

Visual Outcomes after Lens-Sparing Vitrectomy for Stage 4A Retinopathy of Prematurity

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Purpose: To assess the visual outcomes of patients with stage 4A retinal detachments (RDs) from retinopathy of prematurity (ROP).

Design: Retrospective review of a consecutive case series of children referred to the pediatric retina service of Associated Retinal Consultants, Royal Oak, Michigan.

Participants: Forty-five eyes of 39 children.

Methods: The stage of RD for each patient was determined during an examination under anesthesia. All patients underwent a lens-sparing pars plana vitrectomy (PPV) with membrane peeling. Postoperative anatomic status was determined by ophthalmoscopy either during an office examination or during an examination under anesthesia. Visual outcomes were ascertained by consulting pediatric ophthalmologists using either Teller or Allen acuities.

Main Outcome Measures: Anatomic and visual outcomes.

Results: Formalized visual acuity (VA) measurement was performed in 23 eyes of 20 children, and was not performed in 22 eyes of 19 children. All 23 eyes that were formally tested had successful retinal reattachment. The macula appeared to be normal and without distortion in 19 of 23 eyes (83%) during the follow-up period. Average logarithm of the minimum angle of resolution VA was 20/58. Three eyes had acuities of 20/200, and 4 had acuities of 20/100. All other eyes were 20/80 or better. Average age at time of VA was 3.51 years.

Conclusions: Patients with ROP and stage 4A RDs can be treated successfully with respect to anatomic and visual outcome utilizing lens-sparing PPV. *Ophthalmology* 2004;111:2271–2273 © 2004 by the American Academy of Ophthalmology.

Retinal reattachment is achievable with reasonable success in children with advanced retinal detachment (RD) secondary to retinopathy of prematurity (ROP). Because the macula is by definition affected in stages 4b and 5 ROP, visual outcomes, despite successful retinal reattachment, are generally unsatisfying.^{1–4} Children who present with stage 4A ROP, where the macula is uninvolved, provide a unique opportunity to intervene at a time when successful retinal reattachment may leave the macula in its normal anatomic configuration. If the macula is undisturbed, relatively normal visual development can be achieved, resulting in good visual acuity (VA).

Materials and Methods

A consecutive series of children diagnosed with stage 4A RDs from ROP was retrospectively reviewed. Institutional review board approval was not required for this study. The stage of RD for each patient was determined during an examination under anesthesia. All patients underwent 2-port lens-sparing vitrectomy with membrane peeling after parental informed consent was obtained. The operating surgeon determined the postoperative anatomic status either during an office examination or during a subsequent examination under anesthesia when an adequate office examination was not possible. Visual outcomes were ascertained by consulting pediatric ophthalmologists using either Teller or Allen VA tests. The process and timing of visual rehabilitation were determined and implemented by the consulting pediatric ophthalmologists.

Surgical Method

All eyes to be operated on were required to be vascularly quiet enough at the time of surgery such that lens-sparing vitrectomy could be safely performed. Eyes that initially presented with vascularly active detachments had peripheral laser photocoagulation applied, if possible. Lens-sparing vitrectomy was performed as soon as the eyes became vascularly quiescent. The surgical technique, using a wide-field high-flow light pipe, vitreous cutter, and membrane peeler–cutter scissors, has previously been described.^{5,6} After conjunctival peritomy, 2 pars plicata incisions are utilized to enter the eye in a location that maximizes the surgical approach to the detachment. The goal of the vitrectomy is to dissect areas of

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tractional proliferation. Major areas of traction that develop can be seen intraoperatively, and their relative influences are reflected in the configuration of the detachment. These areas of organized vitreous gel are surgically disrupted so that the tractional effect on the retina is relieved. The surgical end point is not retinal reattachment, but rather the relief of all tractional tissue. At the end of the vitrectomy, an air–fluid exchange is performed. Vicryl sutures are utilized to close the sclerotomy sites and peritomy as the case is completed.

