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Effect of scleral buckle removal on strabismus surgery outcomes after retinal detachment repair

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Abstract

Background/Aims—To investigate the effect of scleral buckle removal on the outcomes of strabismus surgery in patients with a prior history of retinal detachment surgery.

Methods—We reviewed the medical records of 18 patients who underwent strabismus surgery following a scleral buckling procedure at one institution. We investigated the effect of multiple variables on outcome, including: gender, age, surgeon, number of strabismus surgeries, adjustable suture use, previous pars plana vitrectomy, preoperative best-corrected visual acuity and time of surgery. Outcomes were considered successful if there was ≤ 10 prism diopter (PD) residual horizontal and/or ≤ 4 PD residual vertical deviation. Outcomes were analyzed statistically using Fisher's exact test and Mann-Whitney test.

Results—Strabismus surgery coupled with scleral buckle removal was associated with a higher rate of success (success with buckle removal, 62.5%; success without buckle removal, 10.0%; $p=0.04$). There were no significant difference in preoperative findings between the scleral buckle removal and non- removal groups. No retinal redetachments occurred after scleral buckle removal.

Conclusion—In our series, scleral buckle removal was associated with improved surgical outcome in patients with strabismus following a scleral buckling procedure.

Keywords

strabismus; retinal detachment

Introduction

Strabismus following retinal detachment surgery may resolve spontaneously,^{1,2} but in 5% to 25% of cases it can persist on a long-term basis.³⁻⁵ Strabismus following a scleral buckling

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procedure may occur on a sensory basis,⁶ from peribulbar anesthesia myotoxicity⁷ or mechanical factors related to the implantation of a scleral buckle. These mechanical factors may arise secondary to direct muscle injury,^{3-5,8} adhesions between muscle, sclera, and fat,^{9,10} the bulk effect of scleral buckling elements beneath extraocular muscles,^{3,5} or the redirection of muscle force vectors either directly or indirectly by the buckle.^{11,12}

When planning the surgical approach for a patient with strabismus following a scleral buckling procedure, the question of whether to remove a scleral buckle frequently arises. If the buckle is the obvious cause of the strabismus, the value of removing the buckle before or during strabismus surgery may be apparent.^{13,14} However, the benefit of scleral buckle removal is often unclear. Some authors have suggested that the removal of a scleral buckle does not affect the outcome of strabismus surgery in most cases,^{3,5} while others have recommended buckle removal to relieve restriction⁴ and even suggested that removal of the scleral buckle alone can improve ocular alignment and consider buckle removal to be the logical first step correcting strabismus in these patients.² Scleral buckle removal is also complicated by the risk of retinal redetachment.¹⁵⁻¹⁸

We retrospectively reviewed the outcomes of strabismus surgery at one institution for patients who had previously undergone a scleral buckling procedure.

Methods

This retrospective study was approved by the institutional review board at Emory University School of Medicine. The data used for this analysis were treated in accordance with the Health Insurance Portability and Accountability Act (HIPAA) and the tenets of the Declaration of Helsinki.

We reviewed the medical records of patients who underwent strabismus surgery following retinal detachment surgery at the Emory Eye Center between 1989 and 2010. Patients were identified from a large database of adult strabismus surgery patients and by searching for adult patients with the ICD-9 code for retinal detachment (361.00-361.09) and strabismus surgery (67311, 67312, 69314, 69316, or 67318) between 1996 and 2010.

We excluded patients known to have strabismus prior to retinal detachment surgery and ocular comorbidities that could have caused restrictive strabismus (e.g. thyroid ophthalmopathy, orbital trauma, etc). We also excluded patients who incurred unintended muscle injuries during scleral buckling procedures such as rupture of a muscle or peribulbar anesthetic myotoxicity. Finally, we excluded patients with a follow-up of less than one month after the final strabismus surgery.

