Significant Visual Increase Following Infectious Keratitis After Collagen Cross-linking

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ABSTRACT

PURPOSE: To report a patient who developed a left paracentral stromal scar due to infectious keratitis that occurred after corneal collagen cross-linking (CXL) for progressive keratoconus. The flattening effect of the scar led to an increase in visual acuity.

METHODS: The corneal scar and flattening effect on the anterior corneal curvature were assessed by slit-lamp photography, high-resolution Scheimpflug imaging, and corneal confocal microscopy.

RESULTS: Three days after CXL, a corneal bacterial infection occurred in the left cornea and was treated with local antibiotics that led to a paracentral scar. Twenty-one days after CXL, a flattening of the anterior curvature of >11.00 diopters was observed. As a consequence, corrected distance visual acuity improved by five lines.

CONCLUSIONS: Corneal remodeling may lead to a homogenization of the anterior corneal surface and an increase in visual acuity. Remodeling may not only occur spontaneously following CXL, but also following an event that results in focal corneal scarring, such as corneal infection. In a highly irregular keratoconic cornea, the benefit of the flattening effect of a scar may outweigh the increase in aberrations and light scatter. [*J Refract Surg*. 2012;XX(X):XX-XX.]
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Corneal collagen cross-linking (CXL) with ultraviolet-A and riboflavin represents a method for the treatment of progressive keratoconus. Although considered a safe procedure, a number of complications may occur, many of which are related to the general risk of infection in a cornea that has undergone a surgically induced large diameter abrasion.[1-5] This report presents a patient who developed a bacterial corneal infection following CXL and subsequent complication that led to an increase in corrected distance visual acuity (CDVA).

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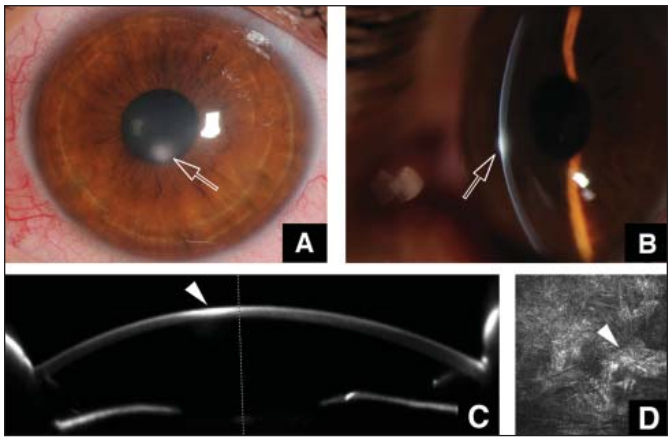

Figure 1. A, B) Slit-lamp images of the paracentral corneal scar (arrow) in the anterior corneal stroma. **C)** High-resolution Scheimpflug imaging of the scar (arrowhead). **D)** Confocal microscopy at a depth of 280 μm showing hyper-reflectivity (arrowhead).

CASE REPORT

A 21-year-old man with documented progressive keratoconus in his left eye was treated in June 2010. Preoperative manifest refraction in the right eye was -1.00 -1.25×58 and $-0.50-1.00 \times 113$ in the left eye. Preoperative CDVA was logMAR 0.7 (Snellen equivalent 20/100) in the right eye and logMAR 1.0 (Snellen equivalent 20/200) in the left eye. Optical pachymetry showed a minimal corneal thickness of 492 µm in the right eye and 481 µm in the left eye. Corneal collagen (CXL) was uneventful and the patient received ofloxacin ointment and a bandage contact lens soaked in preservative-free ofloxacin drops at the end of the procedure.

The patient did not attend follow-up on postoperative days 1, 2, or 3 and was noncompliant with postoperative prophylactic ofloxacin drops. Six days after CXL, he presented with a left paracentral infectious corneal infiltrate of approximately 3 mm in diameter (Fig 1). Intensive therapy was initiated with topical antibiotics (alternating ofloxacin and garamycin drops) for 10 days and the infiltrate turned into a scar within 3 weeks, as demonstrated by Scheimpflug imaging (see Fig 1).

Corneal confocal microscopic analysis performed 3 weeks after CXL showed stromal hyper-reflectivity down to a depth of 280 µm and close to the CXL-induced stromal demarcation line observed at 300 µm (see Fig 1).[6] Analysis of the corneal swab revealed an infection with ofloxacin-sensitive *Staphylococcus aureus*. Uncorrected distance visual acuity improved from logMAR 1.0 preoperatively to logMAR 0.5 (Snellen equivalent 20/200 to 20/63) 3 weeks after CXL. Corrected distance visual acuity improved from logMAR 0.7 preoperatively to logMAR 0.2 (Snellen equivalent

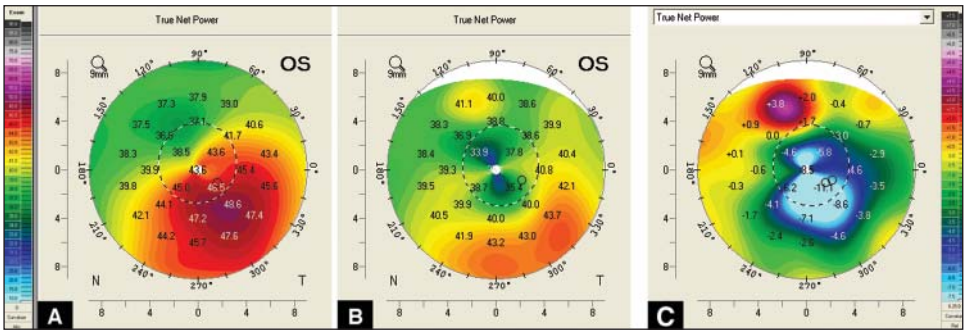

Figure 2. Scheimpflug analysis (true net power) of the **A)** anterior corneal surface of the left eye before and **B)** 3 weeks after CXL. **C)** The difference image shows a distinct decrease of maximum keratometry readings of up to 11.10 D.

