

# Refractive Changes Associated With Scleral Buckling and Division in Retinopathy of Prematurity

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**Objective:** To examine the refractive changes that occur in infant eyes with retinopathy of prematurity (ROP) retinal detachments that are subjected to scleral buckling and subsequent division of the scleral buckle.

**Methods:** A retrospective medical record review of infants with ROP who were managed with an encircling scleral buckle that was subsequently divided and who underwent refraction evaluation during and after division of the scleral buckle.

**Results:** Seven eyes from 6 patients had scleral exoplasms placed for stage 4 ROP retinal detachments at a mean postconceptional age of 48 weeks. The mean re-

fractive error in eyes with the scleral buckle was -11 diopters (D) (range, -5 to -25 D) with an induced mean anisometropia of -9.5 D. After division of the scleral buckle at a mean of 36 weeks postoperatively, the average post-scleral buckle refractive error was -5.68 D, resulting in a mean myopic reduction of 5.5 D.

**Conclusions:** Scleral buckling in infants with ROP results in large myopic shifts, which are significantly reduced after division of the scleral buckle. This highlights the importance of repeated refraction testing in infants after placement and division of the scleral buckle to avoid refractive amblyopia.

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**S**CLERAL BUCKLING for the treatment of retinal detachments associated with retinopathy of prematurity (ROP) has been accepted as a viable treatment option since the early 1980s.<sup>1-3</sup> Although the initial goal of treatment is anatomical reattachment of the retina, the ultimate goal is the maintenance or improvement of visual function. To maintain the maximal visual potential of infant eyes it is important not only to achieve retinal reattachment but also to provide an optically clear image to the retina. Because scleral buckling induces axial and lenticular myopia, it would seem important then to follow up and appropriately treat these optical changes in infants with a scleral buckle. Because many authors also advocate division of the scleral buckle once a stable reattachment has been achieved, it would seem important to know what effect this has on the refractive status of the infant eye to prevent refractive amblyopia. The goal of this article is to address the refractive changes associated with scleral buckling and subsequent division of the scleral buckle in infant eyes with ROP.

## RESULTS

A total of 7 eyes from 6 patients were found that met our inclusion criteria. There were 4 boys and 2 girls who had an average birth weight of 774 g and average gestational age of 25 weeks. The average age to threshold ROP was 37 weeks of postconceptional age. All eyes with threshold ROP were treated with indirect diode laser photocoagulation applied to the peripheral avascular retina. One eye in our series progressed on to retinal detachment without ever developing known threshold ROP despite appropriate clinical examinations and, therefore, did not receive peripheral ablation prior to scleral buckling. The average age at the time of scleral buckling was 48 weeks of postconceptional age, with a median of 45 weeks of postconceptional age. There were 4 eyes with stage 4A retinal detachments and 3 eyes with stage 4B retinal detachments. All eyes were treated with an encircling 2.5-mm exoplasms without drainage of subretinal fluid. Total retinal reattachment was achieved in all 7 eyes. The average time to division of the scleral buckle was 36 weeks postoperatively (range, 12-72 weeks). The patient data are summarized in **Table 1**.

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## PATIENTS AND METHODS

A retrospective medical record review was performed to find all patients with ROP retinal detachments that were successfully treated with scleral buckling alone followed by division of the scleral buckle. The review was limited to those eyes that had refraction testing performed after placement of the scleral buckle and after division of the scleral buckle.

The technique for scleral buckling in our series of patients involved placement of an encircling exoplant (2.5-mm solid silicone band) around the equatorial

region of the globe. The band was secured with intra-scleral 5-0 nylon sutures and pulled up to achieve a moderate-height scleral buckle. An anterior chamber paracentesis of approximately 0.1 to 0.2 mL was performed. In no eye was drainage of subretinal fluid performed. Division of the exoplant was performed when stable retinal reattachment had been achieved clinically, usually 3 months after placement of the exoplant. Division of the exoplant involved isolation of the 2.5-mm silicone band followed by transection of the band. The band was not removed. All refractions were performed following adequate cycloplegia with streak retinoscopy and trial lenses to achieve optical neutralization.

**Table 1. Study Eye Characteristics\***

Eye No.	Birth Weight, g	Gestational Age, wk	Age at Threshold ROP, wk	Treatment of Threshold ROP	Age at Retinal Detachment, wk	Stage of Retinal Detachment	Time to Scleral Buckle Division, wk
1	851	27	38	Indirect diode LP	42	4A OS	32
2	568	23	37	Indirect diode LP	55	4A OD	41
3	568	23	38	Indirect diode LP	55	4A OS	44
4	1107	25	35	Indirect diode LP	38	4B OD	14
5	766	25	40	Indirect diode LP	64	4B OS	36
6	766	26	Never reached	NA	45	4A OS	12
7	795	26	36	Indirect diode LP	41	4B OD	72

\*ROP indicates retinopathy of prematurity; LP, laser photocoagulation; and NA, not applicable.

**Table 2. Refractive Characteristics of Study Eyes\***

Eye No.	Spherical Equivalent With SB, D	Time Refraction With SB, wk	Induced Anisometropia, D	Spherical Equivalent After Division of SB, D	Refraction After Division of SB, wk	Refractive Change After Division of SB, D
1	-6.0	9	4.75	-2.0	19	+4.0
2	-10.25	13	NA	-7.75	23	+2.5
3	-9.75	11	NA	-7.75	18	+2.0
4	-25.0	9	14	-14.5	2	+10.5
5	-9.0	24	9	-5.0	3	+4.0
6	-5.0	9	7	+1.25	15	+6.25
7	-13.0	55	13	-4.0	4	+9.0

\*SB indicates scleral buckle; D, diopters; and NA, not applicable.

