Case Reports in Ophthalmology

Case Rep Ophthalmol 2014;5:255–261

DOI: 10.1159/000365246
Published online: August 7, 2014

1663–2699/14/0052–0255$39.50/0
www.karger.com/cop

Karger Open access

Management of Extreme Ametropia after Penetrating Keratoplasty: A Series of Surgical Procedures for High Myopia and Astigmatism

Jorge E. Valdez-Garcia[a, b] Juan J. Cueto-Gómez[a] Juan F. Lozano-Ramírez[a] Alejandro E. Tamez-Peña[a]

[a]Ophthalmology Research Chair, School of Medicine and Health Sciences, and
[b]Instituto de Oftalmología y Ciencias Visuales – TECSalud, Tecnológico de Monterrey, Monterrey, Mexico

Key Words
Ametropia · Keratoplasty · Refractive surgery · Myopia · Astigmatism

Abstract
A series of surgical interventions – relaxing corneal incisions, intraocular lens, and intrastromal rings – were used to correct a case of extreme ametropia in a thin cornea after a penetrating keratoplasty in an 18-year-old patient who presented with a –10.25 –8.50 × 120 preoperative refraction and 20/200 best-corrected visual acuity (BCVA). After a series of surgical procedures, the patient's BCVA in his left eye improved to 20/30 with +0.50 –1.00 × 170, the slit lamp examination showed no significant findings, and the patient's visual complaints disappeared. At the 1-year follow-up, the BCVA was 20/25, without visual complaints. The process of individualizing the surgical procedure in the present case was employed in an outcome-based approach, that is, the next surgical procedure was defined after the surgery and postoperative evaluation. The patient did not present complications during the follow-up period of 2.5 years.

Introduction

Corneal transplantation, properly known as keratoplasty, is the surgical intervention through which we can replace a cornea. There are two main types of keratoplasty: penetrating keratoplasty (PKP), where the entire cornea is replaced, and lamellar keratoplasty,

Juan F. Lozano-Ramírez
Av. I. Morones Prieto 3000 Pte
Colonia Los Doctores
Monterrey, Nuevo León, C.P. 64710 (Mexico)
E-Mail jfcolr@gmail.com

where a partial segment of the cornea is replaced, both with the ultimate goal of restoring vision [1]. Managing patients after keratoplasty, especially with refractive errors, can be difficult. The first steps implement correction through conservative optical methods before attempting surgery in cases where previous means were not enough to achieve optimal visual correction. However, in some cases, it is difficult to obtain the desired outcome with a single surgical procedure so that two or more interventions might be needed.

The main refractive errors seen after a PKP are myopia and astigmatism, with 15–31% of the patients developing astigmatism >5 diopters (D) [2]. The treatment options vary, mainly being spectacles and rigid gas-permeable contact lenses. In 10–30% of the patients who undergo PKP, contact lenses are used for visual rehabilitation [3]. However, not all patients tolerate contact lenses or obtain the best-corrected visual acuity (BCVA) using them, which makes a surgical option necessary to achieve an optimal visual result and a good quality of life. Some of the options are photorefractive keratectomy (PRK), laser in situ keratomileusis (LASIK), laser-assisted subepithelial keratectomy (LASEK), intrastromal corneal ring segments, wedge resection, intraocular lenses (IOL), and relaxing incisions [1, 4]. Each case is unique, and the best refractive surgical option should be attempted, with the opportunity to use several techniques combined to achieve the best vision for the patient.

We describe a patient with high ametropia and a thin cornea who had a corneal transplantation 6 years ago. He underwent several surgical techniques and achieved an excellent outcome in visual aspects and patient complaints. The patient gave his consent for the treatment and presentation of his case, and IRB approved the report of this case.

Case Presentation

An 18-year-old male who had a vague ophthalmic past medical history presented to our clinic complaining of poor vision and intolerance to a rigid gas-permeable contact lens since he had been transplanted. He also reported a herpetic ulcer on his left eye (OS) at the age of 2 years and a PKP at 12 years of age. As part of his management after PKP, the patient had been using a gas-permeable rigid contact lens since transplantation, which was discontinued because of discomfort and intolerance.

