

Article ▶ Optometric Management of Persistent Diplopia Status Post Scleral Buckle Surgery: Two Case Studies

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ABSTRACT

Background: A scleral buckling procedure repairs retinal detachments by indenting the sclera under the retinal breaks. One of the complications is diplopia, which typically subsides once the muscle heals. Persistent diplopia lasting longer than three to six months is reported in 0.5% - 25% of patients.

Case Reports: The cases presented demonstrate the use of optometric vision therapy and/or prisms as effective treatment options for patients experiencing persistent diplopia and manifesting different magnitudes and directions of deviation.

Conclusion: It is important to know when prisms and/or optometric vision therapy is indicated for patients with persistent diplopia secondary to scleral buckle surgery. Given the non-comitancy of the resultant deviations, optometric vision therapy activities modified to expand fusional reserves in all positions of gaze will help to minimize the diplopia and the final amount of prism prescribed for the patient. The two case reports suggest that patients with smaller vertical deviations could respond to passive optical treatment with compensatory prisms, while patients with larger vertical deviations may benefit from both optometric vision therapy and prism.

Keywords: diplopia, optometric vision therapy, prism, retinal detachment, scleral buckling, strabismus

Introduction

Scleral buckle surgery, which has existed since the 1950s, is a retinal detachment treatment technique that repairs retinal breaks and tears after applying a thermal treatment procedure.¹ Diathermy, cryotherapy, and laserpexy have been employed to irritate the choroid and pigment epithelium so that they form chorioretinal adhesions to seal retinal breaks. Cryopexy is most commonly used with scleral buckling.¹ After sealing the breaks and tears in the retina, a scleral buckle is applied. The buckle, typically made of silicone, is sewn onto the outside of the sclera with mattress sutures (explant) or placed within a scleral lamellar flap (implant). The sewn buckle indents the sclera, providing for a solid elevation of the retina and choroid.² Various kinds and shapes of silicone such as a radial sponge, a circumferential sponge, or an encircling buckle can be used depending on the circumferential extent of vitreo-retinal pathology (Figure 1).¹

Common complications of scleral buckle surgery include eye discomfort, ocular pain, extrusion of the buckle, persistent conjunctivitis, ocular motility disturbances, decrease in visual acuity, and diplopia.^{3,4} Studies show that 0.5% - 25% of patients experience persistent diplopia lasting more than three to six months after scleral buckle surgery.⁵⁻⁸ Hypotropia, hypertropia, or cyclodeviations are encountered with more frequency than horizontal deviations.⁸ In one study, the types of strabismus seen were vertical, horizontal, and combination deviations. Specifically, 75% were vertical and 50% were in

the horizontal direction.³ Another study showed that up to 86.6% of those with an acquired horizontal strabismus would manifest an exotropic deviation.⁵ Cyclodeviations are most often encountered when an encircling band compromises either the superior oblique tendon, inferior oblique muscle, and/or inferior rectus muscle.^{8,9} Cooper et al. examined the frequency of cyclotorsion after scleral buckle surgery. In the study, 46% of the surgically treated patients manifested cyclotorsion with 88% and 12% exhibiting extorsion and intorsion, respectively.⁹

The most common causes of persistent diplopia after surgery are due to myoscleral/orbital adhesions, muscle fibrosis, or tissue scarring.^{7,10} The physical presence of the buckle is also a causative factor for development of strabismus after surgery. Smiddy et al. showed that post-operative deviations were associated with encircling scleral buckles, but not with radial scleral buckles.¹¹ Other possible causes for persistent diplopia include the decompensation of an existing fusional weakness, extraocular muscle insertional change, and myotoxicity from local anesthetic injection.^{7,12}

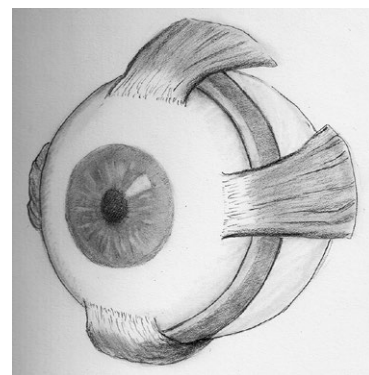


Figure 1: Scleral Buckle

Table 1: Case History

	QY	JG
Patient demographics	72 YO AM	66 YO HM
Chief complaint	Constant diplopia at distance status-post scleral buckle surgery	Constant diplopia at distance and near status-post scleral buckle surgery
Ocular, medical history	History of retinal detachment OD 2 years ago	History of retinal detachment OS 3 months ago
Medications	none	none

