Mushroom keratoplasty and contact lens application: Strategy for management of a pediatric eye injury

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We show the challenging visual rehabilitation of a penetrating eye injury in a child with wide central corneal scar and aphakia. A 9-year-old male patient underwent combined surgery, including membranectomy with pupilloplasty and mushroom penetrating keratoplasty. Corneal transparency was restored; aphakia and irregular astigmatism were corrected first with a rigid gas-permeable contact lens (CL) and then, successfully, with hybrid CL. We discuss the surgical treatment used to restore corneal transparency and the choice of the best CL to overcome irregular astigmatism and aphakia.

Key words: Aphakia, contact lenses, corneal transplantation, pediatric eye injury

Ocular injury is one of the primary causes of monocular blindness worldwide, especially in developing countries. Most pediatric cases derive from sharp object penetration causing open globe injuries. The primary aim of treatment is to restore the integrity of ocular structures through emergency surgery and to prevent infections.[1] Management of residual refractive errors, however, is more challenging.

Corneal scars and aphakia are frequent sequelae, resulting in irregular astigmatism and loss of accommodative function. Options for restoring vision vary from surgery with intraocular lens (IOL) implantation,[2] to nonsurgical treatment with contact lens (CL).[3] Particular attention should be paid to corneal scars involving the visual axis of children to prevent amblyopia.[4]

We show the challenging management and visual rehabilitation of a penetrating eye injury in a young boy with central corneal scar and aphakia.

Case Report

A 9-year-old male patient presented with a penetrating ocular right eye (RE) trauma occurred 4 months earlier. He suffered a full-thickness corneal laceration with lens dislocation caused by a glass bottle explosion. He was promptly treated with corneal suturing and lens extraction in Egypt. Visual acuity was light perception in RE and 20/20 in left eye. Orthoptics evaluation showed a fixed right exotropia, probably because of visual deprivation. Slit-lamp examination revealed a wide linear corneal scar (9.00 mm) through the visual axis and aphakia. The pupil had an inferior decentralization due to the presence of a thick retropupillary membrane and anterior synechiae between the pupillary edge and the iridocorneal angle. Anterior chamber was clear, and intraocular pressure (IOP) was digitally normal. B-scan showed an intact retina without pathological findings or foreign intraocular bodies.

One year after the trauma, we performed a combined procedure including membranectomy with pupilloplasty and mushroom penetrating keratoplasty (MR-PK); the main surgical steps are illustrated in Fig. 1. Mushroom keratoplasty was performed using Prof. Busin's standard technique.[5] The host cornea was trephined to approximately 200 μm in depth and 9.00 mm diameter using a suction trephine (Hessburg Barron Trephine, Altomed, Tyne and Wear, UK), and then an anterior manual partial stromectomy was performed.

The graft was prepared by the local eye bank (Monza Eye Bank, Monza, Italy) using a single-donor cornea split into an anterior and posterior lamellae by a microkeratome set at 250 μm depth (ALTK; Moria SA, Antony, France). The anterior lamella was then punched to 9.00 mm and the posterior lamella to 6.50 mm (Barron Donor Corneal Punch, Altomed, Tyne and Wear, UK). The next step was the full-thickness trephination of the host cornea using a 6.50-mm trephine centered over the pupil, obtaining a host corneal button which was removed and replaced by the 6.50-mm posterior donor lamella, the "stem." The anterior donor lamella, the "hat," was then placed over the "stem." The "hat" was lastly sutured to the host cornea [Fig. 2].

One-month follow-up showed a clear corneal graft. Best-corrected visual acuity (BCVA) was 20/400 with a +12.00 D sphere spectacles correction. Fundus examination was unremarkable. The retropupillary membrane was still present even if reduced in dimensions and IOP was 15 mmHg. Loose sutures were removed. At 2 months of follow-up, BCVA became 20/200 with pinhole and the cornea had healed enough for CL fitting.

The first attempt of CL correction was made with a rigid gas-permeable (RGP) inverse geometry lens Sanalens Rose K2 IC (Sanalens, Pisa, Italy) 7.55/+10.00/10.60 to evaluate the visual potential in a condition of low and irregular astigmatism [Fig. 3].

There was a proper lens fitting and an optimal fluorescein pattern, but the BCVA was only 20/200. This functional result was considered insufficient considering the corneal condition

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and the retina status, together with the observation that the child had an abnormal head posture. The red reflex, assessed at slit lamp, suggested that residual pupillary membrane masked the visual axis. An ND:YAG laser pupillary membranotomy was performed to enlarge the pupil.

