INTRODUCTION

Several reports have shown that penetrating keratoplasty (PKP) is a safe and effective technique for corneal transplant and provides good visual outcomes. However, such as Rathi et al. reported in a retrospective study, the incidence for cataract formation is high. In this study, 24.45% of patients developed cataract within the first years of surgery, being the excessive use of steroids the major risk factor for cataract formation after PKP. When post-PKP eyes develop cataracts, surgeons used to remove the cataract and to implant a monofocal intraocular lens (IOL). Nagra et al. and Hsiao et al. in retrospective studies showed that cataract extraction with monofocal IOL implantation after PKP is a safe and efficient procedure. However, these patients should wear spectacles or contact lenses for distance and/or near vision. Then, multifocal IOL implantation may be a better approach than a monofocal IOL implantation to provide pseudoaccommodation in post-PKP eyes.

To knowledge of the authors, there are not previous case reports of multifocal IOL implantation in eyes submitted to PKP. In this report, we described 3 PKP cases which have been submitted to cataract surgery with multifocal IOL implantation.

CASE REPORT 1

A 54 year-old woman who had undergone PKP in 1997 of her left eye and in 2001 of the right eye due to keratoconus. She returned to our clinic for a vision examination because of progressively blurred vision in both eyes. The manifest refraction in OD was -0.50 –1.75 x 10º, with an uncorrected visual acuity (UCVA) of 0.5 (Snellen decimal visual acuity) and a best corrected visual acuity (BCVA) of 0.7. In her OS the manifest refraction was 0 -4.50 x75º, with an UCVA of 0.2 and a BCVA of 0.8. At near vision, with +3.00D of addition, the best distance corrected near visual acuity (BCNVA) was 0.9 in both eyes. The keratometry reading was 44/46.25 x10º for OD and 48.25/43.5 x 85º for OS. The intraocular pressure was 13 mmHg in both eyes. A slit lamp examination revealed nuclear sclerosis of 2+ and 3+, for OD and OS, respectively. The axial lengths, obtained with IOL Master (Carl Zeiss, Germany), were 23.79 mm and 23.36 mm, in OD and OS, respectively. Other ophthalmic examination findings were unremarkable.

After informed consent was obtained, cataract removal with multifocal IOL implantation was planned for both eyes, with a time between the 2 surgeries of 7 days. We chose the SRK-T formula for IOL power calculation. A 17.5D and 18.5D AcrySof

Diffractive Intraocular Lens Implantation with cataract surgery following penetrating keratoplasty

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We report 3 cases of cataract extraction with multifocal intraocular lens (IOL) implantation after penetrating keratoplasty (PKP). 6 months after multifocal IOL implantation, uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), uncorrected near visual acuity (UCNVA) and best distance corrected near visual acuity (BCNVA) improved in all cases. Cataract extraction with multifocal IOL implantation may be a good option to provide pseudoaccommodation in post-PKP eyes.

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ReSTOR Natural IOL (SN60D3 model, Alcon Inc, Fort Worth, TX) were selected for OD and OS, respectively. The AcrySof ReSTOR SN60D3 spherical IOL utilizes apodisation, diffraction and refraction to create multifocality. The material of this IOL includes a blue-light absorbing chromophore designed to more closely approximate the light-transmittance characteristics of the natural lens at wavelengths below approximately 500 nm. The target of postoperative refraction was emmetropia. Phacoemulsification was performed using the Infiniti Vision System (Alcon, USA).

Phacoemulsification was followed by irrigation and aspiration of the cortex and IOL implantation in the capsular bag using the injector developed for the IOL.

6 months after IOL implantation, the manifest refraction for the right eye was +0.75 -2.00 x0º with an UCVA of 0.7 and a BCVA of 1.0. In the left eye, the manifest refraction was +1.00 -3.00 x72º, with an UCVA of 0.5 and a BCVA of 0.9. At near vision, the uncorrected near visual acuity (UCNVA) was of 0.8 and 0.6 for OD and OS, respectively. Both eyes obtained a best distance corrected visual acuity (BCNVA) of 1.2. The keratometry were 43.75/46 x 105º for OD and 47.5/43.75 ? 85º for the OS.

CASE REPORT 2

A 50 year-old-woman, who had undergone PKP in her OS 3 years earlier, because of keratoconus, returned to our clinic because of blurred vision at distance and near in OS. The manifest refraction in OS was -3 -3.50 x 125º, with an UCVA of 0.7 and a BCVA of 1.0. In the left eye, the manifest refraction was +1.00 -3.00 x72º, with an UCVA of 0.5 and a BCVA of 0.9. At near vision, the uncorrected near visual acuity (UCNVA) was of 0.8 and 0.6 for OD and OS, respectively. Both eyes obtained a best distance corrected visual acuity (BCNVA) of 1.2. The keratometry were 43.75/46 x 105º for OD and 47.5/43.75 ? 85º for the OS.

