

Treatment for Amblyopia after Surgery for Cataract and Vitreoretina in Pediatric Ocular Trauma

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Abstract

Purpose: We investigated the value of occlusion therapy assisted by wearing spectacles or implanting an intraocular lens following surgeries for cataract and vitreoretina in pediatric patients.

Methods: Fifty-one children with ocular trauma, aged from 3 to 12 years, were enrolled in this study, including 39 cases of open global injuries and 12 ocular blunt injuries. The patients underwent a series of surgeries, including suture of the cornea or sclera wound, cataract extraction, vitrectomy, and repair of retinal detachment in some cases. Occlusion therapy was prescribed for 29 eyes wearing spectacles and 22 eyes with implanted intraocular lenses (IOLs) for 6 to 12 months. All the children were followed up for 12 to 60 months (mean 41.5 months) after the final operations.

Results: Best corrected visual acuity was improved in 32 eyes (62.7%) and not improved in 19 eyes (37.3%), including 6 eyes with a leucoma involving the central cornea, 5 eyes with a retina scar involving the macula, and 2 eyes with unsatisfactory overall patching time. Occlusion therapy assisted by wearing spectacles (65.5%) and implanting IOLs (59.1%) showed similar improvements in the visual acuity of the injured eyes.

Conclusion: Occlusion therapy, combined with wearing spectacles and implanting IOLs, is valuable in treating deprivation amblyopia due to ocular trauma and series surgeries in pediatric patients. Spectacles may be dependable during occlusion therapy in the early post-surgery stage. (*Eye Science* 2013; 28:68–72)

Keywords: amblyopia; ocular trauma; pediatric

Introduction

Ocular traumas that occur in children usually lead to irreversible visual impairment; this is especially

the case for combined injuries of the cornea, lens, and retina in open global injuries and some severe global blunt force injuries. The recent development of cataract and vitreoretinal surgical techniques now allows many poor prognosis eyes to be salvaged^{1,2}. Compared with those of adults, the injured eyes of children are still developing; consequently, disturbance of the visual experience during this vulnerable period often causes amblyopia. Therefore, even a temporary deficiency of visual stimulation due to ocular injuries and improper treatment after surgeries may result in poor visual outcome³. Amblyopia is usually treated with occlusion of the dominant eye, which forces the amblyopic eye to view, thereby reversing the amblyopia. Previous studies have analyzed the characteristics of children's ocular injuries and have confirmed the role of vitreous surgery in treating these kinds of emergencies. Some injured eyes showed better vision than eyes with unilateral congenital cataracts after correction of the refractive error and training of the amblyopia⁴, probably because the injured eyes once had normal vision prior to the injuries.

Early surgeries and immediate correction of post-operative refractive errors usually result in a better vision prognosis. Recent clinical data have emphasized the importance of early surgery in children with ocular injury, in order to avert deprivation amblyopia and retard axial myopia⁵. These treatments to avoid amblyopia are especially significant for those eyes that retain potential visual function after the removal of the cataract and vitreous. Research on aphakia in children has suggested that children with traumatic cataract and lens dislocation are more likely to experience an improvement in visual acuity postoperatively than are children with congenital

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cataract⁴, but few clinical studies have mentioned the treatment of amblyopia in children after surgery for ocular injuries.

We demonstrate the importance of early treatment of amblyopia and describe possible treatment methods by follow up of 51 children with complex ocular traumas. All the injured eyes retained relatively clear refractive media and valid retinal function after vitrectomy and lensectomy surgery and therefore had the potential for improvement in visual acuity after treatment for amblyopia.

Materials and methods

A total of 51 eyes (51 children) that underwent cataract and vitreoretinal surgery following ocular trauma in our hospital were enrolled between January 2000 and December 2006. All the cases had normal intraocular pressure, stable ocular condition, and a vision better than counting fingers postoperatively. Children who had a history of prior amblyopia (1 case) or ocular trauma (1 case), or severe injuries resulting in atrophy bulbi after operation (2 cases) were excluded. In total, 32 boys and 19 girls were involved in our study, with a mean age of 6.3 years (10 cases ranging from 3 to 5 years, 33 cases ranging from 6 to 8 years, 8 cases ranging from 9 to 12 years). A total of 12 eyes had contusive closed globe injuries and 39 eyes had open globe injuries, including 5 cases of intraocular foreign bodies. The entrance wound locations of the open globe injuries were within the cornea in 22 eyes, within the sclera in 6 eyes, and involving the corneosclera in 11 eyes. Surgeries were performed by two ophthalmologists trained in pediatric vitreoretinal surgery. The injured eyes underwent serial combined surgeries including wound repair, lensectomy, vitrectomy, removal of the intraocular foreign bodies, intraocular laser treatment, and silicone oil or inert gas filling. After surgeries, 23 eyes developed keratoleukoma; 13 leukomas were cloudy and involved the center cornea and 10 involved the peripheral cornea or limbus. Seven eyes developed retinal scars, and 3 of these involved the macula. The postoperative corrected vision ranged from counting fingers to 20/200 in 21 eyes, from 20/125 to 20/60 in 15 eyes, and from 20/50 to 20/30 in 15 eyes.