To be included in the analysis, patients must have undergone a surgical procedure to treat retinal detachment that included the placement of a scleral buckle with or without a pars plana vitrectomy. If it was deemed possible that removal of the scleral buckle would improve the outcome of strabismus surgery, patients were referred to a retina surgeon prior to strabismus surgery to determine the risk of retinal detachment if the scleral buckle was removed. Risk was assessed based on the history of the patient and the clinical examination of the retina surgeon. Factors considered included history of proliferative vitreoretinopathy,

presence of giant retinal tear, number of operations required to achieve reattachment, length of time since last retinal operation, and any visible traction on the retina.

We extracted the following data from the medical record for each patient: gender and age, strabismus surgeon, type of strabismus surgery or surgeries, the timing of scleral buckle removal relative to strabismus surgery, whether the scleral buckle was partially or completely removed, whether the patient had previously undergone pars plana vitrectomy, whether an adjustable suture technique was used, preoperative best-corrected visual acuity, preoperative horizontal and vertical ocular alignment, horizontal and vertical ocular alignment at the last follow-up examination, pre- and postoperative ductions, postoperative prism use, the length of follow-up after strabismus surgery and whether the strabismus surgery was performed between 1989-1999 or 2000-2010. Ocular alignment was assessed using the alternate prism cover test except in patients with a severe visual deficit. We did not evaluate torsion since it was inconsistently documented in the medical records. Although the reasons for scleral buckle removal or non-removal were not always documented in the medical record, when available, the reasons are shown in Table 1. Because of the retrospective nature of this study, the same structured data were not available for all patients.

Because of many variables present in our series and the small sample size of our study, we grouped patients together into larger groups to facilitate statistical analyses. In regards to strabismus surgery, we analyzed three variables. First, whether the scleral buckle was removed before or at the time of strabismus surgery. Second, the number of strabismus surgeries performed. And lastly, whether the adjustable suture technique was used during strabismus surgery.

For descriptive purpose, esodeviation was assigned a negative value and exodeviation a positive value. For vertical deviation, the right eye was the reference eye. Right hypodeviation was assigned as a negative value and right hyperdeviation as a positive value.

We defined strabismus surgery as being successful when the final postoperative horizontal deviation was ≤ 10 prism diopters (PD) and the final postoperative vertical deviation was ≤ 4 PD.

Two-tailed Fisher's exact test was used to determine whether there was a significant difference in surgical success as defined when the following factors were analyzed: gender, surgeon who performed the strabismus surgery, the number of strabismus surgeries, scleral buckle removal, the performance of a pars plana vitrectomy, use of adjustable sutures, poor vision and strabismus surgery between 1989-1999 or 2000-2010. Poor vision was defined as visual acuity $< 20/200$. Mann-Whitney test was used to evaluate the effect of patient's age on surgical success.

Since the scleral buckle removal was found to be significantly related to surgical success from the primary analysis, we looked into whether there was a difference in the frequency of other variables between the scleral buckle removal and non-removal groups. The two-tailed Fisher's exact test was performed for nominal variables and Mann-Whitney test was used for the continuous variable (e.g age). All statistical analysis was performed using SPSS version 16.0 (SPSS Inc., Chicago, Illinois) and p value for significance was set at 0.05.

Results

The medical records of 23 patients who had undergone strabismus surgery at our institution following a scleral buckling procedure were reviewed. Two patients were excluded because their strabismus was judged to be secondary to the rupture or loss of an extraocular muscle during the scleral buckling procedure. Another patient was excluded who was believed to have developed strabismus secondary to peribulbar anesthesia myotoxicity preceding the scleral buckling procedure. Finally, two cases were excluded because their follow-up was less than one month.

