Partial scleral buckle removal during strabismus surgery after retinal detachment repair

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PURPOSE To describe outcomes after partial scleral buckle removal at the time of strabismus surgery.

METHODS The medical records of consecutive patients with symptomatic diplopia who underwent strabismus surgery after scleral buckling by two surgeons were reviewed retrospectively. All patients underwent forced duction testing and had a segment of the scleral buckle removed intraoperatively. Pre- and postoperative ocular motility and alignment were compared. The outcome was considered successful if residual horizontal deviation was $\leq 8^{\Delta}$, vertical deviation $\leq 2^{\Delta}$, and cyclotropia $<5^{\circ}$.

RESULTS A total of 12 patients (mean age, 51 years; range, 14-71 years) with a mean horizontal deviation of 16^{Δ} (range, 2^{Δ}-40^{Δ}) and mean vertical deviation of 10^{Δ} (range, 2^{Δ}-20^{Δ}) were included. Three patients underwent 2 strabismus surgeries. All patients underwent intraoperative removal of a segment of the scleral buckle near a muscle being advanced or recessed at the time of surgery. An adjustable suture technique was used in 13 of 15 surgeries (86%). Orthotropia was achieved in 7 patients (58%); surgical success, in 11 (92%). Subjective resolution of diplopia was achieved in all patients, in 2 with the aid of prisms. Mean follow-up was 12.4 months (range, 1-75). No patient had retinal redetachment.

CONCLUSIONS In this case series, removal of a segment of the scleral buckle facilitated advancement or recession of a rectus muscle and was associated with good outcomes without retinal redetachment. (J AAPOS 2019;23:16.e1-4)

The introduction of the scleral buckle in the 1950s revolutionized the repair of retinal detachments. However, with it came complications, including postoperative strabismus and diplopia. The incidence of strabismus after scleral buckling has decreased over time but currently remains around 14%-18%, with an increased risk after repeat buckling procedures.[1,2] Although a variety of strategies for the surgical management of diplopia in the setting of a scleral buckle have been described, there is currently no consensus on the best approach to manage this entity.[3,4] We describe removal of a segment of the buckle at the time of strabismus surgery to correct buckle-related diplopia.

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Subjects and Methods

This study was approved by the Emory University Institutional Review Board and conformed to requirements of the US Health Insurance Portability and Accountability Act of 1996. The medical records of consecutive patients with symptomatic diplopia who underwent strabismus surgery between 2007 and 2015 at Everett & Hurite Ophthalmic Association and Emory University after prior scleral buckling for retinal detachment were retrospectively reviewed. All surgeries were performed by one of the two senior authors (DLH, SRL). The indications for strabismus surgery included vertical, horizontal, or torsional diplopia, intolerance of prismatic correction, or cosmetically significant strabismus.

All patients underwent standard strabismus surgery at least 6 months after retinal repair with intraoperative forced ductions and removal of a segment of scleral buckle and associated scar tissue located near the primary muscle(s) of surgical interest (see Figure 1). Once a segment of the scleral buckle was cut and removed, the remaining buckle was not secured to the globe. All patients had been evaluated by a retina surgeon either prior to surgery or on the day of surgery to ensure that removal of a segment of the buckle was safe. Adjustable sutures were used at the discretion of the primary surgeon. Pre- and postoperative ocular motility and alignment were compared, and strabismus was measured in all patients using alternate prism cover testing at distance and near.

