Management of pseudophakic myopic anisometropic amblyopia with piggyback Visian® implantable collamer lens

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ABSTRACT.

Purpose: **To assess the outcomes of sulcus implantation of the Visian® implantable collamer lens (ICL) to correct pseudophakic myopic anisometropic amblyopia with myopic shift and/or primary refractive overcorrection.**

Methods: **Prospective case series enrolled 14 pseudophakic eyes of 14 patients, 5–9 years old, with history of cataract surgery and primary in the bag-intraocular lenses (IOL) implantation, followed by myopic shift and/or refractive overcorrection and anisometropic amblyopia of variable degrees. All cases had implantation of a piggyback ICL/toric ICL, to correct the myopia/myopic astigmatism. Preoperatively, we evaluated the uncorrected distance visual acuity (UCVA), corrected distance visual acuity (CDVA), manifest refraction spherical equivalent (MRSE), intraocular pressure (IOP) and endothelial cell density (ECD). We assessed the position and vaulting of the ICLs on slit lamp examination and confirmed by Scheimpflug tomography. Postoperative follow-up was at 1st week and 1, 3, 6, 9, 12, 18 and 24 months.**

Results: **Uncorrected distance visual acuity improved in all cases, and CDVA improved in 11 amblyopic eyes (2–4 lines). There was no evidence of interlenticular opacification (ILO) throughout the 2-year follow-up. Two cases were complicated with early postoperative acute elevation of IOP and were controlled with topical beta-blockers. Postoperative acute anterior uveitis occurred in six eyes and controlled by topical steroids. Implantable collamer lens (ICL) vault was measured using Pentacam, with mean value of 470 ± 238 μm.**

Conclusion: **Sulcus implantation of the secondary piggyback ICL to correct unilateral pseudophakic myopic refractive error in children was safe, efficient, predictable and well tolerated in management of anisometropic amblyopia in all eyes.**

Key words: anisometropic amblyopia – implantable collamer lens – piggyback

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Introduction

A postoperative myopic shift in refraction following cataract surgery is inevitable to occur in young children with growing eyes (Lee et al. 2005). Refractive surprises should be put into consideration on dealing with children with myopic errors, years after primary intraocular lenses (IOL) implantation. A-scan errors, wrong choice of IOL formula in patients with short axial length, simple human error and mislabelling of an implanted IOL may be the causes of refractive surprise (Holladay 1999). Eric & Earl 2002 studied the myopic shift after paediatric cataract surgery and monofocal IOL implantation. Mean myopic shift in children operated at age between 1 and 2 years was found to be −5.96 dioptres (D), compared to −3.66 D at 3–4 years, −3.40 D at 5–6 years and −2.30 D at 7–8 years.

Correction of refractive error with glasses or contact lenses, as well as simultaneous patching or atropinization of the non-amblyopic eye, is the traditional treatment of anisometropic amblyopia (Attebo et al. 1998; Paysse 2007). Non-surgical treatment modalities fail in 10–50% of the amblyopic children, who may achieve 20/40 or worse as a final visual acuity. Consequently, surgical treatment at an earlier age becomes the final resort in children with significant anisometropia (Al-Zuhaibi et al. 2009; Huang et al. 2009). Failure of traditional non-surgical options in high refractive errors may be attributed to limited field of view through glasses frames, beside the cushion- or barrel-like lens aberrations and distortions. Contact lenses may create problems for both children and their parents due to difficulty with insertion and removal, risk of infection, contact lens related allergy and intolerance (Pirouzian et al. 2009). Photorefractive keratectomy (PRK), laser *in situ* keratomileusis (LASIK), laser-assisted subepithelial keratectomy (LASEK) and phakic intraocular lenses (PIOL) implantation are the possible surgical treatment options for anisometropic amblyopic children. However, each of these refractive procedures has its own pros and cons (Daoud et al. 2009).

Beside common problems such as flap complications, myopic regression, diffuse lamellar keratitis, central toxic keratopathy (CTK) and stromal haze (Alio et al. 2011), all corneal excimer laser procedures carry the potential risk for ectasia, when performed at very young age, with final conclusion of corneal integrity and strength not yet established.