Table 2: Pertinent Findings

	QY	JG
Distance cover test	2 ^Δ R Hypotropia 13 ^Δ RET	14 ^Δ L Hypotropia 12 ^Δ LET
Near cover test	8 ^Δ EP	5 ^Δ L Hypotropia 14 ^Δ LET
EOM	Slight restriction in superior gaze and abduction OD	Restricted abduction OS
Refraction and VA	OD -13.50-0.50x45 20/50+ OS -12.00 sph 20/20	OD -1.00-2.25x100 20/20 OS -2.75-2.25x055 20/20

Often, diplopia secondary to scleral buckle surgery spontaneously resolves within the first three months as the tissue swelling from surgery subsides.^{13,14} With persistent diplopia, however, an intervention is necessary. The possible treatment options for diplopia are monocular occlusion, botulinum toxin injection, prisms, scleral buckle removal, and strabismus surgery.¹² Even though the onset of persistent diplopia corresponds with the time of surgery, one must always keep in mind other possible etiologies. The differential diagnosis for unilateral acquired vertical deviation include: dysthyroid ophthalmoplegia, myasthenia gravis, systemic amyloidosis, multiple sclerosis, trauma, orbital tumor, myositis, brain stem disease, fourth nerve palsy, third nerve palsy, oculomotor nerve paresis superior division, skew deviation, and progressive supra-nuclear ophthalmoplegia.¹⁵

The case reports presented here used optometric vision therapy and/or prisms as treatment options for patients with different magnitudes of persistent diplopia after scleral buckle surgery.

Subject QY

In 2006, a 72-year-old male with a history of scleral buckle surgery after a retinal detachment in the right eye two years prior was referred for an evaluation of his persistent diplopia. His chief complaint was constant diplopia in the distance which worsened in right gaze. His medical history was unremarkable. He did not report taking any medications. He also denied receiving previous optometric or ophthalmologic treatment for his symptoms (Table 1). On examination, the best corrected visual acuity was 20/50⁺ in the right eye and

Table 3: Treatment and Management

	QY	JG
Initial Treatment	6 ^Δ BO Fresnel	20 ^Δ BO Fresnel OD 10 ^Δ BU Fresnel OS AND VT was recommended to improve the fusional ranges
Follow up about 12 to 13 months later	OD 2.5 ^Δ BO/1 ^Δ BU OS 2.5 ^Δ BO/1 ^Δ BD (ground-in prism)	OD: 7 ^Δ BO/2.5 ^Δ BD OS: 7 ^Δ BO/2.5 ^Δ BU (ground-in prism) Completion of 30 sessions of VT improved his fusion ranges.

20/20 in the left eye. His refraction was -13.50-0.50 X 045 in the right eye and -12.00 sphere in the left eye. The patient reported that the vision in the right eye was decreased before the surgery. The distance cover test revealed a constant 13^Δ right esotropia and a 2^Δ right hypotropia, while the near cover test was an 8^Δ esophoria. He had restrictions in his right eye during the extraocular motility (EOM) testing upon elevation and abduction (Table 2). Phorometric testing revealed a distance phoria of 13^Δ eso and 4^Δ right hypo and a near phoria of ortho. Distance base-in (BI) and base-out (BO) ranges were x/6/1 and x/14/10, respectively, with 10^Δ BO in place to fuse the images. Near BI and BO ranges were x/30/16 and x/14/2, respectively, without the need for prism. His pupils were normal. His dilated fundus exam (DFE) revealed a treated retinal detachment in the right superior quadrant in the right eye. The DFE also showed a grade two nuclear cataract and a highly myopic fundus in each eye. After assessing his binocularity and trialing 10^Δ and 6^Δ BO Fresnel prisms,^a QY reported the most comfort with the 6^Δ BO Fresnel prism over the right eye of his current distance glasses.

