Phototherapeutic keratectomy vs. mechanical epithelial removal followed by corneal collagen cross linking for keratoconus

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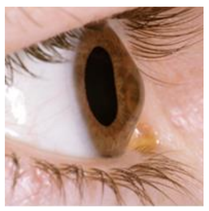
Introduction

Keratoconus is a non-inflammatory disorder of the eye characterized by progressive thinning of the corneal stroma. This affects the biomechanical stability of the cornea causing a gradual change of the corneal shape from a sphere to a cone. This abnormal corneal shape causes high myopia, irregular astigmatism and subsequent decrease in visual acuity[1].

Normal Cornea



Keratoconus

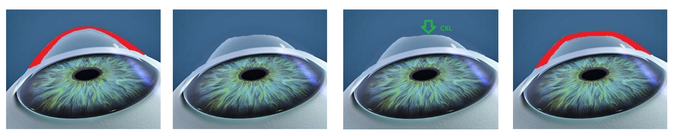
Vision with Keratoconus

Modified from Eye Care London

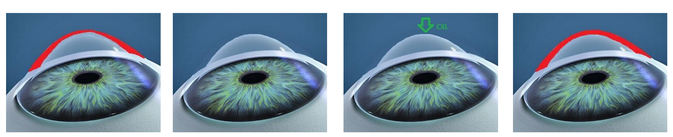
Corneal collagen cross-linking (CXL) is one of the most exciting surgical innovations of modern ophthalmology which addresses the corneal biomechanical weakening described in keratoconus. This minimally invasive treatment was developed to increase the biomechanical stability through the formation of cross-links between and within corneal collagen fibres induced by the photo-mediators riboflavin and UVA light.[2] Wollensak et al. were able to show that the interaction between these photo-mediators caused the formation of reactive oxygen species, which induced the formation of new covalent bonds, thereby strengthening the collagen matrix of the cornea.[3] They also demonstrated the importance of epithelial removal prior to CXL in order to achieve adequate stromal absorption of riboflavain which is of paramount importance to the efficacy of the cross-linking process.[4]

Traditionally, mechanical epithelial removal using an Amoils' brush or similar device has been used in CXL. Transepithelial phototherapeutic keratectomy (PTK) utilizes the excimer laser to remove the epithelium as well as smoothen out the irregular, anterior cornea.