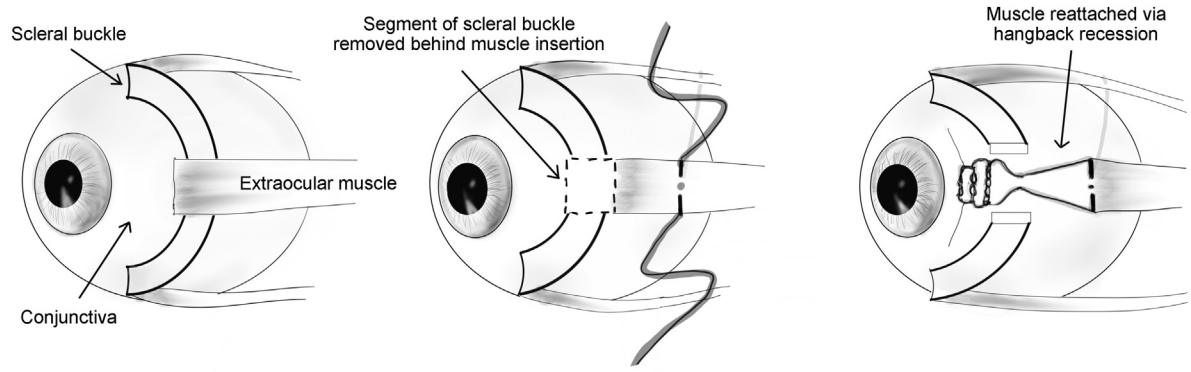

FIG 1. Schematic depiction of surgical technique, with removal of the portion of scleral buckle near the rectus muscle to be recessed and subsequent reattachment of the muscle of interest via a hangback technique.

Motor outcomes were considered successful if the residual horizontal deviation was $\leq 8^{\Delta}$, vertical deviation $\leq 2^{\Delta}$, and cyclotropia $<5°$. Data collected included age at presentation, pre- and postoperative ocular motility and alignment, type and details of strabismus surgery and scleral buckle removal, and need for a postoperative prismatic correction. All available dilated examinations in the medical record were also reviewed for each patient to confirm a normal peripheral retinal examination for the duration of the study through the end of follow-up.

Results

A total of 12 patients (mean age, 51 years; range, 14-71 years; 6 females), who had previously undergone a scleral buckling procedure to repair a retinal detachment were studied. None of the patients had previously undergone vitrectomy. The mean horizontal deviation was 16^{Δ} (range, 2^{Δ}-40^{Δ}); the mean vertical deviation 10^{Δ} (range, 2^{Δ}-20^{Δ}). Combined horizontal and vertical deviations were the most common type of strabismus (n = 8), followed by isolated horizontal deviations (n = 3), and isolated vertical deviations (n = 1). Three patients (cases 1, 2, 10) had small-angle strabismus but elected to proceed with strabismus surgery because of prism intolerance or torsional diplopia (Table 1).

All patients underwent forced duction testing in the operating room prior to strabismus surgery. In all cases ductions were limited and could be attributed to scarring associated with the buckle in relation to at least one of the muscles of interest. A segment of the scleral band was removed if it was deemed likely to create a physical barrier that would hinder the formation of a firm muscle insertion–sclera attachment. Of the 12 patients, 11 (92%) had a segment of the scleral buckle removed during their first strabismus operation. One patient (case 2) did not have a segment of the scleral band removed at the time of the first surgery but did have a segment removed during a second strabismus surgery.

Adjustable sutures were used in 13 of 15 surgeries (87%), and 5 patients (33%) underwent postoperative adjustment. Three (25%) patients underwent a second strabismus surgery. After a mean follow-up of 12.4 months (range, 1-75 months), 7 of 12 patients (58%) were orthotropic, and 11 (92%) achieved surgical success. Two patients (17%) required a prismatic correction to neutralize postoperative diplopia. There were no occurrences of postoperative retinal redetachment. However, 6 of the 12 patients (50%) had a follow-up of <3 months; thus, the long-term risk of retinal redetachment cannot be assessed in these patients.

Discussion

Strabismus surgery after scleral buckle for retinal detachment is technically challenging and can be associated with unpredictable postoperative results. The presence of a scleral buckle at the time of strabismus surgery is associated with increased scarring and difficulty in isolating the extraocular muscles. Various mechanisms for strabismus following scleral buckle have been posited, including scarring of the affected muscles, mass effect of the silicone gel material, and fat adhesion syndrome, as well as extraocular muscle injury, displacement, or disinsertion at the time of buckle placement.[1,5,6] The authors specifically have noted that in some cases, the scleral buckle is found overlying the rectus muscle with associated necrosis of the rectus muscle insertion. This in turn causes the effective muscle insertion to be behind the buckle, thereby weakening the muscle's arc of action. Because of the various underlying etiologies, a variety of strategies to combat buckle-associated strabismus have been suggested, including surgery on the contralateral eye, complete scleral buckle removal, and use of adjustable sutures.