Results

The cohort of patients consisted of 45 eyes of 39 children. Twelve eyes of 11 children were lost to follow-up. The remaining cohort consisted of 33 eyes of 28 children, of which 32 (97%) had anatomic success, defined as no advancement of RD to a higher stage of ROP (4B or 5). Of these 33 eyes, 25 (76%) did not have macular involvement on ophthalmoscopic examination, whereas 7 eyes (21%) had distortion or dragging of the macula, and 1 eye (3%) had an irreparable RD. Formal VA testing was performed on 23 eyes of 20 children with either Allen or Teller tests. Nine eyes of 7 children were not yet formally tested at the pediatric ophthalmologist's preference, because of either the age or the mental status of the child, but all had definite fixation and following behavior. The eye with the persistent detachment did not have light perception. Of the 33 patients observed, 4 had mental retardation (12%).

Of the patients with 23 eyes that had formal VA testing, the average birth weight was 668 g (range, 283.5–1417.5), the average postgestational age at birth was 26 weeks (range, 23–31), and the average postmenstrual age at time of surgery was 43.7 weeks (range, 37–61). Successful retinal reattachment was achieved in all 23 eyes, whereas the macula appeared to be without distortion in 19 of 23 eyes (83%) during the follow-up period.

The average age at time of VA determination was 3.51 years (range, 1.8–6.3 years). The average logarithm of the minimum angle of resolution (logMAR) VA was 20/58. Non-logMAR VAs ranged from 20/200 to 20/20. Three eyes had acuities of 20/200, and 4 had acuities of 20/100. All other eyes were 20/80 or better. Sixteen of 23 eyes (70%) had VAs of 20/80 or better, whereas 11 of 23 eyes (48%) achieved VAs of 20/40 or better.

No eyes progressed to advanced stages of ROP. None of the patients developed rhegmatogenous RD, cataract, or endophthalmitis. No eye developed elevated intraocular pressures or corneal edema.

Discussion

The development of RD in ROP has traditionally heralded the onset of a progressive downward spiral that results in poor anatomic and visual outcomes. Although advanced ROP-related RDs lend themselves to surgical repair and retinal reattachment, visual outcome rarely is better than 20/400.^{1–4} Stage 4A ROP represents an opportunity to interrupt this potentially devastating process before the macula is involved. Because the macula remained uninvolved in our patient cohort, reasonable VA was achieved in most eyes.

All intraocular surgery carries with it real risks of serious complications. The decision to intervene, as in all surgical interventions, must be weighed against the untreated natural history of the disease. Gilbert et al reported on the natural

history outcomes of ROP RDs at 4.5 years in patients who were in the observation arm of the Multicenter Trial of Cryotherapy for Retinopathy of Prematurity. Eyes with ≥ 13 segments of RD had a 92% chance of having an unfavorable outcome whether or not the macula was involved in the detachment, and only 19% of all 4A eyes had normal macular anatomy. From a VA standpoint, 76% of eyes with stage 4A ROP were blind at 4.5 years, 4% had acuities of less than 20/200, and only 20% obtained acuity of 20/200 or better.⁷

The incidence of endophthalmitis after adult vitrectomy is 1 in several thousand cases. No patient in our study cohort developed endophthalmitis. The risk of rhegmatogenous RD after vitrectomy in the adult population has been established at approximately 1 per 100 cases. In our experience, the incidence of rhegmatogenous RD is significantly lower in children undergoing vitrectomy for ROP than in adult vitreoretinal surgery. This decreased incidence is likely secondary to several factors, including the extensive peripheral photoablation that these eyes receive, the lack of synechitic degeneration in pediatric eyes, and the use of air–fluid exchanges at the end of each case to minimize vitreous incarceration. None of our patients developed secondary rhegmatogenous RD. It has been well established that vitreous surgery may result in formation or advancement of crystalline lens opacities. Previously published data suggest that the rate of cataract formation after lens-sparing vitrectomy is 15%.⁸ None of the patients in the study cohort developed lens opacities during the time of follow-up. This may be secondary to the small size of the population, improvements in surgical equipment, and the surgeon's increased facility with the procedure. In view of the poor natural history for eyes with ROP-related RD and the rarity of surgical complications just described, consideration of vitrectomy is certainly warranted.

