



# Outcomes of corneal collagen cross linking prior to photorefractive keratectomy in prekeratoconus

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**Abstract:** The combination of corneal collagen cross linking (CXL) and refractive surgery, such as photorefractive keratectomy (PRK) has been studied extensively that it is important for visual function improvement. This combination might improve corneal stabilization and reshape the corneal tissue. The debating issue is regarding the appropriate timing between CXL and PRK combination surgery, whether it should be performed before or after surgery, as well as on the safety and efficacy of this combined surgery. The mechanism of CXL is believed when riboflavin as a photosensitizer is saturated on the cornea while exposed to ultraviolet irradiation, thus it is excited into an activate state that generating some reactive oxygen species. This processes lead to the formation of covalent bond between collagen molecules that increase the cornea biomechanics. Previous studies CXL followed by PRK removed the cross-linked stiffer anterior cornea. We assumed that our finding is important for the basis of further study.

**Keywords:** Corneal collagen cross linking (CXL); photorefractive keratectomy (PRK); combined surgery

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## Introduction

Corneal collagen cross linking (CXL) increases crosslink of corneal stroma which increases stiffness of the cornea and plays an effective role in the treatment of corneal infections, chemical burns, bullous keratopathy, and forms another corneal edema (1). Recently, CXL plays a role in the treatment of cases of keratoconus and post LASIK ectasia. Parameter of vision improvement, such as: keratometry, spherical euvalen, and corneal haze score was significantly better in patients with surgical treatment fotorefractive and combined with CXL (2).

CXL may prevent ectasia after corneal surgery and improve corneal stabilization in which the incidence of ectasia after LASIK (PLE) ranges from 0.66% (1). Factors that increase the risk of ectasia includes high myopia, thin corneas and lesser residual stromal. The improvement of CXL on post photorefractive keratectomy (PRK) ectasia occurs significantly in the first 3 months, stromal edema post PRT followed by a loss of keratinocytes in the first 4 to

6 weeks. This combination technique has shown effective to reduce the abnormality of posterior and central surface of the cornea (3).

## Case presentation

In this study, we reported 2 prekeratoconus patients who had undergone corneal-ectasia therapy with CXL and followed with PRK. Patient 1 was a 17-year-old girl with a history of frequent change of eyeglasses since 4 years ago. Right eye visual acuity was 6/20 cc S-0.75, C-5.0 ax 180 to 6/9 (max) and the left eye was 6/15 cc S-1.25 C-3.75 ax 5 to 6/9 (max). Physical examination showed Munson's sign, but no signs of Vogt, Fleischer and Rizzuti. Keratometry of the right eye K1/K2 =40.75/44.90, pachimetry =533, endothelial count =2,957 cells/mm<sup>2</sup> and videokeratograph showed irregular bowtie. In the left eye, it showed that keratometry K1/K2 =40.35/44.75, pachimetry =525, endothelial count =2,942 cells/mm<sup>2</sup> and videokeratograph showed irregular bowtie. Patient 2 was an 18-year-old boy

with a history of frequently change eyeglasses for the last 6 years. Right eye visual acuity was 4/60 cc S-3.25 C-5.0 ax 10 to 6/12 (max) and the left eye was 5/60 cc S-2.0 C-4.0 ax 160 to 6/9 (max). In both eyes, it showed positive Munson's sign, however no sign Vogt, Fleischer and Rizzuti. Keratometry of the right eye, K1/K2 =40.35/43.90, pachimetry =479, endothelial count =2,879 cells/mm<sup>2</sup> and videokeratograph showed irregular bowtie. In the left eye, keratometry K1/K2 =40.60/43.55, pachimetry =479, endothelial count =2,679 cells/mm<sup>2</sup> and videokeratografi showed irregular bowtie.

Both patients underwent CXL therapy prior to PRK (a month later). Patient 1 showed, after CXL, the right eye visual acuity 6/15 cc S-1.0 C-3.25-ax 180 to 6/7.5 and left eye was 6/15 cc S-1.0 C-4, 5 ax 5 to 6/6 and post PRK her both eyes vision improved to 6/6. Patient 2 showed, after CXL the right eye visual acuity was 6/20 cc S-1.0 C 3.25 ax C-10 to 6/7.5 and the left eye VA was 6/30 cc S-1.50, C-2.5 ax 160 to 6/6 and post PRK improved to 6/6. It showed that after the combination management CXL prior to PRK, there were improvements in visual acuity and presumably due to the changes in corneal biomechanics which was important to achieve optimal visual acuity (in the short-term evaluation). There were no complications and side effects after the procedures.

## Discussion

We used the standard protocol of Dresden with the applications of 0.1% riboflavin 5-phosphate and 20% dextran solution every 5 for 30 minutes and UVA radiation (370 nm, 3 mW/cm<sup>2</sup>) for 30 minutes interspersed with application solution every 5 minutes (4-10). Previous epi-on prospective study (on the 20 patients) showed a significant improvement in uncorrected visual acuity (UCVA), corrected visual acuity and keratometri and conical apex strength without progression of keratoconus (11). Buzzonetti & Petrocelli [2012] showed that after 18 months follow up on 13 different eye the visual acuity has improved but does not stop the progression of keratoconus (12). As in our cases, Epi-on CXL showed good clinical outcomes, reduce astigmatism and keratoconus with the improvement of BCVA (Best Corrected Visual Acuity) on a prospective study of 22 eyes (13). A study showed a method to increase the absorption of riboflavin by using riboflavin hyperosmolar solution and adding 0.44% NaCl (14). CXL that precedes PRK is that cornea that has undergone cross linking has more rigid biomechanics (15) and it has been developed as

Athens Protocol (2).

## Conclusions

Implementation CXL before PRK is believed as an intervention to strengthen the corneal tissue. We assumed that healthy and optimal stromal collagen matrix provides optimal results of PRK.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Informed Consent:* Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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