

EUROPEAN OPHTHALMIC PATHOLOGY SOCIETY (EOPS) MEETING 2022

Date of meeting: May 25th–28th

Place of meeting: Valencia, Spain

Name: Cristina Peris-Martínez MD, PhD, FEBO

FISABIO Oftalmología Médica (FOM)

cristinaperismartinez0mail.com@gmail.com

TITLE:

Clinical and histological findings after corneal ring segments explantation in a patient with post-LASIK ectasia

CLINICAL HISTORY:

Clinical case

We present the case of a 31-year-old man who underwent surgery for myopia in both eyes using the LASIK technique (laser in situ keratomileusis). Two years after the intervention he developed a progressive loss of vision in his right eye (RE). He was fitted with contact lenses, but gradually he also developed intolerance to them. He had no systemic history or other ophthalmological history of interest.

His corrected preoperative visual acuity was finger count in RE (he did not improve with pinhole, nor with any refraction) and 0.9 in LE with (-1.5, -3 x 45°). Biomicroscopy revealed the existence of corneal flaps with superior hinges in both eyes compatible with the LASIK technique. In addition, in the RE a brownish linear deposit was observed around the corneal flap line simulating the Fleischer ring of keratoconus, an inferior paracentral leukoma and a slight central conical protrusion, as well as a significant reduction in corneal thickness, compatible with ectasia. The rest of the ophthalmological examination was unremarkable in both eyes.

To establish the diagnosis of corneal ectasia, corneal topographies were performed using the *OrbscanIIz* topographer (Bausch & Lomb, Rochester, New York, USA), confirming an image of bilateral central corneal ectasia. The RE showed the existence of advanced keratoconus (Amsler-Krumeich grade IV) with a maximum keratometric reading of 60 diopters (D) in the most curved axis and extreme central corneal thinning of 349 microns.

Diagnosis

Corneal ectasia associated to LASIK.

Treatment

The patient had an intolerance to contact lenses in his OD, while in his LE he perfectly tolerated a gas-permeable contact lens. While waiting for a corneal transplant in the RE (since it was a very advanced keratoconus), it was decided to implant 2 intracorneal rings of the Ferrara-Keraring type (triangular section) with a thickness of 300 microns. The creation of the intrastromal channels was carried out using the femtosecond laser (*Intralase Corp.* RING program, internal diameter 5 mm and external

diameter 5.7 mm). The rings were implanted at a depth of 390 microns (80% of the total thickness in the most curved axis-84°) at 5 mm from the pupillary axis.

Since intrastromal ring implantation failed to improve the patient's VA, it was decided to perform a penetrating keratoplasty after 6 months of follow-up. The extracted button together with the 2 intracorneal rings was analyzed by the pathologist. After penetrating keratoplasty, VA improved to 0.4 with +2, -3 x 57°, at 6-month follow-up.

Ophthalmic Pathology:

Macroscopic pathological anatomy. Macroscopy: Eight mm diameter corneal button after penetrating keratoplasty in the right eye. Only one specimen.

Light microscopy:

There was no evidence of an inflammatory response or foreign-body granuloma. Histological slides show the following aspects described layer by layer: Epithelium, was centrally thin, unstructured, with fewer cell layers than under normal conditions.

Bowman's layer: thinning and microtears. Stroma: The collagen fibers of the corneal stroma remained parallel except in the vicinity of the channels, where they were compacted to give way to the ring. There was loss of fibrils. Keratocyte density decreased above and below the tunnel. A virtual line corresponding to a flap produced by the microkeratome during the LASIK intervention was observed.

Objective

To evaluate the histopathological changes induced in the cornea of this patient with LASIK-associated ectasia after implantation of intracorneal ring segments.

Comment:

Keratoconus, the most common corneal ectasia, is considered an absolute contraindication for performing refractive surgery on the cornea (1). Post-surgical ectasia is an extremely rare but highly feared complication associated with LASIK surgery (1, 2). One of the possible therapeutic alternatives that currently exist for the treatment of the dreaded ectasias is the implantation of intracorneal rings to delay and/or avoid performing a corneal transplant (2, 3).