Considering the discomfort with the RGP lenses, a Hybrid CL SynergEyes A (SynergEyes, Carlsbad, CA, USA) 7.50/8.50/+10.25/14.5 was used to try to increase comfort and thus compliance to correction [Fig. 4]. The fitting comfort was excellent, no air bubble was present, and the clearance was optimal. BCVA was 20/100. The patient was prescribed full-time CL wear.

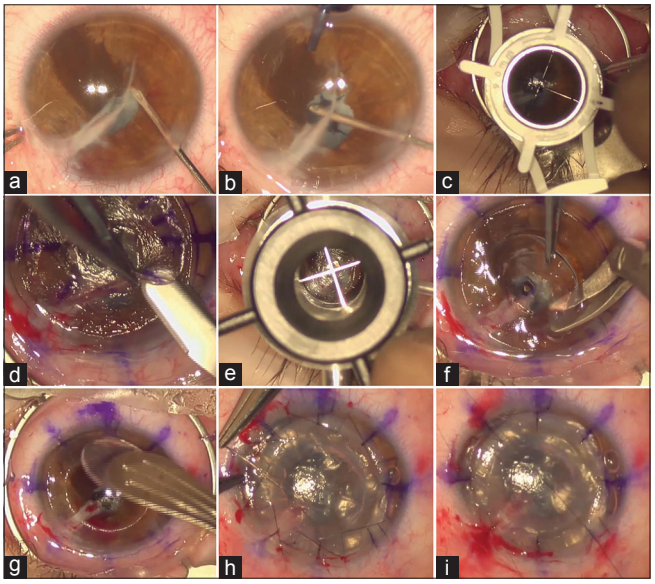

Figure 1: Surgical steps of membranectomy, pupilloplasty and mushroom keratoplasty. Anterior synechiotomy using a 27g sharp blade (a), membranotomy with a 25g vitrectome (b). Trephination was of 9.00 mm diameter and approximately 250 µm depth, centered in relation to the limbus (c). Manual superficial stromectomy (d) and 6.50 mm central full-thickness host trephination centered on the pupil (e), posterior button is removed with scissors (f). Placement of donor posterior lamella with 6.50 mm (e). Anterior 9.00 mm donor lamellar placed and sutured in place (f) and final appearance (g)

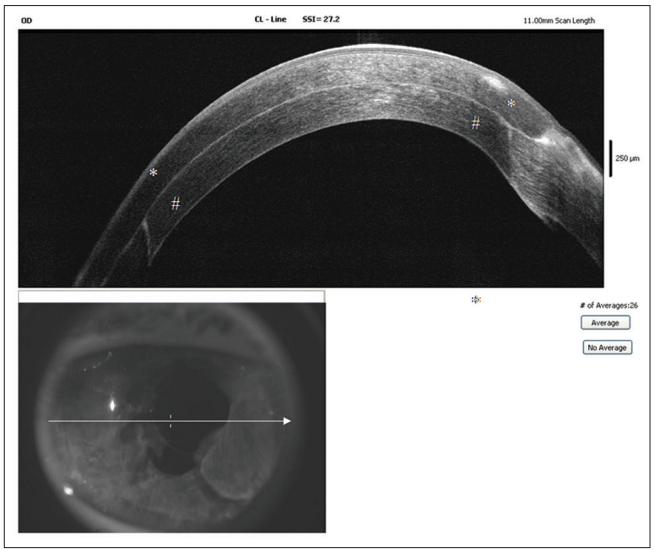

Figure 2: Spectral Domain OCT showing the structure of the mushroom shaped graft, the superior 9.00mm "hat" (*) and the inferior 6,50mm "stem" (#)

