

Supplementary Intraocular Lenses



Michael Amon and Guenal Kahraman

Introduction

The “piggyback” technique, or polypseudophakia, refers to when in which at least two IOLs are implanted in the posterior chamber of the same eye. It was first described by Gayton and Sanders in 1993 for the treatment of high hyperopic errors, where the required lens power to achieve emmetropia was not available.

The aim was to achieve a total refractive power of 46 diopters, which at the time was not possible using a single intraocular lens. Both intraocular lenses were implanted into the capsular, but this implantation technique resulted in a relatively high rate of complications.

A common and significant complication associated with primary piggyback IOLs was interlenticular opacification (ILO), which usually occurred six months to two years post-implantation. This was a direct result of the interactions between both biconvex IOLs into the capsular bag.

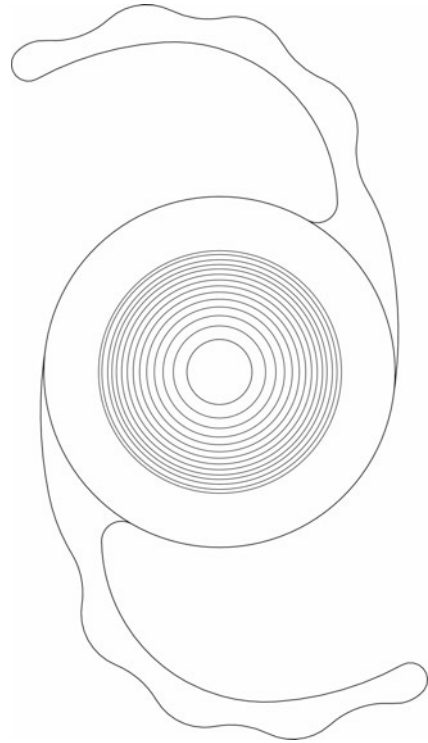
Residual lens epithelial cell growth typically led to membrane formation between the surfaces of piggyback acrylic IOLs, leading to decreased vision, secondary postoperative hyperopic shift, as well as opacification [9, 16]. As a result, this approach for the most part has been abandoned. The modern piggyback approach avoids most of these issues by implanting the first IOL into the capsular

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/978-3-031-05394-8_40. The videos can be accessed individually by clicking the DOI link in the accompanying figure caption or by scanning this link with the SN More Media App.

M. Amon (✉) · G. Kahraman
Krankenhaus der Barmherzigen Brüder Wien, Vienna, Austria
e-mail: michael.amon@bbwien.at; amon@augenchirurg.com

G. Kahraman
e-mail: guenal.kahraman@gmail.com

Fig. 1 Rayner Sulcoflex
Trifocal Model IOL703F



bag and the second IOL into the ciliary sulcus, because the lens epithelial cell migration is blocked by the anterior capsular adhesion [15].

There are currently three companies producing supplementary intraocular lenses: Rayner Sulcoflex, Cristalens Reverso and 1stQ Supplementary IOL (Figs. 1, 2 and 3).

Versions range from trifocal to monofocal aspheric to the more complex multifocal, toric, and multifocal toric. It is important to note that these supplementary lenses are especially designed for pseudophakic eyes, and should not be implanted into aphakic or phakic eyes.

Another advantage of this method is its predictability. Power calculation for the supplementary IOL only depends on the patient's current refraction but the exact calculation should be carried out according to the manufacturer's recommendation.

Implantation

A supplementary intraocular lens is usually implanted under topical anesthesia with a well dilated pupil. A clear corneal incision of appropriate size (1.9 to 2.7 mm) is made and ophthalmic viscoelastic device (OVD) is injected under the iris to create space in the ciliary sulcus. Finally, the supplementary intraocular lens is injected

Fig. 2 Christalens Reverso



Fig. 3 1stq Addon IOL



and positioned in the ciliary sulcus. An upside-down implantation has to be avoided and can result in an iris capture.

Any type of OVD can be used for sulcus preparation but implantation using an anterior chamber maintainer is also possible. After the implantation, the OVD

should be removed as much as possible, particularly from in the interlenticular space. In our experience, an iridectomy is not necessary.

At the end of the procedure we recommend an intracameral antibiotic to reduce the risk of endophthalmitis. Postoperative therapy consists of the application of topical NSAID eye drops for 2–4 weeks.

