Secondary piggyback with PMMA IOL for the correction of refractive surprise after phacoemulsification. Long-term results of 20 cases

Piggyback secundário com LIO de PMMA para correção de surpresa refracional pós-facoemulsificação. Resultados a longo prazo de 20 casos

Fernando Cançado Trindade[1]

ABSTRACT

Purpose: *To evaluate long-term results of the secondary piggyback technique used for the correction of undesired ametropia after phacoemulsification.* ***Methods:*** *Retrospective study comprising of 20 eyes (19 patients). The IOL used was a single-piece PMMA with an overall length of 12.5mm, a 5x6mm oval thin-edged optic with a 10-degree haptic angulation. The same technique was used in all cases, consisting of a scleral-corneal tunnel with a 5mm opening, through which the secondary intraocular lens was implanted into the ciliary sulcus.* ***Results:*** *The undesired ametropia was corrected in all cases. No complications were observed during or after the secondary piggyback procedure.* ***Conclusion:*** *The use of a single-piece PMMA IOL proved to be safe and effective in secondary piggyback for the correction of refractive surprises after phacoemulsification.*

Keywords: *Refractive errors; Phacoemulsification/adverse effects; Intraocular lenses; Ophthalmologic surgical procedures/methods*

RESUMO

Objetivo: Avaliar os resultados a longo prazo da técnica do *piggyback* secundário utilizada para a correção de ametropia indesejável pós-facoemulsificação. **Métodos:** Estudo retrospectivo que compreendeu 20 olhos (19 pacientes). A LIO utilizada foi de peça única de PMMA de 12,5 mm de comprimento total, com óptica oval de 5x6mm, com borda fina e arredondada e angulação de 10 graus com as hápticas. A mesma técnica cirúrgica foi utilizada em todos os casos, consistindo na confecção de túnel esclero-corneano com 5mm de largura, através do qual foi implantada a lente secundária no sulco ciliar. **Resultados:** A ametropia indesejável foi corrigida em todos os casos. Não foi observado qualquer tipo de complicação durante ou após a cirurgia do *piggyback* secundário. **Conclusão:** A utilização de LIO de peça única de PMMA foi segura e eficaz no *piggyback* secundário para a correção das surpresas refracionais pós-facoemulsificação.

Descritores: Erros de refração; Facoemulsificação/efeitos adversos; Lentes intraoculares; Procedimentos cirúrgicos oftalmológicos/métodos

[1]Clínica de Oftalmologia – Belo Horizonte (MG), Brasil.
Study conducted at the author's own clinic — Belo Horizonte (MG), Brazil.

The authors declare no conflicts of interest

Received for publication: 14/11/2011 - Accepted for publication: 26/06/2012

Introduction

Despite the scientific and technological advances that enable us to perform biometry and keratometry with increasing precision, employ more accurate formulas to calculate IOLs, and manufacture IOLs in a more controlled manner, refractive surprises after phacoemulsification occasionally occur. Such undesirable postoperative refractive errors cause considerable frustration and should be corrected as soon as possible. Surgical correction can be performed on the cornea or in the intraocular environment.

The original IOL can be removed and exchanged for another lens with the right dioptric value to correct the refractive surprise. However, a more conservative intraocular approach can also be used, namely the implantation of a second IOL into the ciliary sulcus, while the first IOL is implanted within the capsular bag. This procedure, called secondary piggyback, is the object of this retrospective study.

Methods

A total of 20 eyes (10 REs and 10 LEs) in 19 patients (15 women and 4 men) underwent secondary piggyback to correct refractive surprises. The age of patients ranged from 41 to 78 years, with a mean of 64.3 years.

In all cases, the lens used for secondary piggyback in the ciliary sulcus was the single-piece PMMA-Slim™ manufactured by Mediphacos, with the following specifications:

- Total length of 12.5 mm;
- 5x6 mm oval optic with a thin rounded edge;
- Optic-haptic angulation: 10 degrees.

To calculate the dioptric power of the IOL needed to achieve emmetropia, the following formula was used:

Residual spherical equivalent x 1.0 in cases of myopic surprise and x 1.5 in cases of hyperopic surprise.

The same surgical technique was used in all cases by the same surgeon, consisting of a curved scleral incision approximately 2 mm from the limbus at the central portion, construction of a 5-mm wide sclero-corneal tunnel, and entry into the anterior chamber with production of a corneal valve. This type of incision, called a "frown incision," aims to reduce incision-induced astigmatism[1].