Implanting a second IOL in the sulcus offers a better and easier solution than explanting the adherent primary IOL from the capsular bag. Intraocular lenses (IOL) explantation, especially long duration following the primary surgery, can result in capsular rupture and zonular damage, with increased risk for complications, and may cause difficulties in implanting a new IOL. Cyclodialysis, vitreous loss, retinal tears, retinal detachment and cystoid macular oedema are not uncommon complications following the removal of a primary IOL after a long duration, with surrounding synechiae (Zohar et al. 2005). Besides, IOL power calculation for a piggyback lens is simpler and requires only the subjective refraction, with higher accuracy than in IOL exchange (Gayton et al. 1999).

Implantable collamer lens (ICL) implantation-related problems may include high vaulting secondary to underestimated sulcus-to-sulcus calculations that may need early replacements. Pupillary block and/or angle closure with elevated IOP may occur due to non-functioning peripheral iridectomies (PIs) with V4B model of Visian® ICL, or residual viscoelastic occluding KS-Aquaport with V4C ICL (STAAR Surgical Inc., Monrovia, CA, USA). Night glare/halos are not uncommon and result from the small optical zone relative to the patient's large mesopic pupil diameter (Chen et al. 2008).

Low incidence of interlenticular opacification (ILO) with Visian® ICL can be attributed to the unique material of the lens, hydroxy ethyl methacrylate (HEMA) plus collagen Collamer, which will remain peculiar and different from the material of any primary IOL (PMMA/Acrylic/Silicone) implanted. Besides, the large space between the 0.5-mm-thick ICL and the primary IOL helps to prevent secondary opacifications (Auguste et al. 2001).

Dynamic choice of overall diameter of ICL is based on accurate (W-W) measurements and AC depth. Proper sizing of the piggyback lens in children with growing eyes is essential to minimize problems associated with vaulting, IOP elevation and lens rotation. However, after the age of 2 years, changes in axial length, anterior chamber depth, keratometric readings and sulcus diameter are mild and slow (Gordon & Donzis 1985).

Patients and Methods

This prospective case series included 14 children with myopic shift and/or refractive overcorrection, following unilateral cataract surgery with monofocal IOL implantation and variable degrees of anisometropic amblyopia. Secondary piggyback ICL implantation procedure was performed at a specialized eye hospital, Magrabi Eye Hospital in Saudi Arabia, between December 2012 and November 2013. The mean age of the subjects was 6.21 ± 1.21 years. The study was approved by the ethical committee of Magrabi Eye Hospital. Comprehensive discussion with parents was undertaken before surgery, explaining for them details of the procedure and its benefit and complications and informed written consent, including the off-label use of posterior chamber phakic intraocular lens (PC pIOL), was obtained from all parents. The author performed all surgeries.

Exclusion criteria were children compliant to conventional amblyopia therapy, hyperopic refraction error, primary IOL position in the ciliary sulcus, endothelial cell count less than 2500 cell/mm^2, anterior chamber depth (ACD) below 3.00 mm, W-W less than 11.00 mm and children with secondary glaucoma or zonular instability.

Inclusion criteria were myopic anisometropic amblyopic children 5–9 years old who had mean myopic error of -5.23 ± 1.13, following unilateral cataract surgery of mean duration of 3.03 years, with unsuccessful conventional amblyopia therapy (using different combinations of spectacles, contact lenses and occlusion therapy). None of the patients was compliant with spectacle wear or contact lens, if applicable. All patients suffered amblyopia of different degrees with corrected distance visual acuity (CDVA) less than 20/30. The response to conventional treatment was considered refractory when patients did not show improvement in amblyopia after 2 months of 6 hr per day partial patch occlusion for moderate-to-severe amblyopia, and after 6 weeks of 4 hr per day patching in children with mild amblyopia.

All patients were evaluated for manifest refraction spherical equivalent (MRSE), CDVA, uncorrected distance visual acuity (UCVA), stereoacuity and endothelial cell density (ECD). Preoperative and postoperative visual acuity was measured using Snellen or Allen vision charts. Stereoacuity assessed using Frisby and Titmus stereotests. Endothelial cell counts were measured using specular microscopy (Konan Medical, Torrance, CA, USA). Preoperative Scheimpflug imaging was mandatory in all cases, to assess the position of the primary IOL, measure the ACD, central corneal thickness (CCT), anterior chamber angle and white-to-white measurement (W-W).