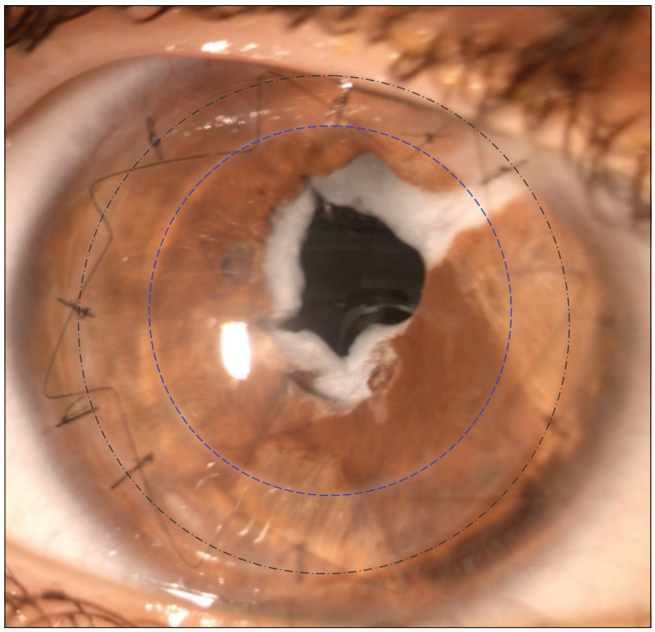

Figure 3: Slit lamp examination at one-month follow-up with the overlay of the margins of the 6.50 mm stem (blue dashes) and the 9,00 mm hat (black dashes)

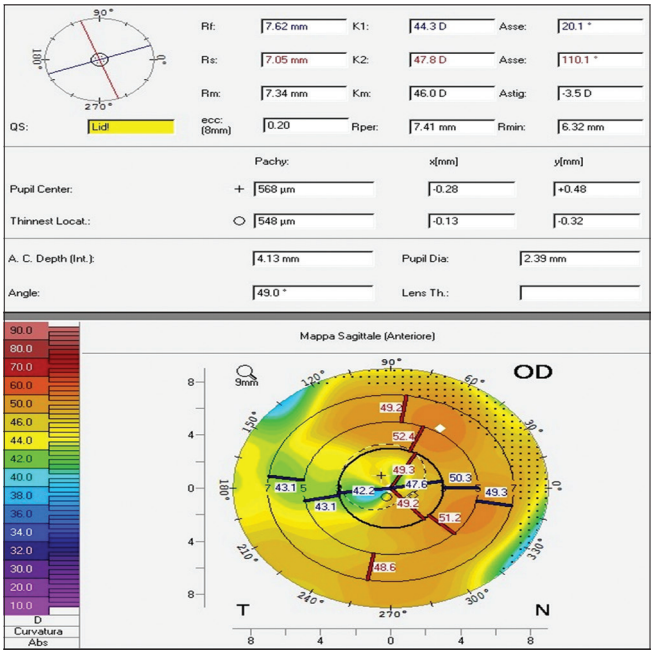

Figure 4: Corneal topography (Pentacam HR, Oculus Inc., Arlington, WA, USA) shows -3.50D slightly irregular astigmatism

At 5 of months follow-up, BCVA was 20/60 with CL correction; the exotropia became intermittent and disappeared with CL fitted. At the 18th month postoperatively, BCVA was 20/30 and the endothelial cell count was 1600 cells/mm^2.

Discussion

The first step was to perform the aforementioned surgical procedure to restore transparency and anatomy of the anterior segment, since the corneal scar and the pupillary membrane were on the visual axis. MR-PK was described to be an effective procedure in pediatric cases.[5] The rationale is to combine the refractive advantages of a wide superior hat (9.00 mm), together with the small diameter of the inferior stem (6.50 mm). This technique should minimize sutures' impact on the visual axis and reduce the number of endothelial cells transplanted, given the chance of transplant rejection.[5]

Aphakia was not corrected in the first surgery considering intraoperative risks and the impossibility of a precise IOL power calculation before keratoplasty. CLs have been successfully used to repair pediatric aphakia in multiple reports.[6]

RGP lens was attempted first, because of the presence of irregular astigmatism of −3.50 D,[7] with a better VA over spectacle correction. Studies indicate as high as a 36.8% dropout rate of RGP wear due to discomfort[8] despite the improvement in BCVA, as in this case.

Hybrid CL was a viable option because it combined the superior comfort over the RGP lens,[9] essential for good compliance, with the optic of RGP lens. The disadvantages of hybrid CL are the increased cost compared with GP and the more frequent replacement. There are some concerns about considering secondary IOL implant in the future: even if it was able to correct the spherical ametropia, the irregular astigmatism would probably still need a CL correction.

Conclusion

We report the complex and integrated management of a pediatric ocular trauma. Surgical (MR-PK) and nonsurgical treatments (ND:YAG laser and CLs) were combined to promote the best restoration of ocular structures. The final use of hybrid CL allowed obtaining good-quality vision and tolerance, reducing residual ametropia and avoiding the unpredictable refractive result and surgical risks linked to IOL implantation at this age.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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