

Outcomes of Keratoconus Treated With Combination of Collagen Crosslinking, Conductive Keratoplasty, and Intrastromal Corneal Ring Segments

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Background & Purpose

Background: Corneal collagen crosslinking (CXL) may serve to arrest the progression of keratoconus by way of creating covalent bonds between stromal collagen fibrils. Whether or not CXL alone leads to improvement in topography or visual acuity remains investigational. The goal of combination treatment is to simultaneously promote long-term structural stability of an ectatic cornea while also reducing myopia, astigmatism, and higher order aberrations - thereby enhancing visual acuity.

Purpose: To evaluate the clinical outcomes of patients treated with concurrent epithelium-on CXL, conductive keratoplasty (CK), and Intacs intrastromal ring segments (Addition Technology, Fremont, CA) .

Methods

- ⊗ Single-centered, retrospective, comparative case series of patients from Minnesota Eye Consultants, Minneapolis, MN.
- ⊗ Inclusion criteria:
 - ⊗ Clinical diagnosis of mild to moderate keratoconus not previously treated
 - ⊗ Received combined treatment of epithelium-on collagen crosslinking (as part of CXL USA study), conductive keratoplasty, and Intacs intrastromal ring segments within a 1 week period.
- ⊗ Primary outcome measures included pre- and post-operative placido disc topography-derived maximum keratometry and uncorrected visual acuity. Scheimpflug based corneal topography was also analyzed but values were highly variable/inconsistent and are not reported herein.
- ⊗ Data were recorded at various time points following combined therapy including 3 months, 6 months, and 1 year following treatment.
- ⊗ Currently, 22 eyes of 20 patients have been identified for study.

Results

	(percentage, number)*
Age (mean)	37.2 yr (range: 16 to 64)
Female	23, 5
Treatment combination: CXL + CK + Intacs	100, 22
Time between CXL and CK/Intacs^{††} (mean)	0.9 days (range: 0 to 2)
Epithelium-on CXL	100, 22

Table 1. Demographic characteristics of keratoconus patients receiving crosslinking combination therapy. 22 eyes of 20 patients studied. *=unless otherwise noted. ††=CK and Intacs were performed on same day for all patients.

Results

	Mean	Standard Deviation
Maximum K (D)	51.1	6.2
Uncorrected Visual Acuity, LogMAR (Snellen)	1.165 (20/292)	0.61
Corrected Visual Acuity, LogMAR (Snellen)	0.462 (20/58)	0.47
Refractive Astigmatism (D)	5.15	2.34
Thinnest Pachymetry by Scheimpflug (nm)	440	59

Table 2. Pre-operative baseline clinical characteristics of patients receiving CXL combination therapy.