Most publications evaluate the results of intracorneal ring implantation in view of the clinical and refractive results (3), without considering corneal histological changes produced by scarring and inflammation of the ring introduced into the corneal stroma (3, 4).

After evaluating the morphological changes of the corneal button by light microscopy, the corneal epithelium surrounding the ring immediately superior to the channels of the Ferrara rings of triangular section was hypoplastic and thinned (Figure 4) compared to that of the central cornea. There was no evidence of an inflammatory response, new vessels, or foreign body granulomas in or near the lumens of the canals. In addition, thinning and microtears are shown in Bowman's layer (also characteristic of keratoconus). The collagen fibers of the corneal stroma remained parallel except in the vicinity of the channels, where they were compacted to give way to the ring. There was loss of fibrils. Keratocyte density decreased above and below the tunnel. In addition, a

virtual line corresponding to a flap produced by the microkeratome during the LASIK intervention was observed (Figure 6).

There are very few studies in the literature that analyze human corneal buttons that have had rings implanted for the treatment of keratoconus or post-surgical ectasia. Samimi et al (5) report the histopathological findings of 8 eyes with keratoconus from 8 patients who underwent penetrating keratoplasty after removing polymethylmethacrylate corneal rings, like ours, but with a hexagonal section (IntacsTM, Addition Technology, Inc.). Our patient's rings were made of the same material, but with a triangular section (FerraraRing[®]) and also the type of ectasia was different, LASIK-associated ectasia, not keratoconus.

In another series of cases, Hamon et al (6) analyzed 15 cases of patients with keratoconus and intracorneal ring implantation using in vivo confocal microscopy. Within their series, they also analyzed 2 corneal buttons from 2 corneas explanted by corneal transplant, with implantation of intracorneal rings with a hexagonal section, as in the case of Samimi et al (5). In addition to the histological study with light microscopy, it shows an analysis with transmission electron microscopy, demonstrating focal accumulations of degenerated keratocytes with cytoplasmic lipid inclusions (6).

Although the histological changes appear to be fully reversible after implant removal, larger histological studies as well as transmission electron microscopy are needed to assess the corneal inflammatory response, if any, after long-term ring implantation.

References

1. Moshirfar M, Smedley JG, Muthappan V, Jarsted A, Ostler EM. Rate of ectasia and incidence of irregular topography in patients with unidentified preoperative risk factors undergoing femtosecond laser-assisted LASIK. *Clinical Ophthalmology* 2014;8 35-42.
2. Moshirfar M, Tukan AN, Bundogji N, Liu HY, McCabe SE, Ronquillo YC, Hoopes PC. Ectasia After Corneal Refractive Surgery: A Systematic Review. *OphthalmolTher*. 2021 Dec;10(4):753-776. doi: 10.1007/s40123-021-00383-w. Epub 2021 Aug 20. PMID: 34417707; PMCID: PMC8589911.
3. Peris-Martínez C, Bueno-Gimeno I, Álvarez-Arana I, Piñero D, Gené-Sanpedro A. Characterization of the effect of intracorneal ring segment in corneal ectasia after laser refractive surgery. *Eur J Ophthalmol*. 2018 doi:10.1177/1120672118808968
4. Park SE, Tseng M, Lee JK. Effectiveness of intracorneal ring segments for keratoconus. *Curr Opin Ophthalmol*. (2019) 30:220–8.
5. Samimi S, Leger F, Touboul D, Colin J. Histopathological findings after intracorneal ring segment implantation in keratoconic human corneas. *J Cataract Refract Surg* 2007; 33: 247-253.
6. Hamon L, Schlötzer-Schrehardt U, Flockerzi FA, Seitz B, Daas L. Morphological characterization and clinical effects of stromal alterations after intracorneal ring segment implantation in keratoconus. *Graefes Arch Clin Exp Ophthalmol*. 2022 Feb 2. doi: 10.1007/s00417-022-05572-2. Epub ahead of print. PMID: 35106630