Corneal Collagen Cross-linking for Keratoconic Cornea Pretreated With PRK

To the Editor:

We read the recent article by Tuwairqi and Sinjab,1 which appeared in the May 2012 issue of the Journal of Refractive Surgery, and would like to offer some comments.

Tuwairqi and Sinjab, in this prospective and noncontrolled study, performed corneal collagen cross-linking (CXL) in patients with stage 1 or 2 keratoconus pretreated with topography-guided photorefractive keratectomy (PRK) and demonstrated the improvements in visual acuity and refraction during 1-year follow-up. The aim of this combination, as the authors stated, was to remodel the irregular cornea and decrease the irregular astigmatism to enhance the final visual and refractive outcomes. In this context, the application of PRK is to reshape the irregular cornea while CXL is applied to arrest the progression of keratoconus. Questions therefore arise about whether PRK substantially influences the biomechanics of the keratoconic cornea, because both the Bowman layer and central anterior stroma, which are thought to be the strongest and the second strongest region of the cornea, respectively, are ablated in this combined procedure.

The biomechanical change in the keratoconic cornea is assumed to occur in the anterior rather than posterior cornea,3 which is evidenced by the achieved optimal outcomes of CXL as a result of the corneal stiffening in the anterior stroma in keratoconic eyes. This assumption can be further supported by modified transepithelial CXL where the formation of cross-links occurs in the upper third of the corneal stroma, 20 to 30 μm beneath Bowman layer, and the 20- to 30-μm-thick cross-links can serve to halt the progression of ectasia.4 Absence of the Bowman membrane and anterior corneal stroma may not elicit corneal ectasia in the normal cornea as seen in most PRK cases; however, there is no evidence that this is the case in the keratoconic cornea. Although significantly decreased keratometry reading was observed in this study, studies with larger sample size and longer follow-up are needed to further assess this combined procedure. Additionally, it is noted that mitomycin C was used to avoid haze formation in this study; its influence on the biomechanics of a keratoconic cornea, however, also needs evaluation. For the treatment of keratoconus, what should be preferentially considered is no elevated risk for disease progression rather than improvement in visual acuity.

Zhen-Yong Zhang, MD
Xing-Ru Zhang, MS
Shanghai, China

Reply:

Zhang and Zhang offered some comments regarding our study.1 First, they mentioned that the epithelial-on-technique halts the progression of ectasia cases and cited the work of Filippello et al.2 However, the study by Filippello et al has a major limitation similar to ours, which is 1-year follow-up. Therefore, the results of the mentioned reference cannot be adopted as an absolute fact, as further studies with larger numbers of patients followed for longer periods are needed. Second, other studies regarding transepithelial cross-linking (CXL) have shown that this procedure had a limited effect in comparison with traditional CXL,3 and per Caporossi et al, “according to limited penetration, its mid- to long-term efficacy needs to be determined in different clinical settings related to patient age and keratoconus progression.”

Waleed S. Tuwairqi, MD
Mazen M. Sinjab, MD, PhD
Al Riyadh, Saudi Arabia

The authors have no financial interest in the materials presented herein.

REFERENCES


Zhen-Yong Zhang, MD
Xing-Ru Zhang, MS
Shanghai, China

The authors have no financial interest in the materials presented herein.

REFERENCES

Stability of Epithelial Thickness During 5 Minutes Immersion in 33°C 0.9% Saline Using Very High-frequency Digital Ultrasound

Very high-frequency (VHF) digital ultrasound has been used to measure the corneal epithelium since 1993, with published studies reporting the epithelial thickness profile in normal eyes, keratoconic eyes, after myopic LASIK, hyperopic LASIK, radial keratotomy, intracorneal ring segments, and orthokeratology, as well as in cases of ectasia and in the evaluation of optical complications after corneal refractive surgery.

As VHF digital ultrasound measurements are obtained with the eye immersed in 0.9% NaCl solution at 33°C, changes in hydration of the corneal layers during immersion could potentially introduce error into the measurement. This possibility is often cited as a criticism of the technique and the validity of the epithelial thickness measurements has been queried. In our 2010 paper in which we reported the repeatability of layered corneal pachymetry with the Artemis VHF digital ultrasound arc-scanner (ArcScan Inc, Morrison, Colorado), we also reported that the corneal thickness was within 1.2 μm for 5 repeated measurements in 10 eyes over a period of 5 minutes. However, the same data for epithelial thickness were not included. Therefore, we would like to use this opportunity to report the longitudinal data for epithelial thickness from this same population to confirm the imperviousness of epithelial pachymetry to the immersion technique.

Figure 1 shows the mean and standard deviation of epithelial thickness for the five consecutive scan sets and Figure 2 shows the mean difference between the corneal vertex epithelial thickness of the first scan set and each of the four subsequent scan sets. All four scan sets after the first scan set were at least 0.22 μm thicker on average than the first scan set; however, repeated measures analysis of variance showed no statistically significant difference between any of the five scan sets (P = .722).

This finding is in agreement with early work by Maurice, who demonstrated that the epithelial thickness did not change for concentrations between 0.9% and 2.7% NaCl solution. Maurice also found that the permeability of the epithelium was affected by both the tonicity and the pH of the solution in which the cornea was immersed, demonstrating an increase in epithelial thickness for immersion in NaCl solution of <0.9%.

During routine scanning, Artemis three-dimensional layered pachymetry data are obtained within 3 minutes of immersion in 0.9% NaCl solution, thus we can expect epithelial thickness data obtained will be unaffected by the immersion technique. This supports the validity of studies in which Artemis VHF digital ultrasound epithelial thickness data were measured and reported.

Dan Z. Reinstein, MD, MA(Cantab), FRCS, FRCOphth
Timothy J. Archer, MA(Oxon), DipCompSci(Cantab)
Marine Gobbe, MST(Optom), PhD
London, United Kingdom
Dr Reinstein is a consultant for Carl Zeiss Meditec (Jena, Germany) and has a proprietary interest in the Artemis technology (ArcScan Inc, Morrison, Colorado) through patents administered by the Cornell Center for Technology Enterprise and Commercialization (CCTEC), Ithaca, New York. The remaining authors have no proprietary or financial interest in the materials presented herein.

REFERENCES

doi:10.3928/1081597X-20120815-03