In principle, supplementary lenses can also be implanted during cataract surgery.

This can be done primarily after implantation of the first lens (Duet implantation, e.g., in the case of trifocal supplementary lenses) or as a secondary procedure in the case of existing pseudophakia.

Indications

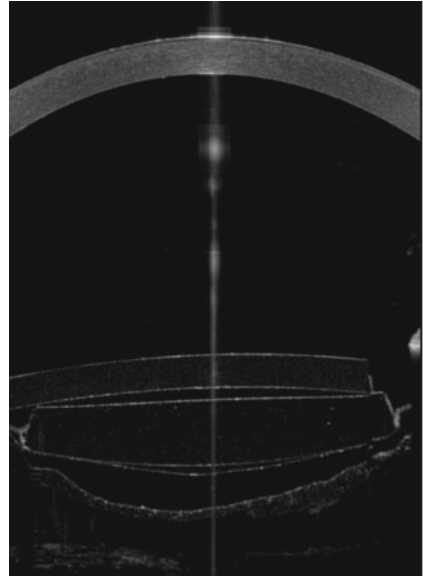
One very important indication for supplementary lenses is secondary implantation after a “refractive surprise”. In the field of refractive lens surgery, in particular, the postoperative expectations are extremely high and for an unhappy patient with a refractive surprise, a secondary lens can be an excellent option to solve the problem [11].

When encountering a refractive surprise, there are typically three options to consider, assuming that the patient does not wish to use spectacle or lens correction. The first option, refractive corneal surgery such as PRK or LASIK (laser enhancement) is predictable and has a high safety profile, though it is irreversible and correction is not immediately possible. Moreover, hyperopic outcomes are more difficult to correct with laser than myopic. The second option, IOL exchange can be considered but in cases where there are capsular defects (either due to capsular rupture or after Nd: YAG capsulotomy) this is more traumatic, and carries a higher risk of dehiscence of the zonular fibers, vitreous loss and subsequent retinal complications [3]. The third option, the implantation of a secondary IOL, is significantly less traumatic than a lens exchange and can avoid a refractive corneal intervention.

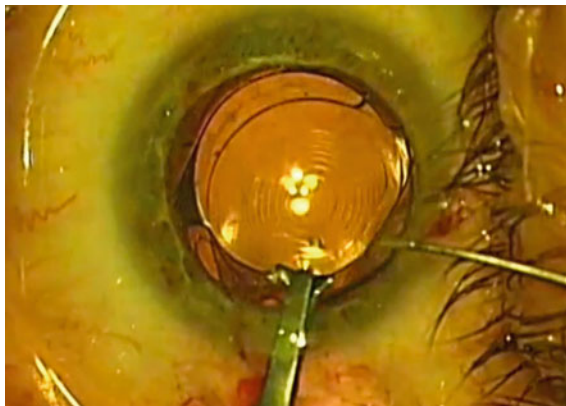
In addition to correcting postoperative ametropia, the introduction of toric and multifocal optics in recent years have widened the spectrum of indications for pseudophakic supplementary IOLs. Nowadays, toric supplementary lenses enable the correction of postoperative astigmatism, especially in pseudophakic patients after penetrating keratoplasty. One major advantage of this approach, compared to refractive laser surgery, is the reversibility and the much higher range of corrections available. IOL rotation, however, may occur more frequently than in toric capsular bag IOLs [12, 13] (Fig. 4).

Multifocal intraocular lenses offer an alternative to monofocal IOLs for patients who wish to be spectacle independent. However, this must always be weighed against the known disadvantages of multifocal IOLs, such as reduced contrast sensitivity and potential dysphotopsias (halos, glare, starburst). Despite careful consideration and patient selection, subjective complaints and multifocal intolerances can occur, which can make explantation of the capsular bag IOL necessary.

Fig. 4 Anterior OCT imaging shows nice distance between both IOLs



The implantation of a supplementary IOL with multifocal optics as part of cataract surgery (Duet implantation) provides a reversible option for presbyopia correction (Video 1). In the event of intolerance, supplementary IOL can easily be removed without disrupting the capsular bag [14] (Video 1).



