Femtosecond laser-assisted Cvintal topoplasty

Topoplastia de Cvintal assistida por laser de femtossegundo

Alexandre Takayoshi Ishizaki[1], Frederico Guerra[2], Issac Ramos[3], Renato Ambrosio Jr.[4]

RESUMO

Apresentamos um relato de astigmatismo tardio progressivo pós-transplante de córnea para ceratocone, associado à afinamento periférico na junção doador-receptor, o que presumidamente pode ser considerado como recorrência da ectasia. O caso foi tratado por meio de Topoplastia de Cvintal assistida por laser de femtossegundo para a confecção da incisão com geometria "top hat", seguido de sutura com ajuste per-operatório guiado por ceratoscopia.

Descritores: Astigmatismo/etiologia; Córnea/patologia; Ceratoplastia penetrante/efeitos adversos; Ceratocone/cirurgia; Terapia a laser/métodos; Complicações pós-operatórias; Relatos de casos

ABSTRACT

We present a case of late high progressive astigmatism following penetrating keratoplasty for keratoconus, which was associated with peripheral thinning in the donor-receptor area, which may be recognized as recurrence of ectasia. Treatment was accomplished with Cvintal's Topoplasty assisted by femtosecond laser for a "top hat", followed by resuture with peroperative adjustment guided by ceratoscopy.

Keywords: *Astigmatism/etiology; Cornea/pathology; keratoplasty, penetrating/adverse effects; keratoconus/surgery; Lasers therapy/methods; Postoperative complications; Case reports*

[1]Second-year resident at the Ophthalmology Department of Benjamin Constant Institute - Rio de Janeiro/RJ, Brazil.
[2]Member of the Cornea Unit of Benjamin Constant Institute - Rio de Janeiro/RJ, Brazil.
[3]Member of Renato Ambrosia Eye Institute – Rio de Janeiro/RJ, Brazil.
[4]Associate Professor at the Ophthalmic Post-graduate Programme of the Federal University of São Paulo (UNIFESP) - São Paulo/SP, Brazil; Catholic University of Rio de Janeiro (PUC-Rio) - Rio de Janeiro/RJ, Brazil; Renato Ambrósio Eye Institute - Rio de Janeiro/RJ, Brazil; Consultant at Oculus.

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Introduction

Astigmatism is the most common cause of low visual acuity after corneal transplantation. According to the literature, the average degree of astigmatism is 2.76 dioptres (D) at 24 months after the procedure, and in 15% of cases it is greater than 5 D.[1] However, irregular astigmatism associated with higher-order aberrations limits visual results as it cannot be fully corrected with glasses.[2,3] Thus, the use of special contact lenses plays an important role in the visual rehabilitation of these patients.

Controlling astigmatism after transplantation is a major challenge for any cornea surgeon. The attempt to control astigmatism begins during surgery, by performing a stable suture with balanced tension in every axis of the keratoplasty. Selective removal of separate sutures based on topographic progression plays a key role in the management of post-PK astigmatism.

Surgical options for correcting astigmatism after a transplant include relaxing incisions, photoablative refractive surgery with laser (LASIK or surface ablation), insertion of intrastromal corneal ring segments, wedge resection with compression suture, toric phakic intraocular lens implantation and retransplantation.[4]

The advent of the femtosecond (FS) laser has increased the accuracy and efficiency of corneal surgery.[5] FS laser-assisted corneal transplantation provides a lower rate of intraoperative complications and can facilitate the control of postoperative astigmatism.[5,6]

Topoplasty, a technique described by Dr. Tadeu Cvintal, is another surgical option in cases of high astigmatism after corneal transplantation.[7] The aim of this paper is to describe the first case of FS laser-assisted Cvintal topoplasty in a patient with high astigmatism associated with thinning of the host cornea, presumably related to the relapse of ectasia after PK.

Case Report

A 54-year-old white female patient was undergoing ophthalmic follow-up at the cornea unit of Benjamin Constant Institute. The patient reported a history of keratoconus, having undergone penetrating keratoplasty in the right eye 16 years ago and in the left eye 8 years ago. Transplantation in the left eye progressed with immune rejection and glaucoma, with loss of transparency. The patient reported a progressive loss of vision in the right eye and did not adapt to rigid contact lenses or glasses.

On examination, uncorrected visual acuity (VA) was 20/200 in the right eye and hand motion in the left eye. Corrected visual acuity in the right eye was 20/80 with manifest refraction of -2.75 -8.00 x 8°. Visual acuity in the left eye did not improve with correction.