At the time of consultation, the uncorrected visual acuity (VA) in the right eye (OD) was 20/20 and in the OS, it was hand motion vision; the OS BCVA was 20/200 with –10.25 –8.50 × 120. The findings of the examination were completely normal. A corneal pachymetry (Orbscan II Software version 4.1; Bausch and Lomb, Rochester, N.Y., USA) of the OS showed a 405-μm central corneal thickness and keratometry values of 43.00/53.00 × 47.

To address the extreme ametropia, we wanted to improve the refraction and VA. However, we were confronted with the limitations of a PKP history and a thin cornea. To reduce the risk and to have a controlled approach, we implemented a stepwise intervention based on the results obtained after each surgery and recovery time interval, discarding the possibility of using LASIK/PRK.

For the first procedure, the use of relaxing corneal incisions at 30 degrees and 210 degrees for correction of the astigmatism was planned, with an arc length of 45 degrees. On the postoperative visit, the patient's OS BCVA was 20/40 with –10.00 –4.00 × 150. The complete anterior eye examination performed by slit lamp examination showed a clear cornea with a clear aqueous humor and no other significant findings. Gonioscopy showed all angles opened with an intraocular pressure of 16, an anterior chamber depth of 3.34 mm, and a keratometry of 47.10/49.90 × 159 (fig. 1). The next step was the implantation of a

Visian ICL® V4 –10.00 D (STAAR Surgical Company, Nidau, Switzerland) with a primary incision at 90 degrees after 6 months to correct the high myopia.

After ICL implantation, the patient had an OS BCVA of 20/40 with –1.00 –4.25 × 150, no significant findings in the slit lamp examination, and an intraocular pressure of 14 mm Hg. At that time, the patient complained of diplopia. Based on the results and refraction obtained, after 1 year of follow-up, we proposed the manual placement of intrastromal annular segments (Ferrara rings) in order to correct the residual astigmatism.

The patient received Ferrara rings (AJL, Boecillo, Spain) with a segment ring thickness of 0.15 mm and 160 degrees of arc, implanted at 80% of the cornea thickness of the thinnest segment, with the incision at 69 degrees with an apical diameter of 5 mm and according to the manual technique. After the procedure, the patient's uncorrected VA was 20/50 and the OS BCVA improved to 20/30 with +0.50 –1.00 × 170. The slit lamp examination showed no significant findings, and the patient's visual complaints disappeared (fig. 2). After 1 year of follow-up, the patient continued to have no visual complaints, his slit lamp examination was unremarkable, and the BCVA obtained was 20/25 (fig. 3). The same surgeon performed all surgical procedures.

Discussion

The visual outcomes after corneal transplantation are often limited by myopia, hyperopia, and astigmatism. In some cases, anisometropia may develop, causing diplopia and blurred vision [5]. The management of these refractive problems is initially focused on conservative means – spectacle lenses and contact lenses – before introducing invasive procedures as surgical options [6]. Different methods, as already presented in the introduction, have been employed to correct refractive errors in patients after PKP. However, combinations of different methods to achieve an outcome that solves the refractive complications of PKP are rarely used. Our case was a surgical success as the patient's visual rehabilitation was completed by a stepwise approach after many years with poor vision and quality of life.

Relaxing corneal incisions have been used successfully for astigmatism after PKP, with the possibility of employing other surgical procedures in combination such as IOL placement. Furthermore, it is a safe, effective, and simple method that can be used in patients with >4.0 D of cylinder [2, 7]. Patients obtained better VA with relaxing corneal incisions when compared to patients who did not undergo the procedure [8]. The team´s surgical expertise, a conservative approach, and a less invasive procedure were the main reasons for using this approach in the patient described here.