Statistical analyses were performed on the remaining 18 patients. The clinical characteristics of the patients are shown in Table 1 (web only). The mean patient age at the time of strabismus surgery was 48 years (range, 14 to 67 years). The patients were evenly divided between males and females. The median follow-up was 3.4 months (range, 1.5 to 59 months). Their preoperative horizontal deviations ranged from 25 PD esodeviation to 70 PD exodeviation (median, 20 PD exodeviation) and the preoperative vertical deviations from 25 PD right hypodeviation to 35 PD right hyperdeviation (median, 0 PD vertical deviation). Eight patients had both horizontal and vertical deviations. Seven patients only had horizontal deviations and three patients only had vertical deviations. According to our criteria, the overall success rate was 33% (6 of 18 patients). The median preoperative best-corrected visual acuity of the post retinal detachment eyes was 20/100 (range, 20/20 to counting fingers). All of the operated eyes had worse visual acuity than the fellow eyes. The median best-corrected visual acuity of the fellow eyes was 20/20 (range, 15/20 to 20/30).

Scleral buckles were removed from 8 patients. The buckle was removed at the time of strabismus surgery in 7 patients and prior to strabismus surgery in one patient. Complete buckle removal was performed on 6 patients and partial removal on two patients. In two patients, extrusion of the scleral buckle prompted its removal. One (patient 8) of the extruded implants was a hydrogel explant (Miragel, Medical Instruments Research Associates, Waltham, Massachusetts). Reasons cited for not removing the scleral buckle included: high risk of redetachment (patient 16, with giant retinal tear), severe fibrosis around the scleral buckle (patient 7), and patient refusal (patients 5 and 9). In one patient (patient 4), the superior oblique tendon was found to be incarcerated by the encircling band. The type of scleral buckle was not always known since many of the patients had been referred from outside institutions for strabismus surgery. Two patients (patients 4 and 10) underwent two strabismus surgeries. An adjustable suture was used for 10 patients. Prisms were prescribed postoperatively for 5 patients. All strabismus surgeries were performed on post retinal detachment surgery eyes only. Three strabismus surgeons performed all of the strabismus surgeries.

Scleral buckle removal was significantly associated with successful ocular alignment following strabismus surgery (two-tailed Fisher's exact test, $p=0.04$). These results are summarized in Table 2.

Statistical tests for differences in the frequency of other variables between the scleral removal and non-removal group showed no significant difference (Table 3).

Discussion

We found that removing the scleral buckling element either before or during strabismus surgery was associated with improved ocular alignment compared to when the scleral buckle was left in place. Although some surgeons believe that scleral buckle removal seldom restores normal ocular motility,^{3,5,19} it may have improved ocular alignment in our patients for a number of reasons: 1) it may have allowed the rectus muscles to attach directly to the sclera; 2) it may have lengthened muscles that were splayed over bulky implants,^{3,20} 3) the careful dissection and lysis of adhesions during removal of the buckle may have lessened muscle restriction,^{4,21,22} 4) it may have permitted the muscles to move more freely during the adjustment procedure^{4,21} and 5) it may have freed an oblique tendon or muscle inadvertently incorporated in the scleral buckle.^{11,12}

Our overall success rate was relatively low (33%) using the criteria we chose to define success. The success rate of this procedure very much depends on what criteria is used to define success. Some series have defined surgical success as binocular vision with or without a prismatic correction or a compensatory head posture.^{12, 19, 20} Still other series have defined success used subjective factors such as 'symptomatic vs. non-symptomatic'¹⁸ or 'cosmetic improvement'.²⁰ We used the more stringent criteria of motor alignment as our definition of success. If we would have used the definition of success of patients achieving binocular single vision with a prismatic correction, our success rate would have risen to 56%. Our surgical success rate in this report in the scleral buckle removal group (62%) compares favorably with the success rate we have reported in adults with other types of strabismus following strabismus surgery.²³

