



Original research

Ocular movement disorders following scleral buckling surgery: A case series study

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Abstract

Purpose: To evaluate ocular movement disorders after scleral buckling surgery (SBS) for retinal detachment.

Methods: In this prospective, observational, case series, 206 patients (206 eyes) with rhegmatogenous retinal detachment who underwent SBS and investigated at the strabismus ward of Farabi Eye Hospital in Iran between November 2011 and November 2014 were assessed. Patients were followed from 6 to 36 months after SBS to evaluate for strabismus. Logistic regression analysis test and SPSS software version 20 were used for statistical analysis.

Results: From 206 patients, 56.8% were male, and 33.2% were female. For scleral buckle in 44.7% of patients, silicone band and tire (SBT) was used, and in 55.3%, a sponge. Among all patients, seven (3.39%) exhibited ocular movement disorder. There was no significant relation between type of buckle ($P = 0.65$) or the location of buckle ($P = 0.56$) and movement disorder.

Conclusion: Ocular movement disorder is one of the main complications after SBS without specific association between the type and location of exoplanet.

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Keywords: Scleral buckling; Ocular movement disorders; Retinal detachment; Strabismus

Introduction

One of the major treatments in rhegmatogenous retinal detachment is the scleral buckling surgery (SBS).^{1–3} Considering the detachment severity, location and number of breaks, different types of buckles with local or encircling location with or without cryotherapy and sub-retinal drainage

could be used in this procedure.^{1,2} Ocular movement disorders are common side effects of eye surgeries following retinal detachments, especially in SBS.^{3–6} In most cases, the major ocular movement disorders appear immediately after surgery.⁴ This condition, which affects about 3–50% of patients, is usually healed after 6 months.^{5,6} In non-healed patients, this situation could cause a decrease in visual quality and surgical satisfaction ratio.⁶ In 1–15% of patients treated with SBS, the deviations remain permanent because of pre-operative decompensated heterophoria or as a direct side effect of the surgery.^{5–7} Inappropriate buckle placement can cause mass effect which may lead to muscular ischemia, dehiscence, slippage, and muscle paresis and scar formation.^{4–8} All these may cause ocular movement disorders. There are several treatment options based on duration, type,

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and severity of ocular movement disorder consisting prism, botulinum toxin, and surgery.^{7,8} This study was performed to evaluate ocular movement disorders after SBS for retinal detachment, factors affecting development of deviations, and their treatments.

Methods

Study design

This prospective, observational, case series was conducted on 206 patients with rhegmatogenous retinal detachment who underwent SBS in Farabi Eye Hospital affiliated to the Tehran University of Medical Sciences (TUMS) in Iran between November 2011 and November 2014. All patients who underwent SBS were referred for this study. This study was approved by the Research and Medical Ethics Committee of Tehran University of Medical Sciences. The aim of this study was explained to the patients, and all participants signed written informed consent. The inclusion criteria of this study includes age above 10 years old, absence of any other eye disorder, glaucoma, congenital or acquired retinal disorders, visually-decreasing anterior segment disorders, absence of diplopia or any other eye movement disorder, negative history of any eye surgery such as pterygium, shunt, strabismus, and glaucoma surgery (except phacoemulsification surgery using clear corneal incision), negative history of medication with side effects on eye movement, and absence of any general neurologic diseases such as cerebral palsy or developmental delay. Exclusion criteria were the need for vitrectomy following SBS and any eye surgeries affecting the ocular movement.

Procedures and assessments

All demographic data of the patients was collected. Then patients were examined by an ophthalmologist, and fundoscopy by using slit-lamp, measurement of intraocular pressure (IOP), and anterior segment evaluation was performed. Furthermore, best corrected distance visual acuity was evaluated with logMAR chart at 6 m. The type of used buckle, location of placement, and possible use of cryotherapy during the SBS were collected. In all SBS, all 4 recti muscles were isolated after peritomy.

All cases underwent strabismus examinations before SBS by an ophthalmology resident. Patients were followed between 6 and 36 months (mean: 18.4 ± 7.3 months) after SBS to be evaluated for any possible eye movement disorder by his/her retinal surgeon. The retinal surgeon performed strabismus examinations in each visit, including alternate prism and cover test, Krimsky test (in a setting of poor vision) and if needed, Hess screen. In the cases with possible eye movement disorder, the patient was referred to the strabismus surgeon. Subjective torsion was measured by Double Maddox Rod (DMR) and major amblyoscope. Persistent diplopia and tropia (more than 4 months) was considered as persistent eye movement disorder, and these cases were followed for at least 1 year.