Retinal reattachment may be achieved by vitreous surgery alone, scleral buckling alone, or a combination of vitrectomy and scleral buckling. Multiple authors have described retinal reattachment rates after scleral buckling surgery.^{1–4,9} Our preferred method of surgical repair is lens-sparing vitrectomy. By sparing the native lens, the patient has an increased likelihood of achieving normal visual system development. For years, we have considered this to be the procedure of choice in stage 4A ROP. We believe that the predominant pathophysiology involved in ROP detachment is a tractional one. The tractional components are numerous, and include proliferative tissue on and between the ridge, stalk, lens, and pars plicata. Unlike scleral buckling, lens-sparing vitrectomy directly addresses the tractional components, allowing for secondary retinal settling after subretinal fluid and exudate are absorbed by the retinal pigment epithelium. Additional advantages over scleral buckling include the lack of induced anisometropia, no need for secondary surgery to remove or cut the element used, and a higher rate of retinal reattachment. The rate of retinal reattachment after lens-sparing vitrectomy is 90%, whereas scleral buckling has an anatomic success rate of approximately 70%.^{3,9,10} Visual outcome in the current series is clearly superior to any published data for scleral buckle to date. Our series achieved retinal reattachment in

all but one patient that we were able to observe, and this may be secondary to our smaller cohort size, improvements in surgical equipment, and the surgeon's increased facility with the procedure.

This study has several limitations worthy of consideration. The series is neither randomized, controlled, nor prospective. The cohort size is relatively small, and only 23 of 45 patients (51%) had formalized VA testing performed. Formalized VA testing was not performed on 9 of the 45 patients (20%) who were observed, and 12 of 45 patients (27%) were lost to follow-up. A standardized examiner did not obtain the visual outcome data, and 2 different tests of acuity were used. Both, however, are acceptable means of visual testing. The fellow eyes of these patients were not controlled for. In several cases, the fellow eye received only laser therapy. In such cases, competitive amblyopia with the operated eye may decrease the eventual visual outcome in the operated eye. In addition, levels of developmental delay were not accounted for. Difficulty with testing may have changed the level of maximum VA noted.

This series involves a cohort of patients who had stage 4A RDs from ROP repaired with lens-sparing vitrectomy. Visual acuity outcomes were substantially better than those previously reported in the literature, with 70% of children having formalized VA testing obtaining 20/80 or better, and no child having a VA of worse than 20/200. In addition, nearly half of the eyes obtained acuity of 20/40 or better. These initial data support the notion that lens-sparing vitrectomy has the potential of providing a significant positive impact on the process of ROP RDs.

References

1. Greven C, Tasman W. Scleral buckling in stage 4B and 5 retinopathy of prematurity. *Ophthalmology* 1990;97:817–20.
2. Noorily SW, Small K, de Juan E Jr, Machemer R. Scleral buckling surgery for stage 4B retinopathy of prematurity. *Ophthalmology* 1992;99:263–8.
3. Trese MT. Scleral buckling for retinopathy of prematurity. *Ophthalmology* 1994;101:23–6.
4. Trese MT, Droste PJ. Long-term postoperative results of a consecutive series of stages 4 and 5 retinopathy of prematurity. *Ophthalmology* 1998;105:992–7.
5. Maguire AM, Trese MT. Lens-sparing vitreoretinal surgery in infants. *Arch Ophthalmol* 1992;110:284–6.
6. Maguire AM, Trese MT. Visual results of lens-sparing vitreoretinal surgery in infants. *J Pediatr Ophthalmol Strabismus* 1993;30:28–32.
7. Gilbert WS, Quinn GE, Dobson V, Multicenter Trial of Cryotherapy for Retinopathy of Prematurity Cooperative Group. Partial retinal detachment at 3 months after threshold retinopathy of prematurity. Long-term structural and functional outcome. *Arch Ophthalmol* 1996;114:1085–91.
8. Ferrone PJ, Harrison C, Trese MT. Lens clarity after lens-sparing vitrectomy in a pediatric population. *Ophthalmology* 1997;104:273–8.
9. Hinz BJ, de Juan E Jr, Repka MX. Scleral buckling surgery for active stage 4A retinopathy of prematurity. *Ophthalmology* 1998;105:1827–30.
10. Capone A Jr, Trese MT. Lens-sparing vitreous surgery for tractional stage 4A retinopathy of prematurity retinal detachments. *Ophthalmology* 2001;108:2068–70.