Secondary lens implantation was then performed in the ciliary sulcus at the meridian providing better IOL stability and centralisation (Figure 1).

Peribulbar anaesthetic block with 2% lidocaine was used in all cases.

Results

For each case, the following data were collected (Table 1).

Of the 20 cases of secondary piggyback included in the study, 10 were performed to correct myopic surprises (cases 1, 2, 5, 6, 7, 8, 13, 16, 17, 20), 8 were performed to correct hyperopic surprises (cases 4, 9, 10, 11, 12, 14, 15, 19) and 2 were performed to improve near vision (cases 3, 18) (Table 1).

Table 1 shows that the difference between desired and achieved refraction (equivalent spherical diopter) after secondary piggyback was minimal.

The longest follow-up period after secondary piggyback was 6 years and 11 months (case 2) and the shortest was 3 months (case 19). The mean follow-up period was 31.6 months (Table 1).

Discussion

Undesirable refractive errors post-cataract surgery can be treated surgically in various ways.

Explantation of the original IOL followed by insertion of a new IOL with the correct dioptric power is a difficult procedure that entails a higher risk than other alternatives. This procedure should be used only in the extremely rare cases of very large refractive errors, and surgical correction should be done as soon as possible, before the formation of capsular adhesions with the IOL.

Implantation of a second IOL in the ciliary sulcus in front of the original IOL, which must be fully implanted within the capsular bag, is a simpler, faster, more accurate and much safer procedure than the IOL exchange. Another important advantage of secondary piggyback versus IOL exchange is that it is not necessary to know the cause of the postoperative refractive surprise, i.e., whether the error occurred during keratometry or biometry, in manufacturing the IOL, in using an inadequate formula for calculating the IOL, etc. All these issues become irrelevant to solving the problem, as the solution does not depend on knowing its cause.

Several types of IOL can be used in secondary piggyback: Foldable lenses of various materials and designs as well as traditional hard polymethylmethacrylate (PMMA) lenses. The latter require a larger incision for implantation.

Importantly, an angulation should exist between the optic and haptic parts of the IOL. The edges of the optic part should preferably be rounded. All these recommendations aim to prevent complications that can occur after secondary piggyback in the ciliary sulcus, such as pupillary capture, pigment dispersion due to friction of the second lens with the posterior surface of the iris, pigmentary glaucoma, areas of transillumination of the iris, hyphema, and vitreous haemorrhage[2-7].

Currently, hydrophobic acrylic lenses are the most commonly used single-piece lenses, without angulation between the optic and haptic parts, which makes them inappropriate for secondary piggyback in the ciliary sulcus. This type of lens requires implantation exclusively within the capsular bag. The haptics of these lenses are relatively thick and have a straight edge. If, for

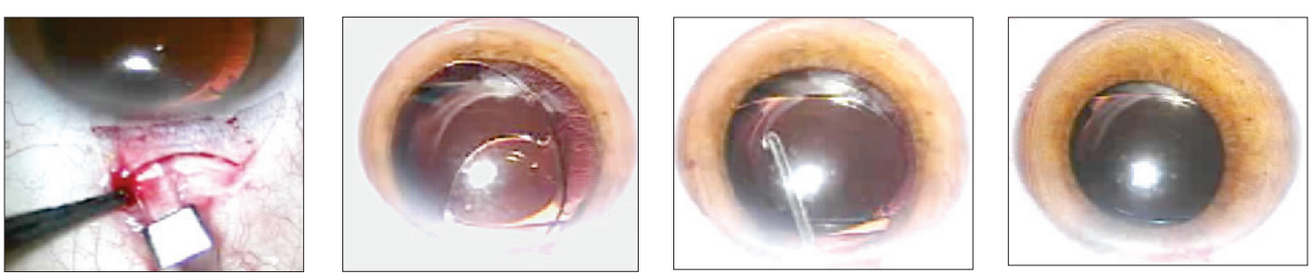

Figure 1: Scleral "frown incision" with sclero-corneal tunnel and secondary piggyback with an oval PMMA IOL in the ciliary sulcus

Table 1

Secondary piggyback with PMMA IOL to correct refractive surprises after phacoemulsification