Additional baseline testing included axial length and keratometry values, using IOL Master (Version 3.00; Carl Zeiss, Meditec, Germany). Follow-up examinations were scheduled at 3 days, 1 week, 1, 3, 6, 9, 12, 18 and 24 months. Postoperative visits included ICL vault evaluation, clinically and using Scheimpflug-enhanced imaging in the 90-degree axis. All enrolled patients completed the 2 years follow-up.

An experienced optometrist was assigned for accurate and reproducible Pentacam scans of high-quality factor (QS > 95%) for the enrolled children, even if several imaging trials were made throughout separate visits for uncooperative children. Retinoscopy was used in all cases for objective preoperative refraction; subjective refraction was determined in cooperative patients.

We calculated the power of secondary piggyback ICL by entering patients' ACD, manifest refraction spherical equivalent (MRSE), back vertex distance and K readings on STAAR company online calculator and ordering system (OCOS). The OCOS system uses a modified vertex calculation formula.

The target postoperative refraction was emmetropia or a certain residual power for the purpose of isometropia with the other eye.

For the pIOL proper sizing, the system requires data entry by the user, for W-W measurement, ACD, CCT, beside the birth date, and any history of previous intervention such as primary IOL implantation. Overall diameter of ICL was selected between increments of 0.50 mm (12.1, 12.6, 13.1, and 13.7) according to (W-W) measurements. We aimed to achieve a relatively low vault between the ICL and anterior surface of primary IOL, with no risk of cataract development, to avoid the high-vault complications such as pupillary block glaucoma.

Preoperative instillation of atropine sulphate 1% eye ointment (Cipla, Mumbai, India) was performed in all operated eyes. All procedures were performed under general anaesthesia (GA). Due to the inherent difficulty of measuring IOP and W-W in infants and children, before draping of the operated eye, two crucial measurements were performed. The first procedure was measuring the preoperative intraocular pressure (IOP) using a handheld tonometer (Tono-pen® XL, Medtronic Solan, Jacksonville, FL, USA). The second measurement was a manual double-check of the Pentacam-measured W-W using a calliper (Castroviejo; Katalyst Surgical, Chesterfield, MO, USA) with 0.50-mm increments. Besides, the zero-degree and 180-degree horizontal corneal axis (for the three toric ICL cases) were marked while the cooperative child was sitting upright to avoid potential cyclotorsion on lying flat. Before opening into the anterior chamber, the desired axis in toric ICL cases was marked with a Mendez degree gauge (Katena Inc., Denville, NJ, USA). Implantable collamer lens (ICL) implantation was performed via the technique described below (Assetto et al. 1996). A 3.00-mm temporal tunnelled clear cornea incision was created, and the anterior chamber was filled with ophthalmic viscosurgical device (Microvisc 1%; Bohus BioTech AB, Strömstad, Sweden). Iris/cyclodialysis spatula was used to dissect any posterior synechiae, followed by pupil viscomydriasis; in which the OVD boluses were injected around the pupillary margin till mechanical dilatation of the pupil was achieved. The PC pIOL (Visian® ICL V4C/V4B; STAAR Surgical Inc.) was loaded into the cartridge and injected very slowly to allow controlled slow lens unfolding. An iris manipulator was used to tuck the footplate haptics of the lens within the posterior chamber, taking care not to enlarge any pre-existing capsular tears. The viscoelastic material was then removed using the Simcoe irrigation aspirating cannula. Peripheral iridectomy was performed in V4B cases, using an ocutome at a cutting rate of 10/min and vacuum of 150 mmHg. However, no peripheral iridectomy was needed in cases operated upon using V4C model, as KS-Aquaport ensures dynamic regular aqueous flow between posterior and anterior chambers. One case with extensive posterior synechiae was excluded from the study, due to failure to reconstruct a 360-degrees patent sulcus for piggybacking with the collamer lens.

Patients were treated with gatifloxacine 0.5% eye drops (Zymar®; Allergan, Inc., Fort Worth, TX, USA) four times daily, prednisolone acetate 1% (Pred Forte® Allergan, Inc. Irvine, CA, USA) four times daily and tropicamide 0.5% (Mydriacyl®, Alcon Laboratories, Inc., Fort Worth, TX, USA) once a day for 2 weeks. Pred Forte eye drops instillations were tapered over a period of three additional weeks. The importance and need of postoperative patching of the sound eye was explained to the parents. Patching the sound eye was recommended in mild amblyopia for 4 hr per day postoperatively for 3 weeks followed by 2 hr daily for another 3 weeks until the visual acuity improved and established near to the level of non-amblyopic eye. In moderate-to-severe amblyopia, patching was performed 6 hr daily for 4 weeks, followed by 4 hr daily for 2 weeks then 2 hr daily for another 2 weeks.