Biomicroscopy of the right eye showed a transparent corneal graft slightly decentred toward the nose, thinning of the donor-host junction and thinning of the host cornea (Figure 1). Biomicroscopy of the left eye showed an opaque corneal graft with diffuse oedema.

The axial (sagittal) curvature map obtained by Placido topography in the right eye (Figure 2) showed corneal astigmatism greater than 14 D. The curvature and elevation maps obtained by tomography with rotating Scheimpflug photography (Pentacam HR, Oculus, Germany) showed similar findings, with higher toricity of the anterior and posterior surfaces of the cornea. In addition, corneal tomography showed inferior corneal thinning, which was consistent with the slit lamp examination (Figure 3).[8]

Total aberrometry or wavefront analysis (iTrace, Tracey Technologies Corp. USA) showed findings consistent with those

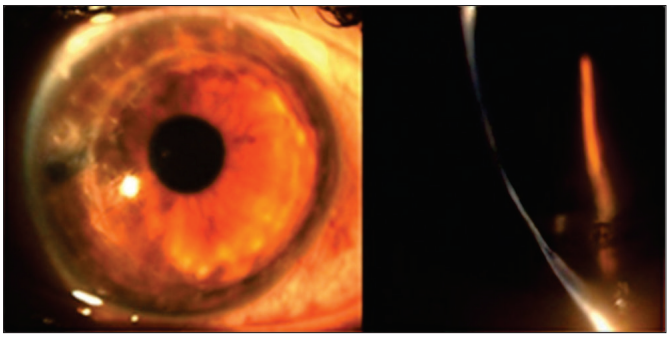

Figure 1. Biomicroscopy (RE): transparent corneal button 15 years after a penetrating keratoplasty to treat keratoconus. The button is slightly off-centre toward the nose, with thinning (presumably due to a relapse of ectasia) of the donor-host junction in the flattest and most elevated meridian on tomography

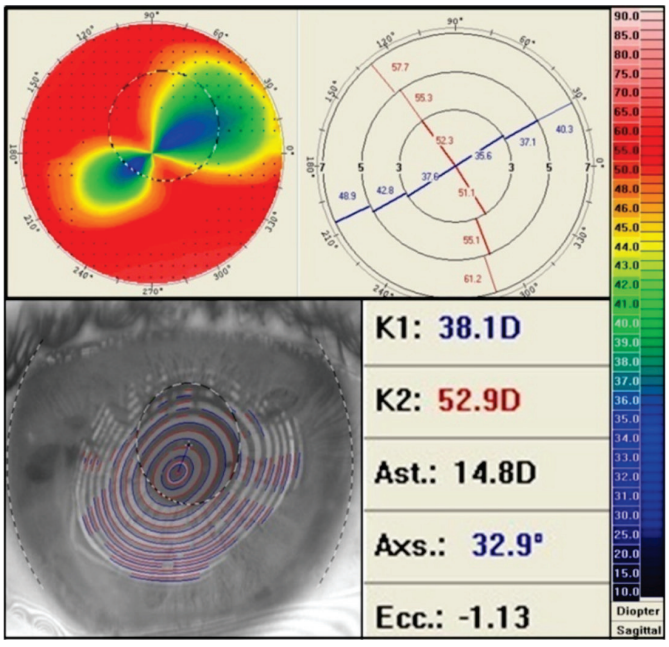

Figure 2. Topography (RE) showing a high degree of corneal astigmatism

of topography and tomography, with a similar pattern of astigmatism. Specular microscopy found 888 endothelial cells per square millimetre.

Since the patient could not see well with glasses and could not adapt to contact lenses, a surgical solution was necessary. Two cornea surgeons indicated a new penetrating transplant due to the severe astigmatism and corneal thinning, as well as the relatively low endothelial cell counts. However, based on the findings, we opted for femtosecond laser-assisted topoplasty as described by Cvintal.

