 17 patients underwent unilateral surgery. The primary purpose of this study was to evaluate the results and complications of surgery performed by residents and attending, which stated that the time of surgery and minor complications such as redness, infection, and postoperative diplopia were higher in patients operated by residents. Still, they also reported that, in general, the rate of these complications was lower in patients who underwent bilateral surgery. These results indicate bilateral strabismus surgery's greater importance and effectiveness (15). The results of our study were in line with the findings of these reports showing lower complications in bilateral surgery compared to unilateral.

Another study was conducted in 2014 by Wan and others in the United States to examine the incidence and severity of complications of strabismus surgery. This study showed that local complications such as redness and eye infection were the most common complications that could not cause severe complications in the long term. On the other hand, complications such as muscle damage, muscle loss, and stretch marks are among the rare complications of this surgery that have long-term effects. They also noted that in patients whose eyes require strabismus surgery, bilateral surgery could help reduce possible complications (16). In a 2016 study, David and others also investigated the data of 90 patients who were followed for an average of 1 year. According to this study, 46.2% of children who underwent surgery for cataracts developed strabismus and required reoperation. In the meantime, it was stated that the complications of unilateral or bilateral strabismus surgery might be variable, and therefore it was recommended that both eyes be operated on simultaneously. Although they did not provide a comprehensive explanation of the existing complications, they suggested that comprehensive studies be conducted on these complications (17). Based on the results of our study, frequency of red-eye, eye discharges, diplopia, and restricted eye movement were significantly higher among patients undergoing unilateral surgery, and these patients had significantly lower satisfaction.

According to our results, unilateral strabismus surgery had higher rates of complications, and as a result, we suggest that the bilateral approach should be considered in these patients. There are also some other studies that reported different results compared to our research. In 2017, a study by Jain et al. in India examined 40 patients. They showed no difference in complications and treatment outcomes between patients who underwent unilateral and bilateral surgery (18, 20-22). Another study by Donahue et al. in 2017 found that there was no significant difference in complications and outcomes of unilateral or bilateral surgery (23-26). Menon and colleagues reported similar results after evaluating 20 patients (27-29). We believe that the most important reason that led to the difference between the results of our study and these studies is the difference in the number of patients studied and the postoperative

care conditions in these studies. In this study, we examined 70 patients who are more than mentioned in terms of recurrence and also spent more time in regular visits and care.

There have also been other studies on the complications of strabismus surgery. Studies have shown that the most common complications of strabismus surgery are eye instability and diplopia. Research shows that most diplopia problems caused by strabismus surgery are temporary, but they can sometimes be permanent. Serious risks and acute issues such as vision loss, infection, bleeding, retinal detachment, or complications from anesthesia are rare. These results were in line with the results expressed by our study. However, as noted earlier, minimal studies have examined these outcomes in patients undergoing unilateral or bilateral strabismus surgery. In this study, for the first time in Iran, we examined the complications of strabismus in unilateral and bilateral surgeries. We showed that performing these surgeries bilaterally has more minor complications. Also, another point that should be considered is that performing bilateral surgeries reduces readmission and re-surgery, which reduces the burden imposed on the country's health care system.

5. Conclusion

Performing bilateral strabismus surgery could have significantly lower minor complications than the unilateral approach. These data were in line with some previous studies, but we also believe that further research should be conducted on this issue.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Funding

This article is extracted from final thesis of Dr Zohre Taheri for his course of ophthalmology residency with registration number (IORC-9905). This study was supported by Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

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