The main concern associated with contralateral eye surgery revolves around patient reluctance to undergo surgery on their untreated eye. However, one study suggested that strabismus surgery on the untreated eye provided the most consistent results if diplopia persisted after buckle removal.[7] Removal of the scleral buckle has been studied, not only in the treatment of diplopia associated with scleral

Table 1. Surgical intervention and outcomes

Patient	Pre-op alignment, PD	1st surgery	Post-op alignment, PD	2nd surgery	Post-op alignment, PD	Post-op prism
1	6 R-HT/2 ET; 10° excyclo secondary to R-SO palsy	R-Harada-Ito; R-SRc 4.0 mm; removal superior portion 240 SB	12-14 R-HT in L head turn; 6 ET; 15° excyclo	R-IO myotomy; R-IRs 4.0 mm; 1.5 mm adv; nasal trans; L-MRc 2.5 mm adj	1 L-H(T), 8 X(T)	Y
2	10 ET/2 L-HT	R-LR adv 5.5 mm adj; re-recessed 2–3 mm post-op[a]	8 R-HT	R-SR adv; 7 mm recess adj; removal superior portion 240 scleral buckle band	Ortho	N
3	18 ET/6 L-HT	R-LR adv 6.0 mm; L-SRc 5.0 mm; removal temporal portion SB	2 X(T)	—		N
4	22 E(T)	L-MRc 3.0 mm adj; L-LRs 7.0 mm; removal medial portion SB	8 X(T)′	—	—	N
5	25 ET′/20 R-HoT	R-LR adv 8.0 mm; R-MRc 4.0 mm with superior trans 4.0 mm of both R-LR and R-MR; L-SRc 8.0 mm adj; removal medial portion SB and minimal post-op adjustment[b]	Ortho	—	—	N
6	15 R-XT′, 12 L-HT′	9.0 mm R-LRc, 5.0 mm R-IR adj with removal temporal portion SB	10 R-HoT	6.0 mm L-SR recess adj	Ortho at distance; 8 X(T)′	N
7	40 XT′	R-LRc 5.0 mm adj; R-MRs 5.0 mm; 1.0 mm adv; 2.0 removal temporal portion SB	Ortho	—	—	N
8	Excyclo OD; 6 R-HT′/4 XT′ secondary to R-SO palsy	R-IO myectomy with 4.0 mm L-IRc adj; removal inferior portion SB	Ortho	—	—	N
9	20 R-ET′/10 L-HT	9.0 mm R-LR adv; 5.0 mm R-IRc adj; 4.0 mm L-MRs; 7.0 mm recess; removal temporal and inferior portion SB; post-op adjustment of L-MR pulled up to insertion and R-IR 1 mm more[c]	Ortho	—	—	N
10	10 R-XT/6 R-HT	R-MRs 3.0 mm with 2.5 mm adv adj; 3.0 mm L-IRc adj; removal medial portion SB; post-op adjustment recessed R-MR and recessed L IR for 8 ET/R-HT	8 L-HT/5 XT	—	—	Y
11	18 L-HoT	L-IR 4.5 mm hangback style recess adj; removal inferior portion SB	Ortho	—	—	N
12	∼30 R-ET	R-MR 4.0 mm hangback style recess adj; R-LRs 6.0 mm with removal medial portion SB	Ortho	—	—	N

Adj, on adjustable suture; *Adv*, advancement; *Encyclo*, encyclotorsion; *ET, esotropia*; *HoT*, hypotropia; *HT*, hypertropia; *H(T)*, intermittent hypertropia; *IO*, inferior oblique; *IR*, inferior rectus muscle; *IRc*, inferior rectus recession; *IRs*, inferior rectus resection; *LR*, lateral rectus muscle; *LRc*, lateral rectus recession; *MRc*, medial rectus recession; *MRs*, medial rectus resection; *OD*, right eye; *Ortho*, orthotropia; *PD*, prism diopter; *SB*, scleral buckle; *SO*, superior oblique muscle; *SR,* superior rectus muscle; *Trans*, transposition; *XT*, exotropia; *X(T)*, intermittent exotropia.