Summary of the traditional surgical technique

The surgical technique of Cvintal Topoplasty[7] will be only briefly described here. It is a combination of four surgical procedures:

- Marginal keratotomy;
- Selective marginal keratectomy with drill;
- Deep delamination of surgical margins, toward the centre in the steepest meridians and toward the periphery in the flattest ones;

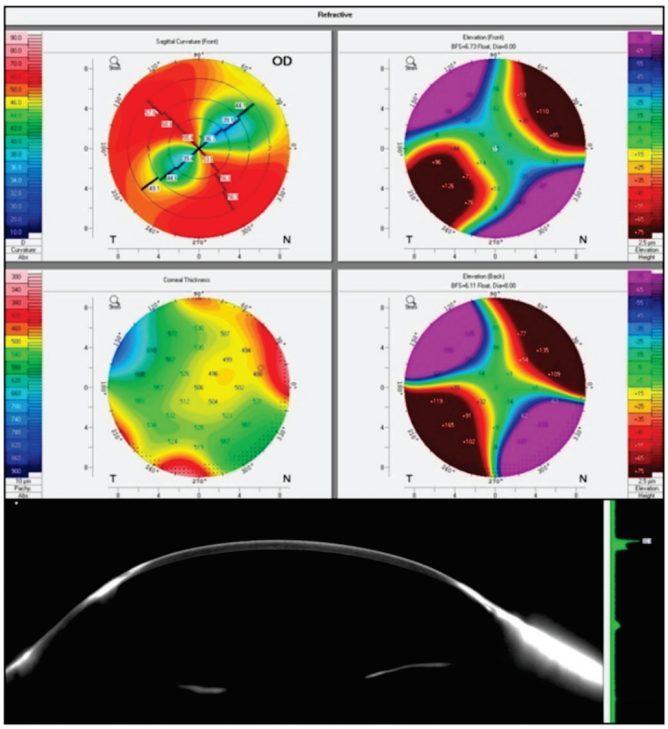

Figure 3. Corneal tomography with Pentacam and Scheimpflug image showing inferior corneal thinning (RE)

Table 1

Surgical planning with Intralase

Femtosecond parameters	**iEK**
External diameter	8.6mm
Internal diameter	7.4mm
Energy	1.70
Posterior depth	330µm
Anterior depth	270µm
Full lamellar cut	Off
Wound alignment	Off
Lateral anterior and posterior cut	On

- Resuture with corrective apposition of incision edges: In the flattest meridian, the suture needle is inserted into the superficial third of the central corneal edge and into the deepest layer of the peripheral edge. In the steepest meridian, the needle is inserted into the deepest layer of the central corneal edge and into the superficial third of the peripheral edge.

Surgical technique

The procedure was performed under mild sedation and topical anaesthesia. There were no intraoperative complications. An Intralase iFS (AMO, USA) FS laser was used the for corneal incisions, avoiding the use of blades and trephine (Table 1). We performed a top hat-shaped circumferential trepanation of partial thickness and complex geometry [9,10] in the donor button using the FS laser.

During application of the FS laser, we noted the presence of air bubbles in the anterior chamber, caused by the laser's interaction with the aqueous humour.

Once the trepanation stage was completed, the patient was taken to another room where, after asepsis and antisepsis and

Figure 4. First day after surgery. Note that the sutures are tighter on the flattest axis

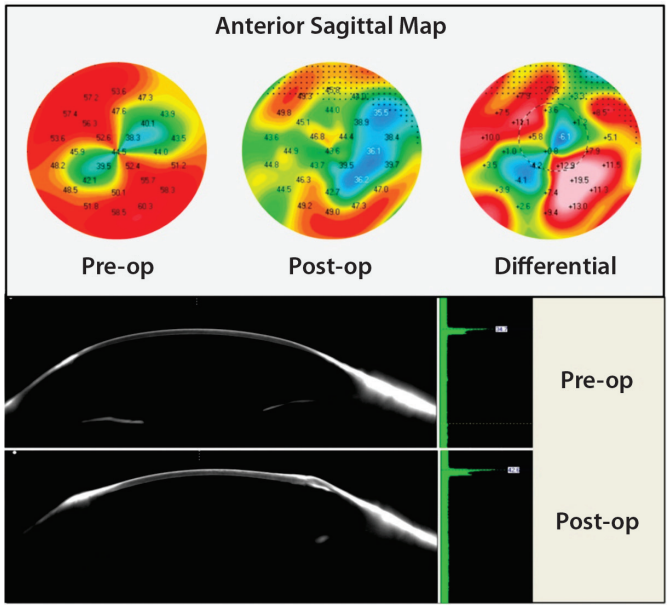

Figura 5: Mapa sagital diferencial e imagem de Scheimpflug: Pré x Pós-op

under a surgical microscope, viscoelastic was injected to stabilise the anterior chamber. Twenty-four separate stitches were made using mononylon 10/0 suture. Tighter stitches were used in the flattest meridians. Final astigmatism was adjusted using an intraoperative keratoscopy device.

On the first day after surgery a biomicroscopy of the right eye showed a clear corneal graft, a formed anterior chamber, a negative Seidel test, a regular photoreactive pupil, and a well-positioned intraocular lens (Figure 4). Uncorrected visual acuity of the right eye was 20/40.

