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Improved vision and contact lens wear time with Piggy-Back Contact Lens Systems in children after penetrating corneal trauma

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Abstract

Objective—Consecutive case series of children treated successfully with "Piggy-back" (PB) contact lens systems after corneal trauma.

Methods—We reviewed the medical record of all children ages 4–14 years treated at the Emory Eye Center between 11/1/03 and 11/1/13 with PB contact lens systems.

Results—Four children with a history of corneal penetrating trauma were treated with a PB lens system, with a mean age of 7 ± 0.08 (range: 6 to 8) years. Best corrected spectacle vision was count fingers in two children and logMAR+0.70 (Snellen equivalent 20/100) and logMAR +0.6 (Snellen equivalent 20/80) in the remaining two. The PB lens system was introduced a mean of 15.7 ± 6.5 (range: 9 to 22) months after the injury. All patients were initially fitted with gas permeable (GP) lenses. Each child achieved 11 or more hours of daily contact lens wear time in PB systems. The mean best corrected logMAR visual acuity using the PB system was 0.26 ± 0.21 (Snellen equivalent 20/36). The mean improvement in best corrected logMAR between GP and PB lens systems was $+0.21 \pm 0.11$, which corresponds to an improvement of greater than two lines on the Snellen chart.

Conclusion—PB contact lens systems can be helpful to improve vision and contact lens wearing time in children with irregular astigmatism following corneal trauma who are intolerant of GP contact lenses.

Keywords

irregular astigmatism; contact lens; piggy-back; cornea; trauma; children

Introduction

Gas permeable (GP) contact lenses are an effective treatment for irregular corneal astigmatism following penetrating corneal injuries.^{1,2} However, there is a subset of patients who do not tolerate wearing GPs. These issues are amplified in children, who are often more challenging to fit and may be less tolerant of GP lenses. As a result, some parents struggle to apply and remove lenses, and wearing time may be truncated.

“Piggy-Back” (PB) lens systems consist of a GP lens on top of a soft contact lens, and were initially used clinically for keratoconus patients with significant irregular astigmatism.^{3,4,5} The use of PB systems have been reported in patients with other causes of irregular astigmatism, including penetrating corneal trauma.^{6,7}

To date, all reported cases of PB contact lens system use have been in adults. We report a consecutive case series of four children whose vision could not be adequately corrected with glasses after corneal trauma, who were treated successfully with a PB contact lens system.

Methods

We reviewed the medical record of all children ages 4–14 years treated at the Emory Eye Center between 11/1/03 and 11/1/13 with PB contact lens systems. We identified four cases with complete information regarding PB system fitting, utilization and outcome. These cases are presented here.

Several considerations regarding fit of the PB systems are important to keep in mind. The application of a soft lens to the cornea alters the corneal shape. There are two basic technique utilized in fitting BP systems. The first technique begins with determination of the best fit and optimum correction for the eye with the GP only. Then, a high oxygen permeable soft lens with low power is applied under the GP. The second technique involves fitting a high oxygen soft lens and then determining the best fit GP and power over the altered corneal shape⁶. In our experience, we frequently utilize PB systems with the hope that the soft lens will be discontinued at some point. Therefore, we recommend the first technique.

In addition, utilizing soft lens powers can optimize the fit of the GP lens. For instance, utilizing a +2.00 diopter soft lens power will loosen the fit of the GP by increasing the altered corneal curvature with a more convex shape. Similarly, utilizing a –2.00 diopter soft lens power will tighten the fit of the RGP by decreasing the altered corneal curvature with a more concave shape³.

Another consideration is that lens thickness aids patients and their caregivers in the insertion and removal of contact lenses. The fitter should also be aware that the soft lens power has approximately a 20% effective power under the GP^{7,8}. For example, a –5.00 diopters soft lens under an GP lens will add approximately +1.00 diopters to the tandem refracting system.

Case Reports

Case 1

An 8-year-old girl was evaluated 3 years after she sustained a corneoscleral laceration to the right eye with a plastic stick that was repaired with 11 sutures. She had undergone a trial with a GP contact lens, but the patient did not tolerate it, and as a result was only wearing spectacles.

On presentation, her best corrected visual acuity with spectacles was logMAR +0.60 (Snellen equivalent 20/80). She had a boomerang-shaped corneal scar with one remaining corneal suture, inferior iridocorneal touch, and was aphakic with opacification of the posterior lens capsule.

She was fit with a Boston XO GP contact lens (Bausch and Lomb;Wilmington, MA) and she underwent a YAG posterior capsulotomy, which improved her best-corrected vision to logMAR 0.3 (Snellen equivalent 20/40). However, she would only tolerate the GP for short periods of time.

One year after initial presentation, she was started in a PB contact lens system. An Acuvue Oasys soft contact lens (Vistakon; Jacksonville, FL) with base curve 8.4 and power +1.50 was placed under her GP (Figure 1). She reported significant improvement in comfort with the PB contact lens system and her visual acuity improved to logMAR +0.17 (Snellen equivalent 20/30) in the right eye.