Statistical analysis

SPSS 15 software (SPSS Inc., Chicago, IL, USA) was used for data analysis. Data were presented as mean ± SD. Repeated measures were analysed using one-way analysis of variance (ANOVA). p value less than 0.05 was considered statistically significant.

Results

The study enrolled 14 pseudophakic eyes of 14 patients, of mean age at primary IOL implantation 3.17 ± 0.95 years, and mean age at piggyback lens implantation of 6.21 ± 1.21, with mean interval between the two surgeries of 3.05 years.

In cases of more than 2 D of astigmatism (three children), toric ICL implantation was decided, whilst in cases of less than 2 D of astigmatism (11 children), the spherical version was considered sufficient to resolve the refractive error.

Of the 14 cases with anisometropic myopic amblyopia, 11 children gained 2–4 lines of CDVA and three children showed no improvement of CDVA. Improvement in CDVA after 1 month was non-statistically significant ($p = 0.073$) and became statistically significant after 3 months ($p = 0.005$), and until 1 year postoperatively ($p = 0.001$), then stable afterwards, until the last follow-up 2 years postoperatively (Fig. 1).

Mean UCVA improved by 4.92 lines ±1.81, with baseline UCVA of 0.11 ± 0.07, and 12 months UCVA of 0.57 ± 0.13 that remained without change over the second year of follow-up (Fig. 2).

Mean preoperative (Piggyback) MRSE of −5.23 ± 1.13 decreased to mean postoperative MRSE of −0.30 ± 0.5 after 2 years, with a statistically significant difference ($p < 0.05$).

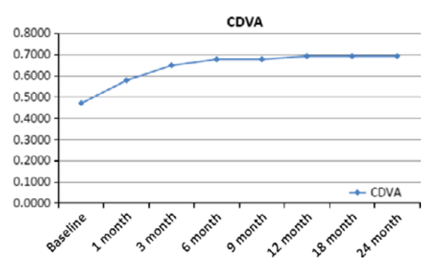

Fig. 1. Corrected distance visual acuity at baseline and at different time points postoperatively.

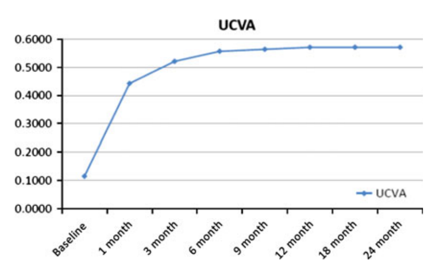

Fig. 2. Uncorrected visual acuity at baseline and at different time points postoperatively.

Throughout the follow-up visits, the ICL/toric ICL was well tolerated and remained stable in all operated eyes. Besides, the three toric lenses showed no rotation from the planned axis on slit lamp examination through a fully dilated pupil. Mean power of the implanted piggyback collamer lens was −5.607 ± 1.27, with mean 2 years postoperative ICL vault of 470 ± 238 μm, as measured by Scheimpflug tomography (Fig. 3), that was correlated with clinical grading of ICL vaulting (Fig. 4). A vault of (1×) is equivalent to the thickness of the central cornea (CCT) using the slit light beam. Preoperative W-W value of 11.5 mm was measured in five eyes, 11.7 mm in three eyes, 11.8 mm in four eyes and 11.9 mm in two eyes. We selected overall lens diameter of 12.1 mm in all cases, aiming at a shift towards a low ICL vault in pseudophakic children.

Improvement in stereoacuity (to smaller than 1200 second arc) was noted in 10 eyes (71.42%) of the 14 cases, as noted by Lang and Frisby stereotests.

Endothelial cell density following piggyback ICL implantation showed a statistically significant drop over the first 12 months postoperatively (p = 0.00). Baseline ECD of 2961.57 ± 139.03/mm^2 decreased to 2851.85 ± 131.28/mm^2 after 1 month, and 2721.71 ± 154.62/mm^2 after 1 year follow-up, followed by a near physiological, statistically non-significant drop in ECD ($p > 0.05$), over the second-year follow-up.