In the first month the VA progressed to 20/60, improving to 20/50 with the removal of a suture. The patient recovered well after surgery and has remained stable for 4 months. The last corneal tomography, shown on Figure 5, illustrates the results of the treatment.

Discussion

Corneal topoplasty was first described by Dr. Tadeu Cvintal in 2004. In the original report,[7] the author described the follow-up of 29 patients submitted to this surgical technique to correct high-degree astigmatism post-PK. For a period of two years, an improvement of visual acuity was noted in 55.5% of cases, with a reduction of spherical equivalent from -7.10 to -1.49.

Topoplasty is indicated in many clinical situations, especially in cases of high-degree astigmatism post-PK and those with an irregular corneal structure.[7] The technique aims to reduce or eliminate the high toricity of the transplanted cornea, attempting to shape it into a more spherical surface.

The introduction of the FS laser in the field of corneal transplant has provided better clinical results and fewer complications.[6] Different incision shapes can be used with this type of laser, of which the most common are the top hat, the mushroom, the zigzag and the Christmas tree. [9,10] Such complex incisions improve the fitting and stability of the donor-host junction.[6] Thus, in theory, fewer sutures are necessary and they can be removed earlier.

Several studies report on different techniques to reduce astigmatism resulting from corneal transplant. Chamberlain et al. studied postoperative astigmatism in a series of patients submitted to PK, comparing the manual technique with the FS laser-assisted procedure.[11] The latter provided better control of astigmatism in the early postoperative period. However, after 6 months of follow-up there was no significant difference in postoperative astigmatism between the two groups.

FS laser is an option for arcuate wedge-shaped resection aimed to correct post-PK astigmatism. The laser-guided procedure provides a controlled and precise excision of tissue. Reductions of 14.5 D in corneal astigmatism have been described with this procedure.[12]

Nubile et al. studied the efficacy of FS laser-guided astigmatic keratotomy to treat post-keratoplasty astigmatism.[13] The procedure consists of incisions in the steepest corneal meridian on the periphery of the graft at a depth of 90% the total thickness of the stroma. The results showed a reduction of astigmatism from 7.16 D (±3.07) to 2.23 D (±1.55) and refractive stability. Similar outcomes have been reported by other authors.[14]

In this case report we presented a patient that had been previously submitted to bilateral PK due to keratoconus. Keratoconus is an ectatic and degenerative corneal disorder, and its progression is rare at the patient's age. The left eye progressed with graft failure, which explains its opacification. The donor button of the right eye showed good transparency; however, corneal thinning was evident at the donor-host junction, indicating a relapse of keratoconus.

The high degree of astigmatism in this case is due not only to the recurrence of keratoconus but also to the probable occurrence of post-transplant astigmatism. The relapse of ectasia contributes to disorganising the corneal structure, increasing the degree and irregularity of the astigmatism. The low visual acuity in the right eye reflects the impact of this refractive error on the optical system.

We opted for FS laser-assisted topoplasty because it is a simpler, more accurate procedure which leads to a greater reduction of astigmatism compared with other techniques, and also because of the availability of the device. However, this technique requires expensive equipment which is available only in a few operating rooms in Brazil.

Conclusion

The recurrence of keratoconus in eyes previously submitted to PK can be considered as an indication for a new corneal transplantation. However, performing a new PK is a very complex approach. The surgical technique described here preserves the corneal tissue graft, thus avoiding exposure to new antigens that could trigger an immune rejection. Another important aspect of the technique is that it leads to more regular astigmatism and corneal topography.

On the first day after surgery an improvement of the visual, refractive, and topographic outcome was noted. During the follow-up period there were no complications or biomicroscopic or topographic signs of progression of corneal ectasia.

Thus, FS laser-assisted topoplasty facilitates the management of astigmatism and the treatment of recurrent ectasia in previously-grafted eyes, with excellent postoperative results.

This procedure was effective in the treatment of high astigmatism associated with relapse of keratoconus after PK. The patient had a significant improvement of visual acuity and showed refractive and topographic stability one month after the procedure; after 4 months, the results had remained stable. Up to this date, with one year of follow-up, there was no need for a new corneal transplant.

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Corresponding Author:
Instituto de Olhos Renato Ambrósio
Rua Conde de Bonfim, nº 211/712 – Tijuca
CEP 20520-050 - Rio de Janeiro – (RJ), Brazil
Tel/Fax: +5521 2234 4233/2264 4430