The use of phakic IOL for the correction of high myopia after PKP has been reported in the literature [9]. Of interest is the effect the intraocular procedure can have on the graft cornea, primarily on the endothelial cell density. The use of ICL implantation had a similar risk ratio in postkeratoplasty eyes and normal eyes for cell density reduction, ranging from 4.41–4.91% in patients with ICL in high myopia and 5.11% in ICL implantation after PKP, all after 6 months [10]. The possibility of crystalline lens opacities has not been observed in similar patients undergoing the same procedure in short trials. However, in long-term trial follow-ups, 6–7% developed anterior subcapsular opacities, with 1–2% progressing to clinically significant cataract, which is the reason why a 1.5-mm space should be left to avoid contact between the ICL and crystalline lens [11, 12]. All of these risks need to be taken into consideration when analyzing the possibility of submitting a patient to such procedures as a graft. The use of an ICL helped correct the high myopic error, supported by the patient

having a good anterior chamber to place the ICL correctly and safely. The ICL implantation was performed before the Ferrara rings were implanted in order to address the refractive defect that was most incapacitating for the patient as well as following the patient´s request to correct the high myopia.

Intrastromal corneal ring segment (ICRS) implantation (Ferrara rings) has been used in patients with positive visual outcomes after PKP, reducing the keratometric measures [13]. Recommendations vary in relation to time after PKP for ICRS implantation, with a waiting time of 1–2 years after corneal transplantation in order to achieve adequate tectonic, refractive, and immunogenic stability [6, 14]. The implantation of ICRS after PKP has different results compared to corneas with keratoconus: in PKP corneas, 73% of the eyes were undercorrected and had a low concordance between the attempted refraction and the achieved refraction. This undercorrection can be related to PKP corneas being more rigid with normal thickness and elasticity compared to corneas of keratoconus that are thinner and more elastic [6]. The ICRS implantation can have several complications affecting the results and might not achieve the correction of the astigmatism; examples would be spontaneous suture rupture, immune reactions, and migration of ICRS [15]. The consideration of ICRS was mainly based on the patient having a thin cornea and the aim of correcting the astigmatism.

When faced with cases in which a simple refractive surgery can help obtain an expected correction in the patients after PKP, the analysis for intervention becomes relatively easy for the surgeon. However, when the surgeon has a case with high astigmatism and myopia, it is necessary to analyze a series of surgical approaches based on individual visual outcomes after each intervention. Even though this case was a success, our stepwise approach needs standardization and validation of the combination techniques.

The use of surgical techniques as relaxing corneal incisions, ICL implantation, and ICRS implantation showed to be effective in this specific case. In addition, these techniques have been observed to be safe and effective in patients who previously underwent PKP. However, we did not identify reports in which our surgical approach was employed in patients with the same characteristics. A large series of patients should be studied in future research to determine the effectiveness of the different surgical procedures in eyes after PKP and to standardize the combination procedure.

Disclosure Statement

None of the authors has a financial or proprietary interest in any material or method mentioned in this paper.

References

1 Fares U, Sarhan AR, Dua HS: Management of post-keratoplasty astigmatism. J Cataract Refract Surg 2012;38:2029–2039.
2 Feizi S, Javadi MA: Corneal graft curvature change after relaxing incisions for post-penetrating keratoplasty astigmatism. Cornea 2012;31:1023–1027.
3 Donnenfeld ED, Solomon R, Biser S: Laser in situ keratomileusis after penetrating keratoplasty. Int Ophthalmol Clin 2002;42:67–87.
4 Wilkins MR, Mehta JS, Larkin DF: Standardized arcuate keratotomy for postkeratoplasty astigmatism. J Cataract Refract Surg 2005;31:297–301.
5 Hardten DR, Chittcharus A, Lindstrom RL: Long term analysis of LASIK for the correction of refractive errors after penetrating keratoplasty. Cornea 2004;23:479–489.