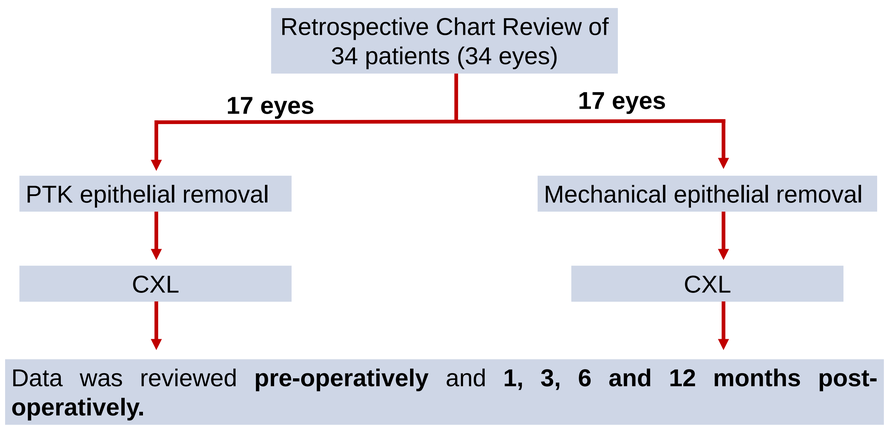
PTK



BRUSH

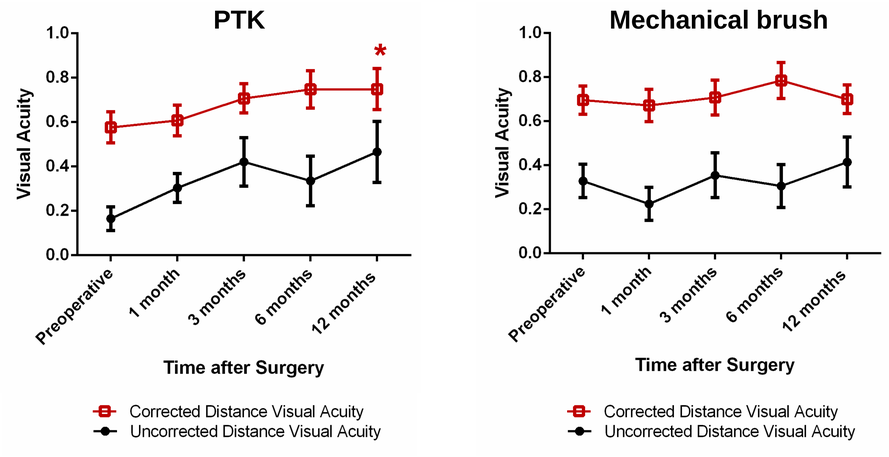


Methodology



Results

Visual Outcomes: The mean CDVA change in the PTK group at 12 months post-operatively is statistically significant.



Refractive Outcomes: Sphere, cylinder or MRSE are not statistically significant in either groups at longer time points of 3, 6 or 12 months post-operatively.

Mean change between the preoperative and the postoperative outcome measures for phototherapeutic keratectomy

	1 month post-operative	3 months post-operative	6 months post-operative	12 months post-operative
Sphere	0.27 ± 0.60	0.12 ± 0.54	0.25 ± 0.62	0.38 ± 0.48
Cylinder	0.53 ± 0.28*	-0.37 ± 0.36	-0.42 ± 0.55	-0.23 ± 0.82
MRSE	1.68 ± 0.80*	-0.07 ± 0.51	0.04 ± 0.65	0.25 ± 0.58

Mean change between the preoperative and the postoperative outcome measures for mechanical collagen crosslinking

	1 month post-operative	3 months post-operative	6 months post-operative	12 months post-operative
Sphere	0.045 ± 0.19	-0.06 ± 0.52	-0.29 ± 0.62	0.31 ± 0.48
Cylinder	0.00 ± 0.18	-0.19 ± 0.33	0.21 ± 0.55	-0.25 ± 0.82
MRSE	0.26 ± 0.90	-0.16 ± 0.50	-0.28 ± 0.65	0.19 ± 0.58

CDVA= corrected distance visual acuity expressed in decimals, MRSE= manifest refraction spherical equivalent. *Indicates statistically significant difference (p<0.05)

Discussion

Transepithelial PTK uses an excimer laser to smooth the anterior, irregular cornea as well as remove the epithelium.[5] In our 17 patients who received PTK CXL, 50µm PTK was used not only to remove the epithelium but to also ablate the apex of the cone where the epithelium is thinner. Normally, corneal epithelial thickness is approximately 50µm but it is thinner in the keratoconic eye.[6] Our results indicate that subjects who received laser epithelial removal had a trend towards a greater change in epithelial thickness than subjects who received brush removal. Furthermore, the amount of change in both groups is as expected; a mean change of 43.5µm for the 50µm PTK group and a mean change of 33.9µm for the mechanical group. Since keratoconic eyes have thinner epithelia, the laser must have removed stroma in addition to epithelium in the PTK group. Therefore, essentially a superficial keratectomy was performed reducing astigmatism and smoothing out the cornea.

The mean change in MRSE and astigmatism pre-operatively to one-month post-operatively was significantly better for the PTK group. However, this significant change in MRSE and astigmatism was not sustained at longer time points of 3, 6 or 12 months post-operatively. There was a trend for PTK CXL patients to have better visual outcomes, identifiable as early as one month post operatively. This improvement was statistically significant at 12 months post-operative. In the mechanical CXL group, there was also a tendency of CDVA improvement however this improvement did not attain significance at any of the time points studied.

Conclusion

Removal of corneal epithelium can be performed using mechanical or transepithelial PTK. One year results suggest better visual outcomes in the PTK group in comparison with the mechanical group.

References

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