[a]Bilateral LRc performed 6 years earlier by another surgeon.

[b]Right 9 mm LRc and 6 mm medial resection was performed by one of the authors 9 years before retinal detachment repair performed using a scleral buckle procedure.

[c]Right LR muscle inserted posterior during scleral buckle procedure.

buckle but also to manage scleral buckle exposure, extrusion, and infection.

The benefit of scleral buckle removal in treating buckle-associated strabismus has been controversial. Chang and colleagues[3] reported that scleral buckle removal was the most significant factor associated with successful surgical realignment, whereas others have found no benefit from this intervention alone.[4] Moreover, significant concerns persist regarding the risk of retinal redetachment after scleral buckle removal. Over the past decade, the overall rate of scleral buckle removal has been reported to be 6%, with a risk of retinal redetachment after scleral buckle removal of 8%, with half of those cases occurring within 3 months of buckle removal.[8] This risk assessment, however, has been debated, with smaller series reporting no risk of retinal redetachment after buckle removal.[3,9,10] The concern for possible retinal redetachment led Kim and colleagues[11] to advocate for the use of adjustable sutures that are passed under the explant to facilitate reattachment of the muscle onto sclera without manipulating the buckle itself. These authors reported good rates of surgical success.

The results of this study are limited by its retrospective nature, the small sample size, and the short follow-up. Nevertheless, we advocate partial removal of the scleral buckle and associated scar tissue in the area immediately under and adjacent to the muscle of interest at the time of strabismus surgery if it is deemed likely to create a physical barrier that could hinder the formation of a firm muscle insertion–sclera attachment. In this case series, if a muscle could be recessed or advanced without manipulating the buckle, a standard technique was used. However, when the capsule, associated scar tissue, or the buckle itself were directly in the desired location where a muscle of interest was to be recessed or advanced, partial scleral buckle removal was performed. Additionally, if the final desired location of the muscle was in a location where the muscle and potential hangback sutures would not be in direct contact with the sclera because of the buckle or capsule, partial scleral buckle removal was performed. Although other groups have explored the idea of partial buckle removal, success rates were grouped by partial and/or complete removal of the explant in one cohort compared to no manipulation of the buckle as a second cohort, without subgroup analysis to assess the effect of partial removal alone on surgical success.[4]

We posit that removal of only a segment of the buckle minimizes buckle manipulation and can allow for the buckle to continue to support the retina, given the significant scarring around the buckle in all other quadrants. Although the overall composite strength of the buckle may be reduced slightly, we hypothesize that some effect persists because the majority of the buckle is left intact. In all cases it was noted intraoperatively that despite removal of a segment of the band, the remainder of the buckle was uniformly surrounded by a thick capsule, which helped keep the remaining scleral buckle band in place. Furthermore, we recommend that scleral buckle segment removal be deferred for at least 6 months after retinal detachment repair to minimize the risk of retinal redetachment. Nonetheless, it should be noted that redetachment can still occur many years following the removal of part or all of a scleral buckle, and long-term follow-up with a retina specialist is warranted to monitor for late redetachment.

Additionally we hypothesize that partial scleral buckle removal improves adherence of the operated muscle to the globe and facilitates postoperative adjustment when adjustable sutures are used. In all cases of postoperative adjustment, it was easily performed, without complication. Removal of part of the buckle with the associated capsule seems to improve motility of the affected muscle and reduce restriction that may have been caused by the buckle. This was confirmed by pre- and postoperative forced duction testing.

Partial scleral buckle removal not only minimizes surgical time, it also permits simultaneous strabismus surgery. In some of our cases, a retina surgeon was able to inspect the buckle at the time of surgery. In others, the retina surgeon had been consulted preoperatively regarding scleral buckle manipulation at the time of strabismus surgery and had decided that such an intervention was safe. This approach can minimize the number of procedures required for a good outcome without compromising patient safety.

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