Remodeling Effect of Cross-linking

To the Editor:

In the August 2009 issue of the Journal of Refractive Surgery, Tu and Aslanides\(^1\) reported eight patients with keratoconus who underwent corneal collagen cross-linking (CXL) with a mean follow-up of 7 months. Two patterns were identified according to distances from maximum anterior elevation to pupil and geometric center. The first group (pattern 1) included patients with more central cones and the second group (pattern 2) included patients with paracentral cones. The authors assumed that in the first group, CXL resulted in central flattening and paracentral steepening, whereas the second group had central steepening. These changes were thought to be related to anisotropy of collagen distribution.

Looking at the difference maps of the patients, most of the patients with pattern 2 showed similar flattening in the cone. Topographic changes were similar in both groups as the steep area flattened and the surrounding flat area steepened—we call this remodeling effect of the CXL (Fig).

In Figure 3, which demonstrated anterior elevation difference maps in eight eyes showing pattern 2 change, only the maps of the third and fourth eyes (left side of the figure) showed steepening in the cone area. Reasons for the steepening might be: 1) Continuous remodeling of the cornea after CXL. Steep keratometry increases in the first months after CXL and flattens later. Although the minimum follow-up was 5 months, remodeling could take longer. Here we should discuss if CXL treatment was effective or not. 2) Progression of keratoconus; however, usual progression is very slow.

Furthermore, more cases and longer follow-up are needed to discuss the refractive results between central and peripheral cones.

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Reply:

In our study,\(^1\) we visually identified two patterns from the Orbscan (Bausch & Lomb, Rochester, NY) anterior elevation (after and before cross-linking [CXL]) difference maps: one showing topographic/pupil area central flattening with paracentral steepening and the other showing topographic/pupil area steepening with paracentral flattening. We did not group the two patterns according to the distances from maximum anterior elevation to pupil and geometric centers.

We sought to determine what characteristics on the preoperative Orbscan anterior elevation maps might lead to which pattern of change. At this point, the distances were considered, suggesting that the first pattern is associated with cones with central cones, and the second pattern with cones that have paracentral cones. Next we looked at pre- and postoperative CXL comparative data on central topographic keratometry and refraction for each group. Our conclusion that anisotropy of collagen distribution being a factor in the outcome of CXL treatment for keratoconus is based on what we know from existing literature of corneal lamellar distribution and on the data we obtained.

Drs Orucov and Kaya pointed out that the cones flattened in most of the pattern 2 maps. A close reading of our article would reveal that it was never stated that the keratoconic cones flattened or steepened; we took care in saying central and paracentral flattening/steepening.

Some corneal remodeling occurs after CXL, and “steep areas flattening and surrounding flat areas steepening” is part of it, but by what mechanism does this process come about? Rather than just invoking collagen CXL of the corneal lamellae, we provided a probable mechanism that was also capable of explaining (and predicting) cases of keratoconus that resulted in more myopia after CXL.

As noted in our article, longer follow-up on more cases would reveal whether the identified patterns of
change persist (or whether all corneas flatten in the center over time).

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Preoperative Keratometry and Visual Outcomes After Hyperopic LASIK

To the Editor:

We would like to congratulate Young et al1 for their article investigating the relationship between preoperative keratometry and visual outcomes in hyperopic LASIK, which appeared in the supplement to the July 2009 issue of the Journal of Refractive Surgery. The cohort size of 2399 patients is remarkable and represents a wealth of effort and experience. Additionally, this is one of the first large studies to look at the question of whether steeper preoperative keratometry values are predictive of an increased risk of poor outcome. Studies of the effects of keratometry on hyperopic LASIK outcome have resulted in a wide range of conclusions in the published literature and the authors above have made a significant contribution to this important question. This large, retrospective study is thus a welcome and informative addition to the literature.

Despite the large scope of this work, some questions remain unanswered. In particular, Young et al did not address patient satisfaction with their retrospective approach and used 1-month follow-up. Young et al note that hyperopic LASIK takes longer to stabilize than myopic LASIK and that regression can lead to decreased visual acuity. Although visual acuity is used as a primary outcome, the 1-month follow-up time is insufficient to assess regression of visual acuity after LASIK. Thus, comparisons with the visual acuity outcome in the Williams et al2 study, which used 6-month follow-up to better assess regression, are limited. In addition, Williams et al found through patient questionnaires that patients with steep preoperative keratometry values reported increased dryness after LASIK and were less satisfied with the results of hyperopic LASIK. When investigating an elective procedure, such as LASIK, patient subjective perception of outcome must be taken into account along with the objective measures used by Young et al. The prospective methodology used by Williams et al also allowed for better monitoring of cohort selection and outcome measurements such as dry eye symptoms and patient satisfaction.

A study that could definitively address the question of whether preoperative keratometry is a predictor of hyperopic LASIK outcome is still needed. Such a study would likely require a prospective approach, at least 6-month follow-up, data on a variety of platforms, and should take into account both objective (visual acuity) and subjective (patient satisfaction) outcomes.

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