Recent studies on retinal redetachment rate following scleral buckle removal report rates from 0% to 8%¹⁵⁻¹⁸ whereas earlier studies reported rates from 14%²⁴ to 47%.²⁵ These differences likely reflect improvements in surgical techniques.²⁵ For example, earlier studies of retinal redetachment often used techniques which are no longer in use (e.g. diathermy, scleral dissection and polyethylene tubing explants)¹⁶ and the many of the removal cases were incited by infected buckling elements.^{24,25} Risk factors for retinal redetachment following removal of a scleral explant include: a short interval between the primary retinal detachment repair and removal of the buckle,²⁴ the presence of retinal tears, as opposed to holes,²⁴ failure to identify retinal breaks at the time of the initial detachment surgery,¹⁶ and the presence of vitreous traction,^{17,24,25} and greater number of involved quadrant of the original retinal detachment.²⁵ Adequate application of retinopexy^{15,16} and identification of vitreous traction¹⁶ were suggested to decrease the chance of redetachment. All of the patients in our study were screened by retina surgeons prior to removal of the scleral buckle and none of the patients who had their scleral buckle removed prior to or in conjunction with strabismus surgery had any risk factors for retinal redetachment. Similarly, no retinal redetachments have been reported in other studies evaluating scleral buckle removal in conjunction with strabismus surgery.^{2,21,22} Consultation with a retinal surgeon should be obtained to assess the risk of retinal redetachment prior to scleral buckle removal.^{4,21}

The effect of scleral buckle removal without strabismus surgery is controversial. One recent report based on 5 patients postulated minimal benefit¹⁹ whereas another study reported resolution of diplopia in 4 patients after scleral buckle removal alone.¹⁵

Our study had a number of limitations. First, it was retrospective and only included 18 patients. Because the data were collected over nearly 20 years and involved three different surgeons, the same structured data were not available for all patients. Second, our sample size was small. Since strabismus surgery after scleral buckle placement is an uncommon procedure, it was difficult to analyze a large group of patients from a single institution. Indeed, the largest case series in the literature only included 20,²¹ 17,²² and 12²⁶ cases. Our small sample size limited the power of our study. However, even if the outliers had been removed from our analyses, scleral buckle removal still would have significantly correlated with the success of strabismus surgery. Third, there may have been confounding factors that many have contributed to the success of strabismus surgery other than the removal of the scleral buckle. Although we did not find a significant difference in the frequency of a number of variables between the scleral buckle removal and non-removal groups (Table 3), we cannot totally exclude the possibility of other confounding variables.

In conclusion, scleral buckle removal was associated with better ocular alignment following strabismus surgery in our series. None of these patients had retinal redetachment after scleral buckle removal.

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Patient Clinical Characteristics.

Table 1

Pt. No.	Gender	Age	Surgeon	Surgery or surgeries*	Time of Buckle Removal	Complete/Partial SB Removal	Reason of removal/no removal	PPV	Adjust	BCVA of operated eye	Preoperative deviation		Final E/U deviation		Year of strabismus surgery	Duration of F/U (months)	Surgical Success
											Hori†	Verti‡	Hori†	Verti‡			
1	F	35	1	RSR rec, RIR res	3 month before	Complete	Due to extrusion	No	Yes	20/30	10	35	0	0	1989	4.4	Yes
2	M	67	1	RSR rec	No removal		N/A	No	Yes	20/200	-12	14	20	9	1991	51.0	No
3	M	44	2	LSR rec, LIR res	No removal		N/A	Yes	Yes	20/100	0	-25	16	-20	1995	58.6	No
4	M	49	1	RLR rec, RMR res/RLR rec, RMR res, RSO repositioning	During 2nd Strabismus Surgery	Partial	Displacement of SO tendon	Yes	Yes	CF	14	14	8	2	1996	16.1	Yes
5	F	53	2	RLR rec, RMR res	During Strabismus Surgery	Partial	Reluctant remove all buckle	Yes	Yes	20/70	20	0	0	0	1996	5.5	Yes
6	F	32	1	RLR rec, RMR res	No removal		N/A	Yes	No	CF	25	0	-15	0	1999	2.1	No
7	F	62	2	LLR rec	No removal		Lessen damage to muscle, severe fibrotic muscle	Yes	No	20/100	35	0	16	0	2001	4.7	No
8	F	41	3	RMR rec	During Strabismus Surgery	Complete	Due to extrusion	No	No	20/30	-20	0	-2	0	2004	1.5	Yes
9	F	53	1	RIR rec	No removal		Patient refusal	Yes	Yes	20/200	0	-14	0	0	2005	1.5	Yes
10	F	58	3	LMR res/LLR rec	During 1st Strabismus Surgery	Complete	N/A	Yes	Yes	20/100	25	-8	-8	-6	2008	2.4	No
11	M	14		RMR res, RLR rec	During Strabismus	Complete	N/A	Yes	No	20/50	45	-4	25	0	2006	2.9	No
12	F	56	1	LIR rec, LSR and LSO adhesion lysis	During Strabismus Surgery	Complete	N/A	No	Yes	CF	50	-15	35	-14	2007	2.5	No
13	M	49	3	RMR rec	During Strabismus Surgery	Complete	N/A	Yes	Yes	20/400	-25	0	-6	0	2007	21.3	Yes
14	F	58	1	RMR rec, RLR rec, Vertical transposition	No removal		N/A	Yes	Yes	20/50	40	6	14	2	2008	3.8	No
15	M	59	1	LMR res, LLR rec	No removal		Risk of redetachment-Giant Retinal tear	Yes	No	20/25	20	0	20	0	1997	1.5	No
16	M	36	1	LMR res, LLR rec	No removal		N/A	No	No	20/80	70	0	16	-10	2001	2.8	No
17	M	31	2	RLR rec	No removal		N/A	Yes	No	20/20	20	3	0	-6	2000	2.8	No
18	M	61	1	LSR rec	No removal		N/A	Yes	No	20/25	0	-20	0	-6	2008	6.7	No