Caso	Idade (anos)	Sexo	Olho operado	Refração pós-Faco + LIO	Acuidade Visual corrigida	Intervalo Faco+LIO Piggyback secundario	Poder Dióptrico LIO Piggyback secundário	Refração desejada pós-Piggyback secundário	Refração pós-Piggyback secundário	Refração desejada - Refração alcançada pós-Piggyback secundário (equivalente esférico dioptrias)	Acuidade visual corrigida pós-Piggyback secundário	Seguimento pós-Piggyback secundário
1	50	Feminino	OE	-5.00 -0.50 x 180	20/25	30 dias	-5.0	0.00	-0.25 -0.50 x 160	-0.50	20/20	6 anos 3 meses
2	74	Feminino	OD	-7.00 -1.00 X 180	20/30	30 dias	-7.5	0.00	-0.25 -0.75 x 155	-0.63	20/20	6 anos 11 meses
3	65	Masculino	OD	-0,25 esf	20/20	120 dias	+2.0	-1.50	-2.00 esf	-0.50	20/20	1 ano 9 meses
4	56	Feminino	OE	+4.50 -1.50 x 105	20/50	60 dias	+7.0	-1.75	-0.50 -2.00 x 105	+0.25	20/30	4 meses
5	68	Feminino	OD	-7.00 -1.50 x 15	20/30	5 anos 8 meses	-7.0	-1.75	-0.75 -2.00 x 10	0.00	20/30	4 anos 7 meses
6	41	Feminino	OD	-2.50 -1.50 x 180	20/20	7 dias	-3.0	0.00	plano	0.00	20/20	5 anos 9 meses
7	63	Feminino	OE	-1.75 -0.50 x 180	20/20	60 dias	+4.5	-2.00	-2.00 esf	0.00	20/20	1 ano 5 meses
8	69	Feminino	OE	-2.25 esf	20/20	120 dias	-2.0	0.00	-0.50 -0.50 x 90	-0.75	20/20	2 anos
9	65	Feminino	OE	+4.00 -0.50 x 165	20/40	90 dias	+6.0	0.00	+1.00 -1.00 x 145	+0.50	20/40	3 anos 7 meses
10	78	Feminino	OD	+1.00 esf	20/20	3 anos	+4.0	-1.00	-1.00 -1.00 x 110	-0.50	20/20	1 ano 7 meses
11	78	Feminino	OE	+2.00 esf	20/20	3 anos	+5.0	-2.00	-1.50 esf	+0.50	20/20	1 ano 6 meses
12	53	Masculino	OE	+3.25 -1.25 x 85	20/25	5 meses	+4.0	0.00	+0.75 -1.50 x 95	0.00	20/20	2 anos 8 meses
13	66	Masculino	OD	-6.00 -0.50 x 45	20/20	6 anos 6 meses	-5.0	-1.25	-1.50 -1.00 x 30	-0.75	20/20	3 anos 11 meses
14	68	Masculino	OD	+1.50 esf	20/25	1 mes	+3.0	-0.50	-0.75 x 100	+0.13	20/25	1 ano 7 meses
15	63	Feminino	OE	+1.75 -0.50 x 180	20/20	2 meses	+4.5	-2.00	-2.00 esf	0.00	20/20	1 ano 9 meses
16	68	Feminino	OD	-1.50 -0.75 x 10	20/20	2 meses	-2.0	0.00	+1.00 -1.00 x 10	+0.50	20/20	1 ano 2 meses
17	47	Feminino	OE	-4.50 -1.00 x 165	20/20	30 dias	-5.0	0.00	+0.50 -0.50 x 10	+0.25	20/20	1 ano 2 meses
18	76	Feminino	OD	+0.25 -0.50 x 110	20/20	1 mes	+3.5	-2.25	-2.00 -1.00 x 115	-0.25	20/20	1 ano 9 meses
19	64	Feminino	OD	+1.50 esf	20/20	1 ano	+5.0	-2.00	-1.50 -1.00 x 115	0.00	20/20	3 meses
20	74	Feminino	OE	-6.50 -1.00 x 165	20/20	2 meses	-7.5	0.00	-0.25 -0.50 x 155	-0.50	20/20	2 anos 8 meses
MÉDIA	64.3				0.88 (em decimal)	396 dias	+0.2	-0.90		-0.11	0.93 (em decimal)	31.6 meses
DESVIO PADRÃO	10.3				0.19 (em decimal)	702 dias	+5.1	+0.92		+0.41	0.15 (em decimal)	23.1 meses
MIN	41				0.40 (em decimal)	7 dias	-7.5	-2.25		-0.75	0.50 (em decimal)	3 meses
MAX	78				1.00 (em decimal)	2370 dias	+7.0	0.00		+0.50	1.00 (em decimal)	83 meses