At last follow-up, 7 years after starting the PB contact lens system, she was using the system for all waking hours and visual acuity was logMAR 0.00 (Snellen equivalent 20/20) in the right eye.

Case 2

A 6-year-old boy was evaluated 4 days after sustaining a corneoscleral laceration to the right eye from a pencil. The corneoscleral laceration was repaired the same day. He had no significant past medical or ocular history. Postoperatively, his best-corrected vision was count fingers at 6 inches in the right eye.

He underwent cataract extraction with intraocular lens (IOL) implantation 2 weeks later. Two months later, he was fit with a Boston XO GP. The following week, he underwent YAG capsulotomy and suture removal.

At his 1-month post-operative visit, he reported discomfort when wearing his GP. He was also patching his left eye about 2 hours per day. His visual acuity with the GP contact lens was logMAR +0.50 (Snellen equivalent 20/63) in his right eye.

One year after initial presentation, he was continuing to have discomfort wearing his GP lens, and he removed it almost every day at school. His vision was stable at 20/63 with the lens in place. He was started on a trial of a PB contact lens system. An Acuvue Oasys soft lens with base curve 8.4 and power +2.00 was placed under his GP. Initially, the system was only minimally more comfortable compared with his GP alone. After adjusting the fit of the soft lens, he was able to see logMAR +0.40 (Snellen equivalent 20/50) and was able to tolerate the PB contact lens system for 11 hours daily.

Three years after his injury and 17 months of successful PB system wear, he stopped wearing his contact lenses. He was able to be refracted to logMAR +0.17 (Snellen equivalent 20/30) with spectacles, and was given bifocal spectacle correction.

Case 3

A 7-year-old boy presented to the Contact Lens service with a full thickness corneal scar across the visual axis of the left eye from a screwdriver injury. His best-corrected visual acuity was count fingers at 2 feet in the left eye. He was initially fit with an GP lens that improved his visual acuity to logMAR +0.48 (Snellen equivalent 20/60) in the left eye. His family was instructed to patch the right eye four hours per day.

One month later, his mother reported difficulty applying and removing the GP lens due to poor cooperation from the patient. He did not tolerate wearing the lens during school hours and was only wearing it intermittently in the evenings and on weekends.

Ten months later, he was started in a PB contact lens system incorporating an Acuvue Oasys soft lens with base curve 8.4 and power +1.00 under his GP (Figure 2).

He tolerated his PB system better than his GP alone. At his last follow-up, 11 months after initiation of his PB contact lens system, his visual acuity was logMAR +0.18 (Snellen equivalent 20/30) in the left eye with the system in place, and he was wearing it for 14 hours per day.

Case 4

A 7 year-old girl presented to the Contact Lens service with a central corneal scar and irregular corneal astigmatism 8 months after a penetrating corneal injury to the right eye. Her best-corrected spectacle acuity was 20/100 in the right eye. She was fit with a soft Air Optix Night and Day Aqua lens (Alcon, Fort Worth, Tx) with base curve 8.6 and power +2.25 lens that improved her visual acuity to logMAR +0.60 (Snellen equivalent 20/80). Her family was instructed to patch the fellow eye 2–3 hours per day.

Eight months later, her vision was stable and she was tolerating the soft lens for all her waking hours. However, she had persistent scissoring of the red reflex on retinoscopy, so she was fitted with a GP in a PB contact lens system. The soft lens corrected a portion of her refractive error, and a GP was fit to the resultant new shape over the convex front surface (Figure 3). With the PG lens system, her visual acuity improved to logMAR +0.48 (Snellen equivalent 20/60) in the right eye. At last follow-up 1 year later she continued to have stable visual acuity and she continued to tolerate the PB lens system.

Discussion

We report 4 consecutive children who were successfully treated using a PB contact lens systems after corneal trauma with a mean age of 7 ± 0.08 (range: 6 to 8) years. Best corrected spectacle vision was count fingers in two of the children and 20/100 and 20/80 in the remaining two. In each case, treatment with a RGP was initially attempted. Only after treatment with RGP contact lenses had failed was treatment with a PB contact lens system initiated. Visual rehabilitation in children in the amblyopic age range is time-sensitive. PB contact lens systems can prove to be invaluable for children intolerant of GP contact lenses.

In the first 3 cases, patient discomfort was the factor leading to PB system use. By placing a soft lens “buffer” between the cornea and the GP, comfort was enhanced, allowing these children to adapt to contact lens use for longer wearing times. The final patient was able to tolerate a soft lens but failed to achieve optimum vision. The use of the PB system enhanced the fit of the system, resulting in an improvement of her visual acuity from 20/80 to 20/60(logMAR improvement 0.12). Sengor et al reported 29 eyes in 16 adult patients with keratoconus who were treated with PB contact lens systems. In their report, visual acuity increased in all eyes compared with spectacle correction, and visual acuity compared with GP systems improved in 89.7% of treated eyes⁸. In our case series, the best corrected logMAR acuity improved a mean of $+0.21 \pm 0.11$ when the patients were transitioned from GP to PB systems confirming that PB systems are at least optically equivalent if not superior to GPs alone in the setting of irregular astigmatism after corneal trauma.