Statistical analysis

For statistical analysis, logistic regression analysis test and SPSS software version 20.0 (SPSS, Inc., Chicago, IL, USA) were used.

Results

According to the inclusion criteria, 238 patients were enrolled in this study, and 32 patients were excluded, considering the exclusion criteria. Finally, 206 patients (206 eyes) were studied (Table 1). The average age of the patients was 42.1 ± 18.2 years (minimum 10 and maximum 86 years old). The average visual acuity (VA) at final postoperative visit was 1.1 ± 0.6 (0.00–2.00) logMAR.

The most common site of scleral buckle implantation was supra temporal quadrant (16%). The relation between buckle site and induced tropia in all the 206 cases 4 months after SBS is shown in Table 2. All sponges were placed circumferentially.

Only seven patients had persistent eye movement disorders. Four were male, and three were female. Six cases underwent surgery with sponge alone, and 1 case underwent surgery with encircling band and segmental tire. All seven patients underwent cryotherapy and general anesthesia. Using logistic regression analysis, it was found that there was no significant correlation between the types of scleral buckle [silicone band and tire (SBT) or sponge] ($P = 0.77$) as well as the site of implanted buckle ($P = 0.99$) and development of eye movement disorder. Similarly, other factors (age, gender, laterality, VA, and cryotherapy) showed no correlation with the development of deviations. The data regarding these seven cases would be reviewed as follows, and a summary of these seven cases is shown in Table 3.

Patient 1

A 28-year-old female was referred due to the diplopia and right eye deviation caused by SBS for a duration of 18

Table 1
Characteristics information of participants.

Characteristics	Frequency (%)
Gender	
Male	117 (56.8%)
Female	89 (43.2%)
Side of study	
Right	107 (51.9%)
Left	99 (48.1%)
Scleral buckle	
Encircling band and encircling tire	22 (10.7%)
Encircling band and segmental tire	70 (34.0%)
Sponge alone	114 (55.3%)
Type of anesthesia	
Local	6 (2.9%)
General	200 (97.1%)
Cryotherapy	168 (81.6%)
Injection of SF6 gas	38 (18.4%)
Eye movement disorders	
None/transient	199 (96.61%)
Persistent	7 (3.39%)

Table 2

Relation between buckle site and induced tropia in all the 206 cases 4 months after scleral buckling surgery (SBS).

Position of buckle	ET	HT	HOT	ET + HOT	XT + HT	XT + HOT	Ortho	Total
MR	0	0	0	0	0	0	2	2
IR	0	0	0	0	0	0	32	32
LR	0	1	0	1	0	0	10	12
SR	0	0	1	0	0	1	18	20
SR + MR	0	0	0	0	0	0	6	6
SR + LR	1	0	0	0	0	0	32	33
SR + MR + LR	0	0	0	0	0	0	10	10
SR + MR + IR	0	0	0	0	0	0	2	2
SR + MR + LR + IR	0	0	0	0	0	0	22	22
IR + LR	0	0	0	0	0	1	25	26
IR + LR + MR	0	0	0	0	0	0	0	18
IR + MR	0	0	0	0	0	0	10	10
SR + IR + LR	0	0	0	0	1	0	12	13

MR: Medial rectus muscle; IR: Inferior rectus muscle; LR: Lateral rectus muscle; SR: Superior rectus muscle; ET: Esotropia; HT: Hypertropia; HOT: Hypotropia; XT: Exotropia; Ortho: Orthotropia.

Table 3

Summary of seven cases with persistent eye movement disorders after scleral buckle surgery (SBS).

#	Age	Eye	Gender	VA	Buckle type	Cryotherapy	Position of Buckle	Tropia	Treatment
1	28	OD	F	1.52	S	+	IR + LR	XT + HOT	Buckle removal
2	63	OD	M	0.40	S	+	SR + LR	ET	Prism glasses
3	38	OS	F	0.10	B&T	+	SR	XT + HOT	Refused surgery
4	70	OD	M	0.10	S	+	SR + LR + IR	HT	Refused surgery
5	59	OD	F	0.40	S	+	LR	ET + HOT	Botulinum injection
6	53	OD	M	1.52	S	+	SR	HOT	Prism glasses
7	61	OD	M	0.40	S	+	LR	HT	Prism glasses