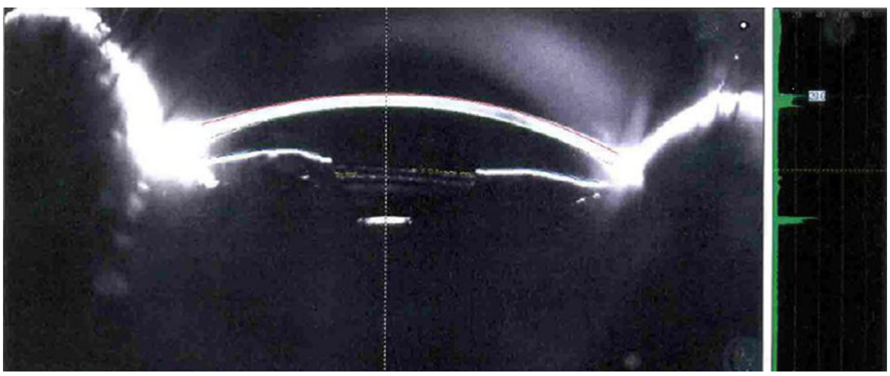

Fig. 3. Postoperative Scheimpflug image showing bipseudophakia; secondary implantable collamer lens in sulcus and primary intraocular lenses in the bag.

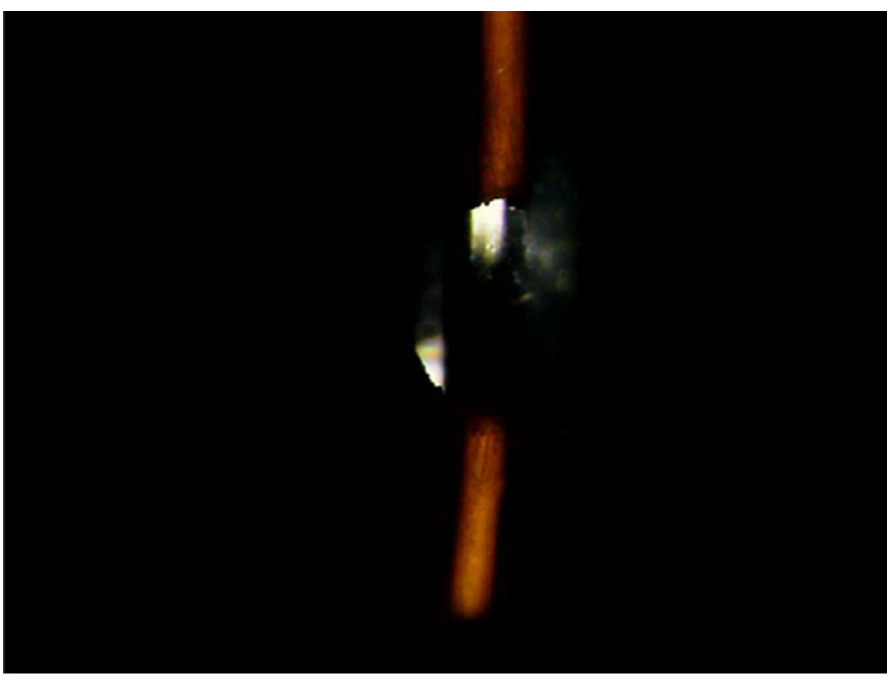

Fig. 4. Slit lamp clinical estimation of implantable collamer lens (ICL) vault. In this case, ICL vault = 3/4 central corneal thickness.

Two 6-year-old patients presented with increased postoperative day-1 IOP, corneal epithelial oedema and ciliary congestion. Elevated IOP could be measured by palpation method/digital tonometry. No signs of high ICL vault or pupillary block signs such as shallow anterior chamber and iris bombe could be detected. The high IOP might be explained by residual ophthalmic viscosurgical device (OVD) in anterior chamber and was controlled by timolol maleate 0.5% eye drops (Timoptol®; MSD, Kenilworth, NJ, USA) twice daily for 3 days.

Postoperative acute anterior uveitis was noted in six paediatric eyes, with anterior chamber flare and cells +4, conjunctival congestion, no hypopyon and iris pigment deposition over the ICL. We controlled the acute anterior uveitis episode by increasing the frequency of prednisolone acetate 1% to every 2 hr for 3 days, together with atropine sulphate eye ointment twice daily.