Spectacles and occlusion therapy (29 cases): The

initial ordered spectacles were evaluated by retinoscopy and visual acuity measurements between 3 to 4 weeks after lensectomy and vitrectomy. The optical power of the spectacles was adjusted for optimal distance vision. Additional spectacles were prescribed, over corrected by +3 to +4 diopters, to encourage near vision, followed immediately by occlusion therapy. Fulltime (all waking hours) spectacle wearing of the aphakic eye and patching of the dominant eye were prescribed 6 days a week. Spectacle fit and retinoscopy were reevaluated every 2 to 3 months for any necessary changes. The patients were followed up for 12 to 48 months, mean 45 months.

IOL and occlusion therapy (22 eyes): Up to 1 month after lensectomy and vitrectomy, 17 eyes underwent secondary implantation of IOLs sutured within the ciliary sulcus. Briefly, two scleral flaps were made at the 2- and 8-o'clock positions. A scleral tunnel was made at the 12-o'clock position. A double-armed 10-0 polypropylene suture on a bent and a straight needle was used to secure the IOL in the ciliary sulcus. The straight needle perforated the sclera under the lamellar flaps 1.5 to 2 mm behind the limbus, from the 2- to 8-o'clock positions. Each scleral suture was tied to itself and the knot was buried under the scleral flap. IOL with an artificial iris was prescribed for 5 eyes, with large area of iridocoloboma to release photophobia. Data from Enyedi were referenced in deciding IOL power⁶. We aim for close to emmetropia and avoid intolerable anisometropia when a child reaches adulthood, so we prefer an initial postoperative undercorrection (hyperopia), which will vary with age at surgery. The refractive status of the healthy eye was taken into consideration in cases of severe irregular astigmatism. Some remaining hyperopia was corrected with spectacles within 2 weeks post-surgery. Additional spectacles were prescribed to each patient, overcorrected by +3 to +4 diopters, to encourage near vision, followed immediately by occlusion therapy.

Occlusion therapy was prescribed for all patients for 6 to 12 months according to visual acuity improvement. All the patients were followed up for 12~60 months, mean 41.5 months, after the final surgery. The naked and the corrected vision, refractive status, intraocular pressure, and fundus of the

eye were recorded at every follow-up examination.

Results

The improvement of the best corrected visual acuity was evaluated by ranking the vision results into four grades: poor (20/200 or worse), moderate (20/125 to 20/60), good (20/50 to 20/30), and excellent (20/25 or better). Table 1 shows the changes in the best corrected visual acuity of patients wearing spectacles or implanted with IOLs before and after occlusion therapy. To reduce the subjective influence in the visual examination, as well as the visual improvement due to the recovery of corneal injury and diminishing of inflammation, improvement of only one line on the visual acuity chart was omitted. The final best corrected visual acuity after occlusion therapy was sorted into unimproved and improved groups. Ultimately, 32 patients (62.7%) improved their visual acuity and 11 (21.6%) of them obtained excellent visual acuity (20/25 or better).

Table 1 Comparison of Snellen VA corrected by spectacles and IOLs after occlusion therapy

BCVA group	BCVA before patching		Final BCVA after patching	
	No. (%) of eyes		No. (%) of eyes	
	Spectacles	IOLs	Spectacles	IOLs
20/200 or worse (Poor)	13(44.8)	8(36.4)	4(13.8)	3(13.6)
20/125 to 20/60 (Moderate)	10(34.5)	5(22.7)	7(24.1)	2(9.1)
20/50 to 20/30 (Good)	6(21.7)	9(40.9)	12(41.4)	10(45.5)
20/25 or better (Excellent)	0	0	6(20.7)	7(31.8)
Total	29	22	29	22

BCVA indicates best corrected visual acuity

A total of 23 eyes developed cornea scars. Of these, 17 eyes improved in visual acuity after occlusion therapy due to a relatively smaller scar or a scar limited to the peripheral cornea. Among the 28 eyes without cornea scars, 21 eyes showed improved visual acuity. The unimproved 7 eyes included 5 eyes with a retinal scar involving the macula and 2 eyes with an unsatisfactory patching for no more than 50% of the overall time.

After patching, 32 (62.7%) patients improved their visual acuity, and 11 (21.6%) patients were unimproved. Wearing spectacles and implanting IOLs played similar roles in improving visual acuity, as

shown in Table 2. For 29 patients wearing spectacles, visual acuity was improved in 19 eyes (65.5%); 14 eyes improved moderately and 5 eyes improved significantly. On the other hand, for 22 patients implanted with IOLs, visual acuity was improved in 13 eyes (59.1%); 9 eyes improved moderately and 4 eyes improved significantly.