Video 1 Supplementary IOL explantation (► <https://doi.org/10.1007/000-8d6>)

It is also known that multifocal lenses are not advised in the presence of pathological retinal findings. Even in healthy eyes, later pathological changes (e.g., AMD, diabetic macular edema, etc.) can occur, therefore, the implantation of an additional “reversible” multifocal lens in the context of cataract surgery is a

interesting alternative. If an eye disease occurs later in life, the sulcus-supported, multifocal, IOL can be removed with very little surgical trauma [6].

Another potential indication for a supplementary intraocular lens is in dynamic refraction cases, such as pediatric cataracts or after silicone oil filling [1]. One of the challenges of pediatric cataract surgery is predicting the postoperative refraction, which changes due to the further growth of the eye, which can cause significant myopic shift. The supplementary IOL can then be exchanged for the necessary refraction.

Note: The reversibility of the procedure, and the different optical options expand the range of indications for refractive cataract surgery.

Conclusion

The implantation of an add-on IOL is a simple and reversible procedure to optimize the refractive result in pseudophakic cases. Refractive results are predictable and based on preoperative refraction rather than lens calculation formulae.

References

1. Amon M, Kahraman G, Schrittwieser H. Supplementary intraocular lenses for pediatric cataract: Primary (Duett Implantation) or secondary implantation. *Spektrum der Augenheilkunde*. 2012.
2. Chang, Wellington H. et al. Pigmentary dispersion syndrome with a secondary piggyback 3-piece hydrophobic acrylic lens. Case report with clinicopathological correlation. *J Cataract Refract Surg*. 2007.
3. Dages, Evgenios, Mushtaq A. Khan, Graham M. Kyle, David Clark. Perioperative complications of intraocular lens exchange in patients with opacified aqua-sense lenses. *J Cataract Refract Surg*. 2004.
4. Findl, Oliver et al. Morphological appearance and size of contact zones of piggyback intraocular lenses. *J Cataract Refract Surg*. 2001.
5. Gayton, Johnny L., Valerie N. Sanders. Implanting two posterior chamber intraocular lenses in a case of microphthalmos. *J Cataract Refract Surg*. 1993.
6. Gerten, Georg et al. Dual intraocular lens implantation: Monofocal lens in the bag and additional diffractive multifocal lens in the sulcus. *J Cataract Refract Surg*. 2009.
7. Hesse, Richard J. Refractive changes produced by capsule contraction after piggyback acrylic intraocular lens implantation. *J Cataract Refract Surg*. 2002.
8. Iwase, Takeshi, Nobushige Tanaka. Elevated intraocular pressure in secondary piggyback intraocular lens implantation. *J Cataract Refract Surg*. 2005.
9. Gayton JL et al. Interlenticular opacification: clinicopathological correlation of a complication of posterior chamber piggyback intraocular lenses. *J Cataract Refract Surg*. 2000.
10. Kahraman G, Dragostinoff N, Brezna W, Bernhart C, Amon M. Visual outcomes and patient satisfaction after bilateral sequential implantation of a capsular bag IOL and a supplementary sulcus-fixated trifocal IOL. *J Refract Surg*. 2021;37(2):105–11.
<https://doi.org/10.3928/1081597X-20201215-01>.

11. Kahraman G, Amon M. New supplementary intraocular lens for refractive enhancement in pseudophakic patients. *J Cataract Refract Surg.* 2010; 36(7).
12. Linz K, Auffarth GU, Kretz FTA. Implantation of a sulcus-fixated toric supplementary intraocular lens in a case of high astigmatism after a triple procedure. *Klinische Monatsblätter für Augenheilkunde.* 2014.
13. Meyer, Jay J, Bia Z Kim, Mohammed Ziaei, Charles NJ McGhee. Postoperative rotation of supplementary sulcus-supported toric intraocular lenses. *J Cataract Refract Surg.* 2017.
14. Munõz, Gonzalo, Ceşar Albarrán-Diego, Lurdes Belda, Stephanie Rohrweck. Add-on sulcus-based versus primary in-the-bag multifocal intraocular lens: intraindividual study. *J Refract Surg.* 2014.
15. Shugar, Joel K, Scott Keeler. Interpseudophakos intraocular lens surface opacification as a late complication of piggyback acrylic posterior chamber lens implantation. *J Cataract Refract Surg.* 2000.
16. Werner, Liliana et al. Analysis of elements of interlenticular opacification. *Am J Ophthalmol.* 2002.