All 4 of the children in our series sustained corneal injuries while in the amblyopic age range (< age 7 years). A vital part of visual rehabilitation for these children included patching the better-seeing eye to promote use of the amblyopic eye. This is difficult when a child is intolerant of his or her contact lens system. In two of the three cases, patching was not successfully performed until the PB lens system was initiated.

In adults, it has been reported that PB systems can be a bridge for patients into GP lens alone. After a period of time in the PB systems, patients are more tolerant of GP systems alone. It is possible that, in the future, these children may be transitioned into more traditional systems with GP use alone. One of the children reported was able to transition to spectacle correction alone. His PB system was vital during the healing process of his central scar and corneal remodeling. He is now doing well in spectacles alone.

PB systems have several disadvantages over GP lenses used alone. First, they are more expensive because of the additional cost of soft lenses and the care products necessary to care for them. Second, two lenses have to be applied and removed. Finally, combination systems have lower oxygen permeability compared with single lens systems. This last drawback has been reduced over time as newer high-DK hydrogel and gas permeable materials have become available for use in PB systems⁹. The disadvantages of PB systems are offset by the increased comfort of the system. This resulted in increased wearing time for our patients. Each child achieved 11 or more hours of daily contact lens wear time in PB systems.

Piggy-Back contact lens systems are not the first line treatment for the management of irregular astigmatism in children. However, they can be helpful to improve vision in children with irregular astigmatism following corneal trauma who are intolerant of GP contact lenses.

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References

1. Titiyal JS, Sinha R, Sharma N, et al. Contact lens rehabilitation following repaired corneal perforations. *BMC Ophthalmology*. 2006; 6:11. [PubMed: 16536877]
2. McMahon TT, Devulapally J, Rosheim KM, et al. Contact lens use after corneal trauma. *J Am Optom Assoc*. 1997; 68(4):215–224. [PubMed: 9150657]
3. O'Donnel C, Maldonado-Codina C. A hyper-Dk Piggyback Contact Lens System for Keratoconus. *Eye & Contact Lens*. 2004; 30(1):44–48. [PubMed: 14722470]
4. Tsubota K, Mashima Y, Murata H, et al. A piggyback contact lens for the correction of irregular astigmatism in keratoconus. *Ophthalmology*. 1994; 101(1):134–139. [PubMed: 8302546]
5. Sengor T, Kurna SA, Aki S, et al. High Dk piggyback contact lens system for contact lens-intolerant keratoconus patients. *Clinical Ophthalmology*. 2011; 5:331–335. [PubMed: 21468342]
6. Baldone J. Piggy-back fitting of contact lenses. *The CLAO Journal*. 1985; 11(2):130–134. [PubMed: 4006166]
7. Michaud L, Brazeau D, Corbeil ME, et al. Contributions of soft lenses of various powers to the optics of a piggy-back system on regular corneas. *Contact Lens and Anterior Eye*. 2013; 36:318–323. [PubMed: 23510570]
8. Woo M, Weissman BA. Effective optics of piggyback soft contact lenses. *Contact Lens Spectrum*. 2011 Nov 1.
9. Sengor T, Kurna SA, Aki S, et al. High Dk piggyback contact lens system for contact lens-intolerant keratoconus patients. *Clin Ophthalmol*. 2011; 5:331–335. [PubMed: 21468342]
10. Mehta M, Bhagwanjee A, Hilliar O. A clinical and optical evaluation of a modified lens for irregular corneae. *Clinical and Experimental Optometry*. 2006; 89:30–36. [PubMed: 16430438]
11. Gilando-Ferreiro A, Galindo-Alonso J, Sanchez-Tocino H, et al. Contact lens fitting in 133 eyes with irregular astigmatism. *Arch Soc Esp Oftalmol*. 2007; 82(12):747–751. [PubMed: 18040917]
12. Baldone JA, Clark WB. Contact lens in the aphakic child. *Contact Lens Med Bull*. 1970; 3:25–27.
13. Westerhout D. The combination lens and therapeutic uses of soft lenses. *Contact lens*. 1973; 4:3–9.

Figure 1.
Anterior segment photograph of Piggy-Back lens system in Case 1. Even though there is a significant central corneal scar the patient is able to see 20/20 in this eye wearing the piggy-back lens system.

Figure 2.
Anterior segment photograph of Piggy-Back lens system in Case 3.

Figure 3.
Anterior segment photograph of Piggy-Back lens system in Case 4.