Discussion

Myopic shift is not an uncommon refractive issue following primary IOL implantation in children. According to David et al. (2002), children operated at age 2 or 3 years had a mean myopic shift of −4.60 D over a mean of 5.8 years postoperatively. Children operated at age 6 or 7 years had a mean myopic shift of −2.68 D over a mean of 5.3 years. Children operated at age 8 or 9 years had a mean myopic shift of −1.25 D over a mean of 6.8 years.

The principle of piggybacking is to use two or more IOLs in the posterior chamber of the same eye. Gayton and Sanders used secondary piggyback IOLs to correct postoperative refractive errors in 1999 (Gayton et al. 1999). The material of the secondary piggyback IOL was PMMA, silicone or acrylic (Masket 1998). However, the most popular IOL being used for piggybacking since 2007 was the Sulcoflex (Rayner Intraocular Lenses, Ltd., East Sussex, UK). It is a one-piece hydrophilic acrylic IOL with a 6.5-mm optic and 13.5-mm overall length. The optic has a round edge with a concave posterior surface and convex anterior surface. The haptics have 10° posterior angulation. The special design of the lens with convex anterior surface, concave posterior surface and 10° posteriorly angulated haptics ensure separation of the IOL from the iris anteriorly and the primary IOL posteriorly, resulting in significant reduction in the risks of ILO and iris chafing (Mohamad & Mohammed 2010).

Visian® ICL is the only PC pIOL that is currently approved by the United States Food and Drug Administration (FDA) for the treatment of moderate-to-severe myopia in adults (Fernandes et al. 2011). In our study, piggybacking using collamer lens is considered an off-label procedure, and an informed consent was signed by all parents preoperatively.

Kojima et al. (2010) investigated eight pseudophakic eyes of five adult patients who underwent piggyback insertion of a Toric ICL to correct residual refractive error. The results showed that pre- and 6-month postoperative logMAR UCVA were 0.759 ± 0.430 and 0.201 ± 0.458, respectively, with all eyes within ±0.50 D of intended spherical equivalent refraction and refractive astigmatism within ±0.50 D in five (62.5%) eyes and ±1.00 D in seven (87.5%) eyes. No eyes lost more than one line of CDVA and pupillary block occurred in one eye on postoperative day 1. They concluded that piggyback insertion of a Toric ICL appears to be effective and predictable in correcting refractive error in pseudophakic eyes.

In 2001, Auguste et al. described piggybacking using ICL for correction of pseudophakic ametropia in an 80-year-old pseudophakic female patient with myopic error of −6.00/−0.50 × 50 in one eye that required insertion of −8.00 D ICL (ICM125V3) in sulcus. Her UCVA improved from 20/400 to 20/25 with −0.50/−0.75 × 55 postoperative refraction, and anisometropia totally abolished (Auguste et al. 2001).

Hsuan et al. (2002) reported ICL implantation in six pseudophakic adult patients, with two YAG laser iridotomies performed 2 weeks before surgery. Preoperative pseudophakic anisometropia ranged from 2.00 to 7.9 D (mean 4.4 D). All patients showed diminution in anisometropia to asymptomatic levels, with mean reduction of 3.15 D. However, CDVA did not improve in any of the cases.

Previous studies by Kojima et al. (2010), Auguste et al. (2001) and Hsuan et al. (2002) enrolled only adult patients in piggybacking with collamer lens, with improved UCVA and decreased anisometropia, if any. However, no lines of CDVA did improve, owing to the age of recruited patients in the above-mentioned studies.

In 2002, Lesueur and Arne reported on the anatomical and functional outcomes of Visian® ICL implanted in 12 paediatric phakic anisometropic eyes, who were non-compliant to conventional treatment such as spectacles and contact lenses, with mean preoperative MRSE of −12.70 and CDVA ranges from CF to 20/63. Mean postoperative CDVA was 20/63, with six patients having improved quality of life and recovered binocular vision. Children in this study had a follow-up period of 20.5 months (Lesueur and Arne 2002). In our study, mean MRSE of −5.23 ± 1.13 before piggy back ICL implantation decreased to a mean postoperative MRSE of −0.30 ± 0.5 after 2 years, with a statistically significant difference ($p < 0.05$).