6 Coscarelli S, Ferrara G, Alfonso JF, et al: Intrastromal corneal ring segment implantation to correct astigmatism after penetrating keratoplasty. J Cataract Refract Surg 2012;38:1006–1013.
7 Feizi S, Zare M: Current approaches for management of postpenetrating keratoplasty astigmatism. J Ophthalmol 2011;2011:708736.
8 Claesson M, Armitage WJ: Astigmatism and the impact of relaxing incisions after penetrating keratoplasty. J Refract Surg 2007;23:284–289.
9 Iovieno A, Guglielmetti S, Capuano V, Allan BD, Maurino V: Correction of postkeratoplasty ametropia in keratoconus patients using a toric implantable Collamer lens. Eur J Ophthalmol 2013;23:361–367.
10 Akcay L, Kaplan AT, Kandemir B, Gunaydin NT, Dogan OK: Toric intraocular Collamer lens for high myopic astigmatism after penetrating keratoplasty. J Cataract Refract Surg 2009;35:2161–2163.
11 Alfonso JF, Lisa C, Abdelhamid A, Montes-Mico R, Poo-Lopez A, Ferrer-Blasco T: Posterior chamber phakic intraocular lenses after penetrating keratoplasty. J Cataract Refract Surg 2009;35:1166–1173.
12 Valdez-Garcia J, Espino-Barros A: The use of ICLs in the treatment of high-grade myopia. AVANCES 2007;4:8–11.
13 Coscarelli S, Ferrara G, Alfonso JF, Ferrara P, Merayo-Lloves J, Araújo LP, Machado AP, Lyra JM, Torquetti L: Intrastromal corneal ring segment implantation to correct astigmatism after penetrating keratoplasty. J Cataract Refract Surg 2012;38:1006–1013.
14 Chang DH, Hardten DR: Refractive surgery after corneal transplantation. Curr Opin Ophthalmol 2005;16:251–255.
15 Birnbaum F, Schwartzkopff J, Bohringer D, Reinhard T: The intrastromal corneal ring in penetrating keratoplasty-long-term results of a prospective randomized study. Cornea 2011;30:780–783.

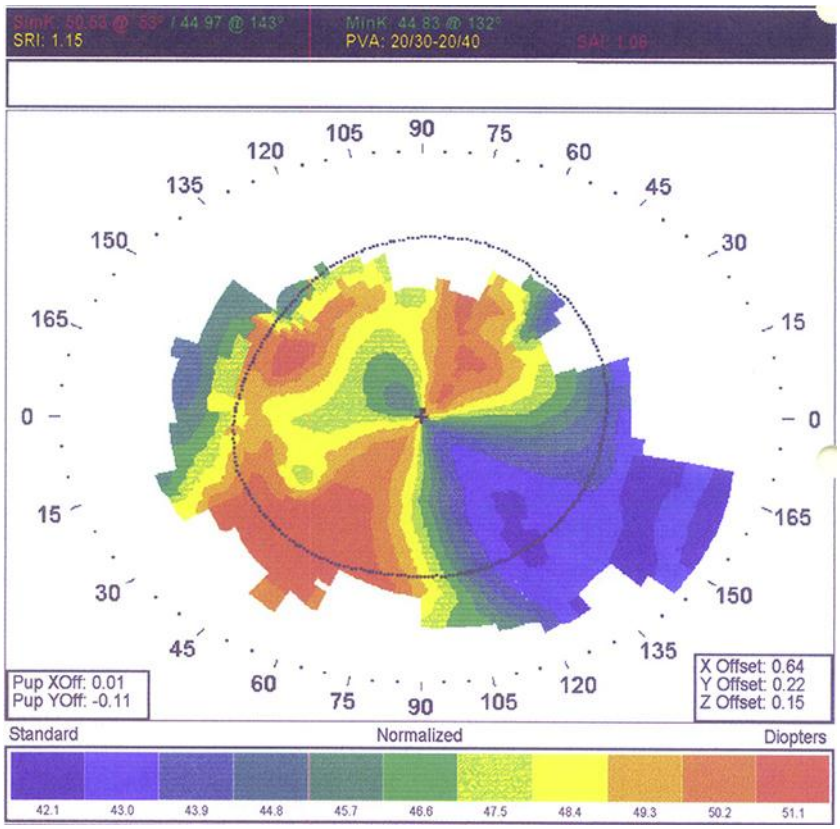

Fig. 1. Corneal topography after relaxing corneal incisions, showing persistence of the regular astigmatic defects.