Table 2 Visual acuity outcomes after occlusion therapy

VA improvement	Spectacles, No. of eyes	IOLs, No. of eyes	P value
Not improved	10	9	0.267
Improved moderately	14	9	
Improved significantly	5	4	
Total	29	22	51

Improved moderately indicates visual acuity improved from poor (20/200 or worse) to moderate (20/125 to 20/60), or from moderate to good (20/50 to 20/30), or from good to excellent (20/25 or better); improved significantly indicates visual acuity improved from poor to good, or from moderate to excellent. χ^2 test was used, $P=0.267$.

Discussion

The visual system is underdeveloped in children; therefore, the recovery of vision after ocular trauma in pediatric patients differs from that in adults. Even temporary interruptions might prevent the development of the visual system, resulting in deprivation amblyopia. Therefore, some pediatric patients do not achieve ideal final vision after successful surgeries. The visual outcome following surgery depends on the age of onset, the severity and location of the ocular injuries, the duration between the occurrence of ocular trauma and the correction of the refractive error, and the efficiency of the occlusion therapy.

The human visual system is sensitive to the effects of depriving vision only during a limited period of time in childhood; this critical period is important in the treatment of amblyopia⁷. No definitive age is recognized at which the critical period can be said to terminate, although most pediatric ophthalmologists agree the critical period probably ends near the ninth year of life. Some additional unknown factors may indefinitely extend the critical period in humans⁷⁻⁹. Our data involved a mean age of 6.3 years (ranging from 3 to 12 years) in our pediatric patients; only 8

patients were older than 9 years and beyond the postulated limit of the critical period. The time duration between the ocular trauma incident and the correction of refractive error with spectacles or IOL was 8 to 21 weeks. We believed that the deprivation amblyopia due to short interruption of vision development was reversible in most of these children. Previous studies suggested that the occlusion therapy was more efficient in children with traumatic cataract than with congenital cataract¹⁰⁻¹². Our study showed that occlusion therapy was also efficient after surgery for complex pediatric ocular trauma. By correcting refractive errors and patching, up to 74.5% of the patients improved their final visual acuity. The visual prognosis of ocular trauma was superior to unilateral congenital cataract, perhaps because the visual function had developed normally before injury.

After successful cataract and vitreoretinal surgery, refractive errors of the aphakic eyes were corrected immediately, followed by occlusion therapy. Many choices suggested in previous studies included IOL implantation, contact lenses, and spectacles^{4,13}. Since young children with a growing eye will not maintain a stable refractive status, opinions are ambiguous in deciding the power of IOLs^{14,15}. For some patients in this study, we chose an IOL power that would generate certain initial postoperative hyperopia that varies with age at surgery, in order to reduce the child's ultimate myopia. We anticipated that the injured eyes with moderate initial hyperopia would become emmetropic with some rapidity, followed by a slower curve into myopia. Some surgeons choose emmetropia or myopia to help in the early management of amblyopia¹². They have proposed that refraction will change considerably during the subsequent years and that the eye will become highly myopic, but not highly amblyopic. However, thus far, no prospective study has shown which strategy ultimately achieves the best visual acuity. Whatever IOL power is decided during this developing process, the refraction must be managed at each point to optimize the focus for the child, for both distance and near vision.

For 29 patients, no IOL was implanted during the first year post-surgery. Spectacles were prescribed for the aphakic eyes to correct the high hyperopia.

Both the far and the near focus were taken into consideration, especially the near vision. Therefore, bifocal glasses were recommended for some children intolerant of 2 pairs of glasses. Our data demonstrated a similar efficiency in treating amblyopia assisted by wearing glasses (75.9%) or implanting IOLs (72.7%). Other studies suggested that contact lenses were best fitted in addition to IOL¹⁶. However, most parents of the pediatric patients in this study preferred spectacles rather than practicing the skills needed for wearing contact lenses.

Unstable optical status at the early stage post-surgery due to inflammation and repair of the cornea scar usually complicates the choice of the correct IOL power. Suitable spectacles and immediate occlusion therapy to prevent otherwise irreversible deprivation amblyopia should be considered the best choice. Our data confirm that wearing spectacles soon after surgeries could efficiently assist the occlusion therapy and improve visual acuity to levels similar to those achieved by IOL implantation. However, anisometric spectacles cause a prismatic deviation that varies in all directions, leading to diplopia in side gaze that can be bothersome¹⁷. On the other hand, anisometric spectacles induce different sizes of images that are beyond binocular vision. Therefore, as soon as the visual acuity is improved by occlusion therapy, the proper power of IOL should be implanted into the aphakic eyes to encourage binocular vision and possible stereoscopic vision.

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