Results

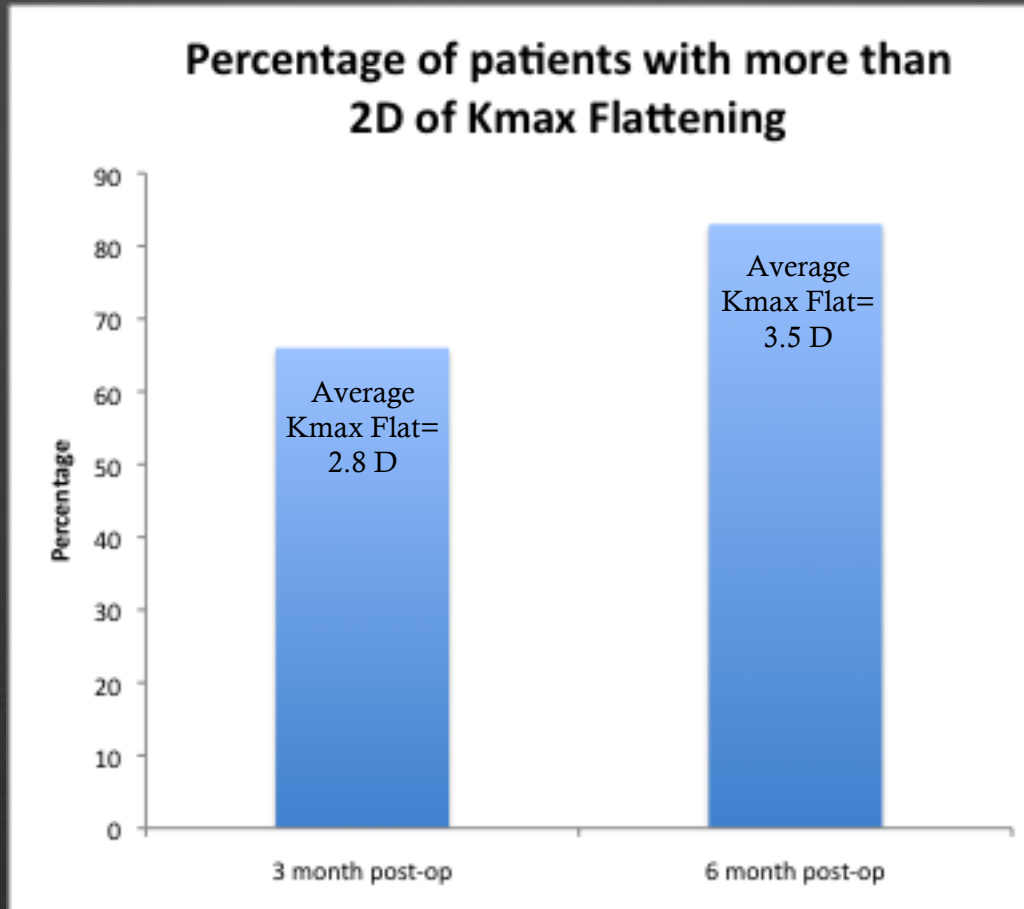


Figure 1. Following combination treatment with CXL, CK, and Intacs, the majority of patients experienced significant flattening of maximum keratometry (K max) measured by placido disc topography. A larger percentage of patients experienced flattening as more time elapsed. 45% of patients had more than one Diopter of flattening between months 3 and 6.

Results

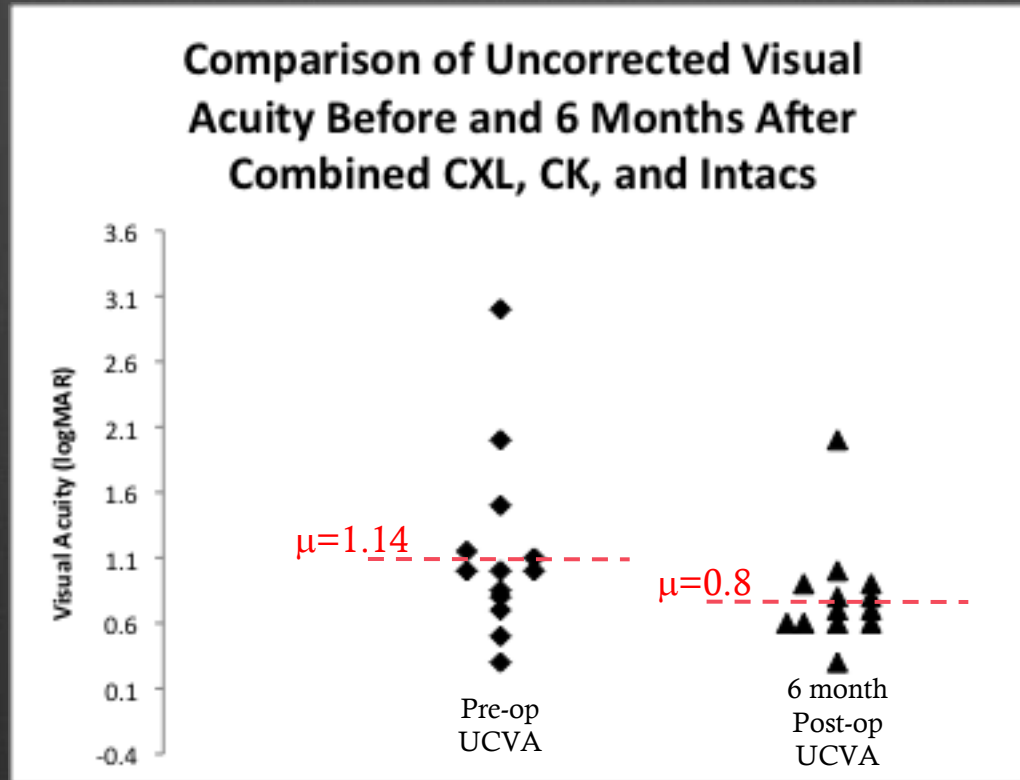


Figure 2. On average, there was a trend toward improved uncorrected visual acuity after combined CXL, CK, and Intacs. Paired, two-tailed t test with $p=0.09$. Uncorrected visual acuity improved at least 2 lines in 46% of patients.

Conclusions

- ⊗ Progressive topographic flattening occurs over the course of several months following combination treatment. Current data limited by 6 month follow-up.
- ⊗ Uncorrected visual acuity trends toward improvement after combined treatment of CXL, CK, and Intacs.
- ⊗ The amount of topographical flattening observed among our patients is comparable to prior studies describing Intacs alone. Whether or not the final amount of flattening with concurrent CXL and CK will prove to be greater has yet to be determined, and will be dictated by future results looking at 1 and 2 year data.
- ⊗ Aside from quantifiable flattening, we still recommend combination CXL treatment as it may help to promote more long-term structural stability of the beneficial refractive impacts of CK and Intacs.