Case Rep Ophthalmol 2014;5:255–261
DOI: 10.1159/000365246

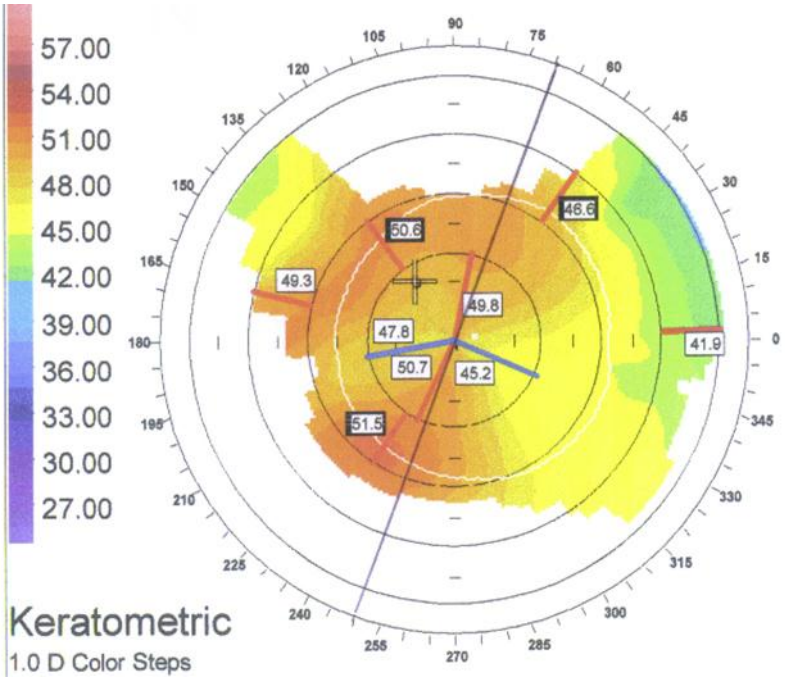

Fig. 2. Corneal topography after the implantation of Ferrara rings, showing no changes and an oblique astigmatic defect.

Case Rep Ophthalmol 2014;5:255–261
DOI: 10.1159/000365246

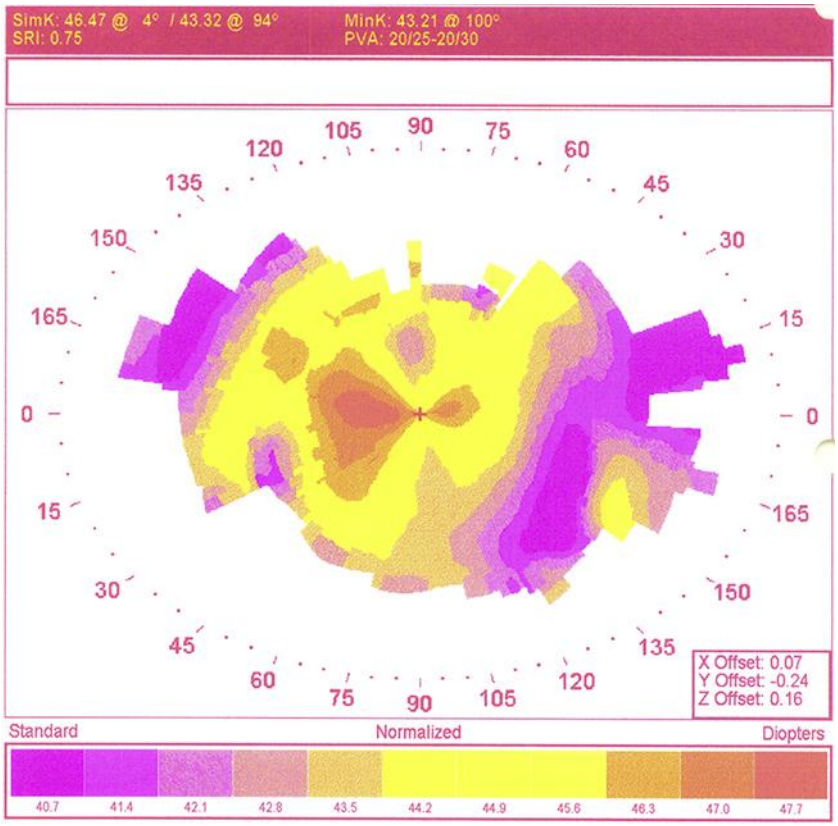

Fig. 3. Final corneal topography after 1-year of follow-up, showing a change in the axis evidencing with the rule astigmatism.