After placement of the scleral buckle the average spherical equivalent was -11.1 diopters (D) (range, -5 to -25 D). These refractions were performed at an average of 12 weeks following placement of the scleral buckle. In eyes with unilateral scleral buckles, the average induced anisometropia was -9.5 D. After division of the scleral buckle, the average spherical equivalent was -5.7 D (range, 1.25 to -14.5 D). These refractions were performed at an average of 12 weeks after division of the scleral buckle. The induced refractive change following division of the scleral buckle averaged a hyperopic shift of 5.5 D (range, 2-10.5 D). This was significantly different from the refractions obtained with the scleral buckle ( $P = .004$ ). The refractive data are summarized in **Table 2**.

### COMMENT

Management of the neonate with visually significant ROP retinal detachments requires more than timely and appropriate surgical intervention to achieve the best visual results. Often neglected in the management of these infants is the fact that they are in a critical period of visual development and as such are susceptible to any and all potentially amblyogenic factors. Aside from the risk of organic amblyopia, which the retina surgeon addresses through retinal reattachment with scleral buckling, there are the risks of refractive or strabismic amblyopia, which are common problems in premature infants, especially those who develop ROP.<sup>4</sup> When retina surgeons use scleral buckling as

their form of treatment for stage 4 ROP retinal detachments, they need to be cognizant of the induced refractive changes that can be caused by scleral buckle that potentially lead to refractive amblyopia. In adults it is well known that the average induced refractive error with an encircling scleral buckle is on the order of  $-2.75$  D.<sup>5</sup> It has been assumed that similar changes occur in infant eyes subjected to encircling scleral buckles. Our study shows that the average induced refractive error with an encircling scleral buckle on an infant eye with ROP is  $-11.0$  D, a refractive change far greater than that seen in adult eyes and clearly of a magnitude that can cause refractive amblyopia. There are 2 likely causes for the myopic refractive changes seen in these infants after scleral buckling. The first is axial elongation induced by the encircling silicone band. The second is a forward shift of the lens that induces lenticular myopia.<sup>6</sup> In infant eyes, with their short axial lengths and high-powered lenses, this lenticular shift may more dramatically affect the refractive error than in adults, causing the observed larger refractive changes.

In addition to refractive amblyopia, there are the risks of anisometric amblyopia in neonates who are subjected to scleral buckling in only 1 eye. Our study shows an average induced anisometropia of  $9.5$  D in those neonates with a unilateral scleral buckle. This puts the buckled eye at risk of amblyopia irrespective of the outcome of the retinal reattachment procedure. Based on these data we currently recommend that all infants be sent to a pediatric ophthalmologist for refractive evaluation and appropriate management within 4 to 6 weeks of the scleral buckling procedure.

Once a stable retinal reattachment has been achieved, many authors suggest dividing the scleral buckle to reduce the risks of intrusion and to promote eye growth.<sup>1-3</sup> We have concurred with this line of thinking and have found another advantage to division of the scleral buckle, namely, reduction of the induced refractive error. Our study shows that division of the scleral buckle results in a  $5.5$ -D reduction in the myopic shift induced by the encircling scleral buckle. This reduction in refractive error is enough to induce refractive amblyopia if the infant's optical correction is not changed appropriately. As

such, we also recommend that infants be seen by a pediatric ophthalmologist following division of their scleral buckle to make the appropriate changes in their optical correction.

These study results have reaffirmed for us the close interaction that must exist between the pediatric ophthalmologist and retina surgeon to maximize the visual results in infants with ROP retinal detachments who are subjected to scleral buckling. The results also provide added incentive to avoid "overbuckling" infants with ROP retinal detachments and to dividing the buckles postoperatively. Currently we only transect our buckles and do not typically remove the element. We have hesitated from removing the entire element or using a temporary buckling material, even though this may reduce the induced refractive error and risk of refractive amblyopia, because of the persistent traction and risk of recurrent retinal detachment that is present in these eyes even following retinal reattachment. Finally, the amblyopic considerations of scleral buckling in infants with ROP have caused us to think there may be a role for lens-sparing vitrectomy in stage 4 ROP retinal detachments.<sup>7</sup>

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## REFERENCES

1. McPherson AR, Hittner HM, Lemos R. Retinal detachments in young premature infants with acute retrolental fibroplasia. *Ophthalmology*. 1982;89:160-169.
2. Greven C, Tasman W. Scleral buckling in stages 4B and 5 retinopathy of prematurity. *Ophthalmology*. 1990;97:817-820.
3. Trese MT. Scleral buckling for retinopathy of prematurity. *Ophthalmology*. 1994;101:23-26.
4. Cats RP, Tan KF. Premature infants with and without regressed retinopathy of prematurity: comparison of long-term (6-10 years) ophthalmological morbidity. *J Pediatr Ophthalmol Strabismus*. 1989;26:271-275.
5. Smiddy WE, Loupe DN, Michels RG, Enger C, Glaser BM, deBustros S. Refractive changes after scleral buckling surgery. *Arch Ophthalmol*. 1989;107:1469-1471.
6. Rubin ML. The induction of refractive errors by retinal detachment surgery. *Trans Am Ophthalmol Soc*. 1975;73:452-490.
7. Maguire AM, Trese MT. Lens-sparing vitreoretinal surgery in infants. *Arch Ophthalmol*. 1992;110:284-286.

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