VA: Visual acuity; F: Female; M: Male; S: Sponge; B&T: Band and tire; IR: Inferior rectus; LR: Lateral rectus; SR: Superior rectus, ET: Esotropia, HT: Hypertropia, HOT: Hypotropia, XT: Exotropia, Ortho: Orthotropia.

months in which the sponge was inserted beneath inferior rectus (IR) and lateral rectus (LR) muscles. She had a VA of 0.5 logMAR (OD) and 40 PD exotropia (XT) and 14 PD hypotropia (HOT) in both far and near without any torsion in DMR and amblyoscope. There was a limitation in adduction and supra-adduction of the right eye. Moreover, in the right eye abduction, an obvious herniation of sponge was seen in the sub-conjunctival space. Buckle removal surgery was done for the patient. One week after the operation, HOT totally disappeared, and XT decreased to 30 PD. The patient was stable for 6 months, and although strabismus surgery was considered for her, she refused it.

Patient 2

After SBS with sponge implantation under the superior rectus (SR) and LR muscles for a 63-year-old male in the 4th month after surgery, he was referred with limitation in superior and lateral gaze of the right eye. The corrected VA was 0.1 logMAR. The deviation was 14 PD and 6 PD right esotropia (RET) for far and near, respectively. In DMR and amblyoscope examinations, no torsion was found. In further evaluations by Hess screen test, abduction limitation of OD was recorded. Because of diplopia which increased in the far, prism glass of 5 PD base out (right eye), 3 PD base out (left eye) was prescribed, and the patient was followed.

Patient 3

A 38-year-old female with SBT implanted under the SR muscle. VA of 0.7 logMAR and deviation of 30 PD XT and 9 PD HOT in far and 40 PD XT and 9 PD HOT in near was found. Evaluation by DMR and amblyoscope for torsion was negative. Although the patient was candidate for strabismus surgery, she refused the treatment.

Patient 4

A 70-year-old male after SBS with sponge implantation under the IR, LR, and SR was referred with severe persistent diplopia. He had a corrected VA of 0.4 logMAR and a deviation of 10–12 PD hypertropia (HT) in both far and near. Significant limitation was detected in inferior gaze, but no torsion was found. In his 6th month postoperative examination, increase in deviation and diplopia were observed, with 20 PD HT in the right eye. After retinal consult (because of severe inferior limitation), he was a candidate for scleral buckle removal, but he refused the surgery.

Patient 5

Following retinal detachment, SBS was performed for a 59-year-old female using sponge implantation located under the

LR muscle (right eye). Six months after the surgery, the patient complained of severe diplopia in primary gaze. Corrected VA was 0.22 logMAR. 30 PD ET and 8 PD HOT was observed in far and near as well as underaction of LR muscle. Furthermore, in evaluations with DMR and amblyoscope, no torsion was found. For this patient, 10.0 IU of botulinum toxin (Dysport®) was injected into the right medial rectus (MR) muscle. After 3 months, the patient was orthophoric in both far and near, and only a mild diplopia in the right lateral gaze remained. The results were persistent in the 6th and 9th month after the injection (Fig. 1).

Patient 6

A 53-year-old male was referred with vertical diplopia and underaction of right SR muscle after SBS (sponge implantation under the SR muscle). In examinations, corrected VA of 0.3 logMAR and deviation of 12 PD HOT in far and 8 PD HOT in near were detected. Also, using DMR, 10 degrees of extorsion was found in the right eye. A limitation of elevation in the same eye in Hess screen test was seen. For this patient, a prism glasses (6 PD base up for OD and 3 PD base down for OS) was prescribed, and he was followed afterwards. After 6 months of wearing prism glasses, the patient had no diplopia, and a mild HOT of right eye was detected. Torsion was completely improved.

Patient 7

A 61-year-old male was referred 6 months after implantation of sponge under right LR muscle. VA was 0.5 logMAR. Vertical deviation of 4 PD HOT was detected in the right eye. No limitation of movement and no torsion (evaluated by DMR and amblyoscope) was found. Finally, a prism glasses (4 PD base down for right eye and plano for left eye) was prescribed, and the patient was followed at next visits.