BenEzra et al. (2000) reported Visian® ICL implantation in three phakic eyes (aged 9–18) with myopic error range of −6 to −16 and anisometropic amblyopia. They did not find any statistically significant change in endothelial cell count. The study showed significant improvement in visual acuity and stereoacuity after 9 months of follow-up. In our study, mean preoperative decimal CDVA of 0.47 ± 0.12 improved to a mean postoperative CDVA of 0.69 ± 0.15 after 2 years postoperative. Besides, mean UCVA improved by 4.92 lines ± 1.81, with baseline UCVA of 0.11 ± 0.07 improved to 0.57 ± 0.13 after 1 year that remained without change over the second year of follow-up.

The children in this study were non-compliant with use of spectacles or contact lenses as well as occlusion therapy for treating anisometropic amblyopia. Improvement in CDVA in pseudophakic amblyopic eyes enrolled in our study may be attributed to the plasticity of visual cortex that could be changed if visual input balance between eyes was restored through the correction of refractive errors (Chan et al. 2016). Different refractive protocols can boost brain plasticity, even in adults, and may allow the reinstatement of visual functions in amblyopic patients (Baroncelli et al. 2011).

Mean ICL vaulting of 470 ± 238 as measured and confirmed by Scheimpflug tomography imaging explains the safety of piggybacking principle using ICL, without high-vault complications that may require secondary lens exchange or explantation.

Our results are promising compared to the Lesueur and Arne (2002) and BenEzra et al. (2000) studies, which enrolled collamer lens implantation in phakic anisometropic children. However, in our study, endothelial cell density before piggyback ICL implantation showed a statistically significant drop over the first 12 months postoperatively ($p = 0.00$), followed by a near physiological, statistically non-significant drop in ECD, over the second-year follow-up. Baseline ECD of 2961.57 ± 139.03/mm^2 decreased to 2851.85 ± 131.28/mm^2 after 1 month, and 2721.71 ± 154.62/mm^2 after 1 year follow-up. This drop following ICL implantation may be explained by considering piggybacking as the second intraocular procedure carried out in these pseudophakic eyes.

Intraocular pressure elevation in children following secondary IOL implantation might be explained by mechanical deformation of angle structures during surgery, inflammation and pigment dispersion. However, the amount of OVD remaining at the end of surgery is likely to influence the level of early postoperative IOP (Rupal et al. 2012). The early postoperative IOP elevation in our study was most likely attributed to Healon-block glaucoma owing to aqueous outflow obstruction by this high molecular weight OVD.

The technique of ICL implantation is the same like the on-label procedure of phakic posterior chamber IOL implantation. However, our study recommended the preparation of the patient pupil and sulcus for collamer lens insertion before the ICL loading steps, to confirm the existence of 360-degrees patent sulcus and exclude zonular dialysis or large posterior capsular tears. Besides, viscomydriasis following posterior synechiolysis was efficient enough to negate the need for iris hooks, or intracameral adrenaline injection with its potential systemic side-effects in children.

The relatively high incidence of postoperative anterior uveitis in our study (42.85%) may encourage further studies on safety and efficacy of routine periocular injection of steroids such as triamcinolone acetonide at the end of secondary IOL implantation in children.

In our study, no single case required collamer lens explantation, reposition, exchange or rotation. Being designed for sulcus implantation, with forward vaulting of optic and posteriorly angulated haptics resting on the sulcus, Visian® ICLs proved feasible for piggybacking. Collamer lens has advantages over other piggyback IOLs such as Sulcoflex, as the former have wider range of errors to correct (−1 to −18 D). Dynamic choice of overall diameter of ICL is being selected between increments of 0.50 mm (12.1, 12.6, 13.1, 13.7), according to W-W measurements and AC depth. Proper sizing of the piggyback lens minimizes problems associated with vaulting, IOP elevation and lens rotation. KS-Aquaport/central hole made piggybacking very practical and reasonable, obviating the need for peripheral iridectomy. Later during the long follow-up course, exchange of ICL with a different power collamer lens is possible, with non-comparable risk of complications to primary IOL explantation. Besides, ICL exchange at the age of refractive stability can be replaced by a corneal refractive procedure, such as LASIK or PRK.

To our knowledge, this is the first study to assess ICL as secondary piggyback IOL in anisometropic amblyopia management.

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