CASE REPORT 3

A 50 year-old woman who had undergone to PKP in 2003 for her OS and two years later in her OD, due to bullous keratopathy, came back to our clinic because of decrease in her visual quality. The manifest refraction in OD was -10 -2.00 x 90º and -10 -3.00 x 80º in OS, with an UCVA of fingers count at 3 meters and BCVA of 0.5 in both eyes. At near vision, with +3.00D of addition the BCNVA was 0.5 in both eyes. The keratometry reading was 45.75/43.25 x 90º for OD and 45.75 /42.25 x 60º for OS. The intraocular pressure was 13 mmHg and 15 mmHg for OD and OS, respectively. A slit lamp examination revealed cortical and posterior subcapsule of 2+ in both eyes. The axial lengths, obtained with IOL Master, were 26.57 mm. Other ophthalmic examination findings were unremarkable.

After informed consent was obtained, cataract removal with multifocal intraocular lens (IOL) implantation was planned for OS. SRK-T formula was chosen for the IOL power calculation. Acri.LISA 366D IOL (Acri.Tec, Germany) with +11D of power was selected for the implantation with a target postoperative refraction of emmetropia. The Acri.LISA 366D IOL is an aspheric bifocal biconvex refractive–diffractive IOL. Phacoemulsification was performed using the Infiniti Vision System. Phacoemulsification was followed by irrigation and aspiration of the cortex and IOL implantation in the capsular bag using the injector developed for the IOL.

6 months after IOL implantation the keratometry reading was 44.75/43.25 x 130º and the manifest refraction was +1.00 -3.00 x 135º, with an UCVA of 0.4 and a BCVA of 0.8. At near vision, the UCNVA was of 0.8 and the BCNVA of 1.0.
OD and 26.80 mm in OS. Other ophthalmic examination findings were unremarkable.

After informed consent was obtained, cataract removal with multifocal IOL implantation was planned for both eyes, with a time between the 2 surgeries of 7 days. We chose SRK-T formula for IOL power calculation. A +9D and +10D AcryLISA 366D IOL were selected for OD and OS, respectively, with a target postoperative refraction of emmetropia. Phacoemulsification was performed using the Infiniti Vision System. Phacoemulsification was followed by irrigation and aspiration of the cortex and IOL implantation in the capsular bag using the injector developed for the IOL.

6 months after IOL implantation, the manifest refraction for OD eye was 0.00 -3.50 x70º, with an UCVA of 0.3 and a BCVA of 0.8. In OS, the manifest refraction was 0.00 -4.00 x100º, with an UCVA of 0.3 and a BCVA of 0.7. At near vision, both eyes obtained an UCNVA of 0.3. The BCNVA was of 0.8 and 0.7 for OD and OS, respectively. Keratometry readings were 47.75/ 42.5 x 93º for OD and 46.5/ 41.75 x 65º for OS.

**DISCUSSION**

Although PKP has been shown as a safe and effective procedure for corneal transplant, some residual refractive error may be a problem and provide visual limitations after PKP. In young accommodative patients, these residual refractive errors may be corrected using spectacles, contact lens or even different surgical options7-17. However, in older non-accommodative patients or in patients who develop cataract, the near vision can be another drawback. As we have introduced, it has been reported54 that cataract extraction with multifocal IOLs implantation in eyes with PKP is a safe procedure and provide a good visual outcomes. Nagra et al5 reported a low risk of graft failure, with only 1 of 29 patients (3%) developing graft failure following cataract extraction. Hsiao et al6 reported that failed grafts occurred in 2 (8%) of 26 eyes. Furthermore, in this study they did not find differences in mean endothelial cell density, coefficient of variation in cell area, and percentage of hexagonal cells measured by specular microscopy between before and after cataract surgery with IOL implantation. Therefore, these authors suggested6 that cataract surgery did not cause a great deal of damage to the graft. However, these patients have to wear different optical correction as a function of the distance. For this reason, in these patients is interesting to analyse the possibility to implant a multifocal IOL.

These case reports present a new approach for removing cataract and providing pseudoaccommodation in patients who had undergone PKP, reducing the dependency on several optical corrections. To our knowledge, there are not studies of the implantation of multifocal IOLs in patients who had PKP.

All cases reported here showed good BCVA and BCNVA (≥ 0.7). However, some residual refractive errors may appear after IOL implantation combined with astigmatism of previous PKP surgery. Spectacles or contact lenses can be a good option for correcting residual postoperative ametropia (both spherical and astigmatism), but different surgical options, such as photorefractive keratectomy7-9, lasik in situ keratomileusis10-14, piggyback IOL implantation15,16, anterior17 and posterior18 phakic IOL implantation may also be considered.

In conclusion, these case reports suggest that in patients who have undergone PKP and developed cataracts, multifocal IOL implantation may be a good option to provide pseudoaccommodation. Although our results are encouraging, long-term randomized comparative masked prospective studies are necessary to assess this technique and its complications and future studies with larger series of patients should be carried out to assess the long-term stability and safety of this procedure.

**REFERENCES**