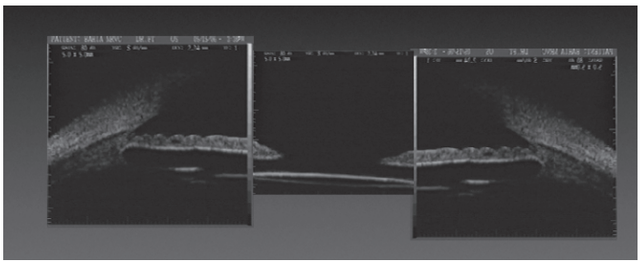

Figure 2. Ultrasound biomicroscopy showing the intraocular lens in the capsular bag and a large posterior chamber

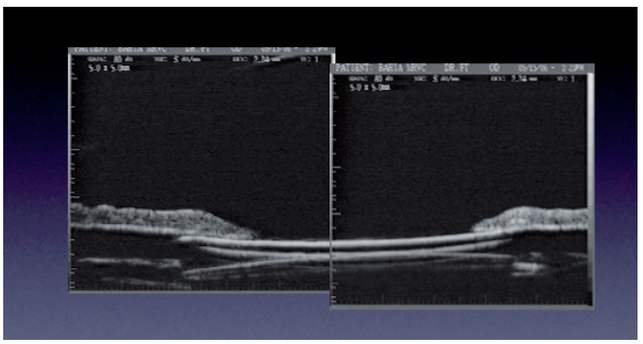

Figure 3. Ultrasound biomicroscopy showing the original lens in the capsular bag and the single-piece PMMA IOL, used for secondary piggyback, in the posterior chamber, with support in the ciliary sulcus

some reason, the haptic is outside the capsular bag, friction with the posterior surface of the iris or even with the ciliary body can cause complications such as uveitis, glaucoma and haemorrhage[5].

Therefore, their use is absolutely contraindicated for secondary piggyback in the ciliary sulcus. Three-piece hydrophobic acrylic or silicone lenses with optic/haptic angulation are suitable for this purpose. More recently, foldable lenses have been developed specifically for secondary piggyback in the ciliary sulcus: The single-piece hydrophilic acrylic IOL called Sulcoflex™, manufactured by Rayner, and the three-piece lens with a silicone optic and PMMA haptics called Add-On™, manufactured by HumanOptics, with monofocal, both with toric and bifocal versions. However, the purpose of this retrospective study was to show that old single-piece PMMA lenses with an oval optic were useful in secondary piggyback for correcting refractive surprises after phacoemulsification.

Calculating the dioptric power of the second IOL is extremely simple (dioptric power of the IOL = spherical equivalent of myopic surprise x 1, or dioptic power = spherical equivalent of hyperopic surprise x 1.5). This formula proved to be very accurate, as shown in Table 1.

Excimer laser (PRK or LASIK) can also be used to correct refractive surprises. A disadvantage of LASIK in relation to secondary piggyback is the need to wait at least three months to perform the LASIK procedure. This time interval is necessary for consolidation of the surgical wound, since the vacuum needed for the corneal flap can open the original incision, causing a sudden collapse of the anterior chamber with serious consequences. However, secondary piggyback can be done at any time postop-

eratively, as it does not require the surgical wound to heal. Also, the original incision can be used for implantation of the second IOL in the ciliary sulcus.

It is worth noting that secondary piggyback in the ciliary sulcus is indicated only when the first IOL is implanted entirely within the capsular bag. In this situation, the posterior chamber is large, especially in high myopic eyes. This space between the anterior capsule and the posterior surface of the iris is well suited for implantation of the second IOL.

Ultrasound biomicroscopy is very useful in assessing the posterior chamber before (Figure 2) and after (Figure 3) secondary piggyback in the ciliary sulcus.

Implantation of the second IOL within the capsular bag should be avoided. This technique is much more difficult and unpredictable than the secondary implantation in the ciliary sulcus. Moreover, interlenticular opacification could occur, especially when both IOLs are made of hydrophobic acrylic[6].