20/100 to 20/32). Keratometry readings showed a maximal decrease of 11.10 diopters (D) (Fig 2).

DISCUSSION

The arrest of progressive keratoconus after CXL may be assessed when analyzing shape factors, keratoconus indices, keratometry values from Scheimpflug imaging, and by analyzing biomechanical properties, ie, with the Ocular Response Analyzer (ORA; Reichert Technologies, Depew, New York).[7,8] In general, the mechanism of flattening of the anterior corneal surface following CXL is poorly understood. Flattening after CXL is commonly observed and occurs with a mean of 2.68 D in approximately 60% of patients in the first year.[9,10] Others have reported massive flattening of >9.00 D in select cases.[11] The current report demonstrates significant flattening that has a direct morphological correlate: a paracentral scar due to a bacterial stromal infection in the early postoperative period.

The patient responded rapidly to therapy with ofloxacin drops, once they were initiated. An alternative would have been a second CXL procedure to reduce the microbial load and stop the infectious melting process.[12]

In an otherwise healthy eye, a paracentral scar usually represents a devastating complication that leads to a distinct decrease in CDVA, contrast sensitivity, and a reduction in the overall quality of the optical image. In the case of our patient, the massive flattening of the cornea induced by the scar led to a distinct increase in CDVA 3 weeks after CXL. The patient did not complain about increased halos and light scatter. Apparently, these relative disadvantages of the scar were far outweighed by the increase in CDVA in this highly irregular cornea. A remodeling process, once it is initiated, will continue over several months. We cannot exclude that a part of this flattening effect and thus, a part of the observed increase in visual acuity, would be reversed once the remodeling process was complete. However, the patient returned to his home country soon after the 3 week-control and could not be reached for long-term follow-up.

This case illustrates that with improved understanding of the eremodeling process following CXL will be beneficial for the visual rehabilitation of patients with keratoconus.

REFERENCES

1. Mangioris GF, Papadopoulou DN, Balidis MO, Poulas JL, Papadopoulos NT, Seiler T. Corneal infiltrates after corneal collagen cross-linking. *J Refract Surg.* 2010;26(8):609-611.
2. Pérez-Santonja JJ, Artola A, Javaloy J, Alió JL, Abad JL. Microbial keratitis after corneal collagen crosslinking. *J Cataract Refract Surg.* 2009;35(6):1138-1140.
3. Pollhammer M, Cursiefen C. Bacterial keratitis early after corneal crosslinking with riboflavin and ultraviolet-A. *J Cataract Refract Surg.* 2009;35(3):588-589.
4. Sharma N, Maharana P, Singh G, Titiyal JS. Pseudomonas keratitis after collagen crosslinking for keratoconus: case report and review of literature. *J Cataract Refract Surg.* 2010;36(3):517-520.
5. Zamora KV, Males JJ. Polymicrobial keratitis after a collagen cross-linking procedure with postoperative use of a contact lens: a case report. *Cornea.* 2009;28(4):474-476.
6. Seiler T, Hafezi F. Corneal cross-linking-induced stromal demarcation line. *Cornea.* 2006;25(9):1057-1059.
7. Koller T, Iseli HP, Hafezi F, Vinciguerra P, Seiler T. Scheimpflug imaging of corneas after collagen cross-linking. *Cornea.* 2009;28(5):510-515.
8. Vinciguerra P, Albé E, Mahmoud AM, Trazza S, Hafezi F, Roberts CJ. Intra- and postoperative variation in ocular response analyzer parameters in keratoconic eyes after corneal cross-linking. *J Refract Surg.* 2010;26(9):669-676.
9. Coskunseven E, Jankov MR II, Hafezi F. Contralateral eye study of corneal collagen cross-linking with riboflavin and UVA irradiation in patients with keratoconus. *J Refract Surg.* 2009;25(4):371-376.
10. Raiskup-Wolf F, Hoyer A, Spoerl E, Pillunat LE. Collagen cross-linking with riboflavin and ultraviolet-A light in keratoconus: long-term results. *J Cataract Refract Surg.* 2008;34(5):796-801.
11. Hafezi F, Koller T, Vinciguerra P, Seiler T. Marked remodelling of the anterior corneal surface following collagen cross-linking with riboflavin and UVA. *Br J Ophthalmol.* 2011;95(8):1171-1172.
12. Iseli HP, Thiel MA, Hafezi F, Kampmeier J, Seiler T. Ultraviolet A/riboflavin corneal cross-linking for infectious keratitis associated with corneal melts. *Cornea.* 2008;27(5):590-594.