Discussion

In this observational case series 206 patients (206 eyes) were studied, and seven patients had persistent eye movement disorders of which four patients were male and three were female. Strabismus and diplopia can occur following different vitreoretinal surgeries while being more prevalent in SBS. Some studies reported the incidence of strabismus after SBS as 2–57%, and the incidence in our study was 3.39%. One of the most possible causes of this difference could be the considered time period after SBS for evaluation.^{9–12} Although studies showed phenomenon was more prevalent in the early weeks after surgery, in our study, a decrease was observed. Some studies reported a 50% rate of transient strabismus caused by SBS due to the explants, post-surgery tissue edema, or transient muscular paresis.^{11,12}

Strabismus with four main mechanisms can happen after SBS, including sensory, mechanical, muscular, and anatomical factors.¹³ The Seaber et al. study showed that possible causes of this kind of sensory disorders could decrease in VA caused by subretinal fluid and vision distortion and anisometropia due to the eye elongation by scleral buckle effect.¹⁴ One of the most common etiologies for strabismus following SBS is mechanical adhesion which is seen in different sites such as Tenon's capsule, sclera, inter muscular septum, extraocular muscles, and orbital fat.¹⁵ Surgical trauma induces a fibrotic reaction which causes fat adherence syndrome.¹⁶ Moreover, nerve damage, muscle ectopia and gliosis, and oblique muscle inclusion or rotation are known as other anatomic factors that induce strabismus after SBS.^{17–19}

In our studies cases with persistent strabismus, some of these mechanisms were involved. In patient 1, leash effect and fat adhesion were detected as the etiology of post-SBS strabismus, which was successfully treated after buckle removal surgery. Muscle ischemia was considered an etiology in



Fig. 1. Preoperative picture of patient #5 showing esotropia (ET) and limitation of abduction of right eye. Postoperative (botulinum toxin injection) with improvement of both ET limitation of abduction.

patient 5. Muscle paresis, non-specific adhesion, and reverse leash effect were proposed in patients 2, 3, 4, and 7.

Theodossiadis et al.'s study mentioned a rapid movement dysfunction in one third of their patients following SBS, most of whom had undergone cryotherapy.¹² Several studies proposed cryotherapy as a possible cause of tearing and detachment of muscles during surgery or in the postoperative period.^{20,21} In this study, all seven patients underwent cryotherapy during SBS and had no serious side effect and complication. Arruga et al.'s study reported a direct relation between movement disorders and retrobulbar anesthesia because of its toxic effects on muscles and suggested subtenon injection as an alternative safer option.²² In the current study, all patients with ocular movement disorder underwent general anesthesia while patients with retrobulbar anesthesia did not show any movement disorder. Thus, retrobulbar anesthesia was not a predisposing factor in this study.

So far, several choices such as botulinum toxin, prism, buckle removal, and strabismus surgery have been suggested for treatment of ocular movement disorders following SBS.²³ Peduzzi et al. reported that prism could eliminate diplopia if the strabismus is incomitant.²⁴ In all 3 patients treated with prism, the fusion was established successfully. So it seems that prism can be considered a non-invasive treatment which may reduce future surgical interventions in these cases without any side effect. Botulinum toxin is another therapeutic method for post-SBS strabismus.²³ Petitto et al. used this method for 20 cases diagnosed with post-SBS strabismus (with a range of 10–60 PD deviations) and reported that final deviation decreased to 0–20 PD.²³ 75% of their cases showed less than 10 PD deviations, and 85% of their patients gained fusion.²³ The average change in each injection was 14 PD.^{25,26} In the current study, only one patient (30 PD deviations) was treated with a single injection of botulinum toxin. The eyes were completely orthotropic in 3, 6, and 9 months of the postoperative visits. The surgical options for patients with strabismus after SBS are releasing adhesions,⁷ extraocular muscle recession and resection, and removal of scleral buckle.^{10,27} In this study, only one case underwent releasing of adhesions and buckle removal. One week after the operation, vertical component completely disappeared, and horizontal deviation decreased in amount 10 PD. However, the risk of re-detachment after buckle removal should be considered in these cases.⁷

The main limitation in our study was a small incidence of diplopia. Because of the small incidence, a pattern for deviations or the implication of other factors cannot be elucidated. In addition, lack of forced duction testing is the other limitation of our study. With the results of forced duction testing, understanding of the mechanism of strabismus in these cases could be easier. The other limitation is lack of data about high myopia, pseudophakia, previous trauma, macular involvement, rhegmatogenous retinal detachment type [giant tear, proliferative vitreoretinopathy (PVR) grade, retinal dialysis], and anisometropia.

In conclusion, ocular movement disorder is the main complication after SBS. Based on this study, a single mechanism

for strabismus after SBS was not found. Early consultation with a strabismus expert is highly recommended. After appropriate strabismus evaluations, treatment modalities such as surgery, botulinum toxin injection, and prism prescription can be done.

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