In secondary piggyback in the ciliary sulcus, an angulation should exist between the optic and haptic parts of the second IOL to avoid undesirable contact with the posterior surface of the iris and reduce the possibility of pupillary capture. Such contact causes pigment dispersion which can progress to secondary glaucoma[7]. Iritis and cystoid macular oedema are other possible complications. Pupillary deviation can also occur when the haptics of the IOL are supported on the base of the iris and not in the ciliary sulcus. None of these complications were observed in this study.

It is also important to ensure that the piggyback IOL does not have an exaggerated size or angulation, as such a lens would cause posterior axial displacement of the primary IOL, thus causing hyperopia as the final refractive outcome.

The PMMA IOLs used in all 20 cases of this study are much more easily available and less costly than foldable IOLs, especially when an unusual dioptric power is needed for the piggyback, such as -7.50 D (case 20).

Due to the characteristics of the PMMA IOLs used in this study, they should be implanted only within the capsular bag, otherwise there is a high probability of postoperative decentralisation. However, such IOLs provide stable fixation and excellent centralisation when implanted in the ciliary sulcus, as observed in all 20 cases of this study, even after several years of follow-up in some cases. Because these are hard IOLs, it advisable to implant them using a scleral incision with a sclero-corneal tunnel in order to minimise the induction of astigmatism. In fact, this type of incision does not require suture as it does not induce clinically-significant astigmatism, as observed in this study. However, for safety reasons, in some cases two isolated mononylon 10-0 stitches were used on each side of the scleral incision. The astigmatism induced by these sutures was minimal and regressed over time.

Foldable lenses are obviously considered more appropriate for secondary piggyback in the ciliary sulcus, as they can be implanted through the same incision of the original phacoemulsification. However, such lenses are not always easily available, especially when a dioptric power higher than -5.00 diopters is needed (cases 2, 5 and 20).

The implantation of phakic posterior chamber lenses such as ICL™ is another alternative to secondary piggyback to correct refractive surprises. However, such lenses are not yet manufactured in low diopter and have a much higher cost.

In this study no complications were observed during the secondary piggyback procedure or in the immediate or late postoperative period. All patients were fully satisfied with the final visual outcome.

Conclusion

The use of single-piece oval PMMA IOLs for secondary piggyback in the ciliary sulcus is a safe and effective procedure for correcting refractive surprises after phacoemulsification.

References

1. Singer JA. Frown incision for minimizing induced astigmatism after small incision cataract surgery with rigid optic intraocular lens implantation. J Cataract Refract Surg. 1991;17 Suppl:677-88.
2. Micheli T, Cheung LM, Sarma S, Assaad NN, Guzowski M, Francis IC, et al. Acute haptic-induced pigmentary glaucoma with an AcrySof intraocular lens. J Cataract Refract Surg. 2002;28(10):1869-72.
3 LeBoyer RM, Werner L, Snyder ME, Mamalis N, Riemann CD, Augsberger JJ. Acute haptic-induced ciliary sulcus irritation associated with single-piece AcrySof intraocular lenses. J Cataract Refract Surg. 2005;31(7):1421-7.
4 Rajak SN, Bahra A, Aburn NS, Warden NJ, Mossman SS. Recurrent anterior chamber hemorrhage from an intraocular lens simulating amaurosis fugax. J Cataract Refract Surg. 2007;33(8):1492-3.
5. Trindade FC. Haptic-induced recurrent vitreous hemorrhage and increased intraocular pressure with a hydrophobic acrylic intraocular lens. J Cataract Refract Surg. 2009;35(2):399-402.
6. Gayton JL, Apple DJ, Peng Q, Visessook N, Sanders V, Werner L, et al. Interlenticular opacification: clinicopathological correlation of a complication of posterior chamber piggyback intraocular lenses. J Cataract Refract Surg. 2000;26(3):330-6.
7. Chang WH, Werner L, Fry LL, Johnson JT, Kamae K, Mamalis N. Pigmentary dispersion syndrome with a secondary piggyback 3-piece hydrophobic acrylic lens. Case report with clinicopathological correlation. J Cataract Refract Surg. 2007;33(6):1106-9.

Autor correspondente:
Fernando Cançado Trindade
Rua Manaus, nº 595
CEP 30150350 - Belo Horizonte (MG), Brasil
fernandotrindade@mac.com