PPV, history of pars plana vitrectomy; Adjust, use of adjustable suture technique; BCVA, best corrected visual acuity; Hori, horizontal; Verti, vertical; Preop, preoperative; F/U, follow up; SR, superior rectus; IR, inferior rectus; LR, lateral rectus; MR, medial rectus; SO, superior oblique; rec, recession; res, resection; N/A, not available; SB, scleral buckle.

* */ delineates different surgical intervention.

† +, exotropia; -, esotropia.

*, right hypertropia; -, right hypotropia

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Table 2
Summary of individual variable statistic analysis

Variable	Test	p-value
Gender	Fisher's	0.37
Age	Wilcoxon	0.29
Surgeon	Not possible for ANOVA	-
Number of strabismus surgeries	Fisher's	0.70
SB removal	Fisher's	0.02*
Prior PPV	Fisher's	0.62
Adjustable	Fisher's	0.09
Poor vision (Less than 20/200)	Fisher's	0.37
Pre-op vector magnitude of deviation	Wilcoxon	0.03*

SB, scleral buckle; PPV, pars plana vitrectomy; Pre-op, preoperative. In surgeon variable, ANOVA test was not available since most of cells have less than 5 cases.

* denotes statistical significance.

Table 3
Preoperative Characteristics of Scleral Buckle Removal and Non-removal Group

Name of variable	Categories	No SB removal group (n=10)	SB removal group (n=8)	p-value
Age [†]	-	Median = 56 (interquartile range: 35-61)	Median = 49 (interquartile range: 37-55)	0.29
Gender	Male	6	3	0.64
	Female	4	5	
Surgeon	Surgeon 1	7	3	0.07
	Surgeon 2	3	1	
	Surgeon 3	0	4	
Number of strabismus surgeries	Once	10	6	0.18
	Twice	0	2	
Prior PPV	No	2	3	0.61
	Yes	8	5	
Adjustable	No	6	2	0.19
	Yes	4	6	
Poor vision	20/200	9	5	0.28
	<20/200	1	3	
Year of strabismus surgery	Before 2000	4	3	0.63
	After 2000	6	5	

SB, scleral buckle; PPV, pars plana vitrectomy; Pre-op, preoperative.

* denotes statistical significance. For all nominal variables, Fisher's exact tests were performed.

[†] Mann-Whitney tests were performed for age. The number in the cell is median and numbers in parentheses are interquartile range from 25% to 75%.