QY returned to the clinic after 13 months for follow-up. He adapted well to the prism and reported no diplopia. With the 6^Δ BO Fresnel prism over the right eye of his current glasses, the distance cover test was a 4^Δ esophoria and a 2^Δ right hypotropia. Distance BI and BO ranges were x/2/1 and x/14/4, respectively, with the Fresnel prisms. Near BI and BO ranges were x/18/14 and x/>45/>45, respectively, without the need for additional fusional prism. After trialing several prism combinations, his final distance prescription was ground in prism of 2.5^Δ BO/1^Δ BU in the right eye and 2.5^Δ BO/1^Δ BD in the left eye (Table 3).

Subject JG

In 2003, a 66-year-old male with a history of scleral buckle surgery after a retinal detachment in his left eye three months prior was referred for evaluation of his persistent diplopia. His chief complaint was constant diplopia at both distance and near since his surgery. His medical history was unremarkable. He was not taking any medications. He did

not receive previous optometric or ophthalmologic treatment to address his symptoms (Table 1). On examination, his best corrected visual acuity was 20/20 in each eye. His refraction was -1.00-2.25 X 100 in the right eye and -2.75-2.25 X 055 in the left eye. The distance cover test was 12^Δ left esotropia and a 14^Δ left hypotropia. The near cover test was 14^Δ left esotropia and a 5^Δ left hypotropia. There was a restriction of the left eye upon abduction (Table 2). Phorometric testing revealed a distance phoria of 18^Δ eso and 10^Δ left hypo, while the near phoria was 12^Δ eso and 10^Δ left hypo. JG was able to fuse images with a minimum prismatic amount of 20^Δ BO and 10^Δ BU OS at distance and near. His pupils were normal. His DFE revealed a treated retinal detachment in the left eye. Because of his large vertical and horizontal deviations, 30 sessions of weekly in-office optometric vision therapy were recommended to improve his fusional ranges and minimize the final amount of prism to be prescribed in his glasses. He was initially given a 20^Δ BO Fresnel prism in the right eye and a 10^Δ BU in the left eye over his current bifocal glasses.

During the eight months after the initial evaluation, the patient successfully completed the 30 sessions of vision therapy. The initial phase of therapy emphasized peripheral fusion techniques, smooth vergence especially in the BI direction, and monocular oculomotor activities concentrating on abduction. As binocularity improved, higher level activities including the Brock string (bug on a string and prism jump ductions), vectogram ranges at both distance (projected) and near, and computer vergences (stereo and random dot stereograms) were added. His progress was monitored through re-evaluations after approximately every 16 sessions.

At his final re-evaluation, the distance and near cover test showed orthophoria with the Fresnel prisms. Phorometric testing revealed a distance phoria of 17^Δ eso and 5^Δ left hypo and a near phoria of 7^Δ eso and 4^Δ left hypo. JG was able to fuse with a range of 9-14^Δ BO and 4-6^Δ BU OS. The amount of prism was significantly reduced to 14^Δ BO and 5^Δ BD OD, which was evenly split between the two eyes (Table 3). At the end of the re-evaluation, he was dismissed from in-office therapy and prescribed home activities. At his one month and three month follow-ups, JG did not report diplopia with his new prism glasses and no change was recommended.

Discussion

Two patients are presented here who sought non-surgical interventions for their persistent diplopia. Prisms and/or optometric vision therapy were implemented to successfully treat their symptoms. Similarities and differences were seen between these two patients. Both showed esotropia and hypotropia in the operated eye. The deviation was larger at distance than at near. Both patients had a restriction of extraocular motilities in the operated eye. Although exotropic deviations are more frequently seen in strabismus status-post scleral buckle surgery as stated earlier, these patients manifested esotropic deviations. The major difference between

the two cases was the magnitude of the vertical deviations; JG had a significantly greater turn as compared to QY. Prism was a simple yet effective treatment option for QY who had the smaller vertical deviation. QY had a significantly high spectacle prescription and could easily adapt to lens aberrations and distortions typically present in high powered spectacle lenses. Thus, QY did not report any difficulty adapting to the new ground-in prism or to the Fresnel prisms. One study demonstrated a 40% success rate using prism alone.⁵ When persistent diplopia results after surgical interventions, prisms are often an effective treatment option. Another study showed that prism increases the success rate by 50% when combined with scleral buckle removal.⁵

On the other hand, a combination of prism and optometric vision therapy was used with JG, who had the higher vertical deviation and persistent diplopia for only three months. Therapy was initiated soon after his initial evaluation since the chance of spontaneous recovery was small considering his significant vertical and horizontal strabismus. Optometric vision therapy was incorporated in order to minimize the final amount of ground-in prism. When prisms are used, it is important to prescribe the least amount so as to minimize the negative prismatic effects which include: distortions, reflections, chromatic aberration, weight, cosmesis, and angular magnification.^{16,17} As you increase the amount of prism, the induced prismatic effects are greater. The upper limit of prism that can be ground into plastic ophthalmic lenses is approximately 12^Δ per lens for a plano lens and 10^Δ for a -5.00D lens before edge thickness becomes problematic, i.e. too thick to fit into the frame.¹⁷

Caloroso said, through optometric vision therapy “one can change the neurophysiological vergence-control mechanism through various visual stimulations.”¹⁸ As an example, Cooper presented cases in which four symptomatic patients with vertical deviations were successfully treated with a combination of prisms and optometric vision therapy.¹⁹ Optometric vision therapy can help patients reduce the amount of prism required. In clinical practice, prismatic power is usually split equally between the two eyes unless the amount is less than 2^Δ, then it is placed before the non-dominant eye.¹⁷ If vertical prism is to be ground into one spectacle lens only, a base-up orientation is preferable because distortion is greater towards the base and will also result in reflections from overhead lights if placed base down.¹⁷ In addition, until the patient’s symptoms stabilize, it is cost-efficient for the patient to use Fresnel prisms initially due to the expense of ground-in prisms. Fresnel prisms have the advantage of conforming and adhering to the spectacle lens surface through surface tension.¹⁷ Other advantages of Fresnel prisms include modest cost, negligible thickness and weight, and wide range of power (up to 30^Δ).¹⁷ The disadvantages are reductions in visual acuity and contrast sensitivity, visibility of ridges, reflections and scattered light from prism facets, and discoloration of the prisms with time.¹⁷ Other considerations

when prescribing prism are the limitation and ineffectiveness for incomitant and torsional deviations.¹²

Although prisms are very effective and an easy management option for patients with persistent diplopia, adjusting can sometimes be difficult.⁵ For instance, if a patient's fusion abilities decompensate after surgery, they may still be symptomatic even with prisms or surgical interventions because they may exhibit binocular instability depending on their visual demands or level of fatigue. In such cases, optometric vision therapy will be the more effective approach. Optometric vision therapy is also recommended especially for patients who manifest larger (greater than 8^Δ to 10^Δ) vertical deviations.²⁰ This option is particularly beneficial for those who seek a less invasive approach. Prognosis is better when the vertical deviation is smaller than 8^Δ to 10^Δ. The number of therapy sessions recommended can vary depending on the magnitude of the vertical and horizontal deviations.²⁰ It is not uncommon to recommend 20 to 30 sessions of therapy when there is a significant horizontal and vertical deviation.²⁰

Conclusion

Most diplopia secondary to scleral buckle surgery eventually resolves as the muscle swelling from the surgery subsides. Intervention is necessary if diplopia persists longer than three to six months. In general, when evaluating patients with acquired strabismus one must assess visual acuity, ocular alignment, motility, concomitancy, refraction, sensorimotor fusion, and ocular and systemic health. When there is a distance horizontal misalignment of greater than 10^Δ to 15^Δ in combination with a vertical deviation that is greater than 8^Δ to 10^Δ, vision therapy is strongly indicated, particularly when there is binocular instability when fusional prism is trialed during the evaluation.

More research is needed to study the effectiveness of optometric vision therapy for patients with persistent diplopia after ocular surgery. Initially, retrospective studies would be more informative so as to determine the parameters required to set up a controlled study. Another clinical question is that of when an optometric vision therapy evaluation is indicated: one month, three months, or six months after surgery? Descriptions of the types of effective optometric vision therapy techniques used to treat similar cases of acquired strabismus need to be investigated and reported in the literature. Finally, further studies are needed to examine the long-term treatment outcomes of patients with persistent diplopia.

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Appendix: Source List

- a The Fresnel Prism and Lens Co., 6824 Washington Ave. S, Eden Prairie, MN 55344; 1-800-544-4760; Info@Fresnelprism.com

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