

Additional references are provided by the authors to support their claims. However, the Hashemi and Mehravaran study¹ reported results from only 23 subjects, which is likely underpowered to detect small changes in the posterior surface.² Ciolini and Belin³ investigated a larger dataset but reported a mean difference between preoperative and postoperative changes in the posterior surface without a statistical analysis, so the differences in the posterior surface that were measured are difficult to interpret. Both references reported a statistically significant difference between the 2 devices used to make the measurements. The authors also suggest that the statistically significant posterior surface steepening reported by Smadja et al.,⁴ which occurred in proportion to the amount of anterior tissue disruption during myopic LASIK and regressed during the 1 to 3 month postoperative interval, is "minute and clinically irrelevant." We disagree with this characterization of the conclusions since the study demonstrates with yet another imaging technology the tendency of photoablative severing of stromal lamellae to produce peripheral corneal thickening and central posterior surface steepening in the early postoperative period.

In conclusion, consistent changes to the posterior surface after refractive surgery have been reported with multiple tomographic devices, although the magnitude of the changes differs by device. These changes decrease over time and are associated with a normal postoperative outcome of a safe procedure. They are also consistent with our proposed biomechanical response to refractive surgery.⁵—*Cynthia J. Roberts, PhD, William J. Dupps Jr, MD, PhD*

Dr. Roberts is a consultant to Oculus Optikgeräte GmbH, Inc. and Ziemer Ophthalmic Systems AG and has received research funding from Carl Zeiss Meditec AG, as well as travel funds from Sofft Italia. Dr. Dupps is listed as an inventor on intellectual property held by Cleveland Clinic, Cleveland, Ohio, USA, related to biomechanical measurement and modeling and has received research funding and royalties related to the use of intellectual property from Avedro, Inc., Carl Zeiss Meditec AG, and Topcon Medical Systems, Inc. Dr. Dupps is a consultant to Ziemer Ophthalmic Systems AG and serves on the advisory board of Avedro, Inc.

REFERENCES

1. Hashemi H, Mehravaran S. Corneal changes after laser refractive surgery for myopia: comparison of Orbscan II and Pentacam findings. *J Cataract Refract Surg* 2007; 33:841–847
2. Wilhelmus KR. Beyond the *P*. III: possible insignificance of the nonsignificant *P* value. *J Cataract Refract Surg* 2004; 30:2425–2426
3. Ciolino JB, Belin MW. Changes in the posterior cornea after laser in situ keratomileusis and photorefractive keratectomy. *J Cataract Refract Surg* 2006; 32:1426–1431

4. Smadja D, Santhiago MR, Mello GR, Roberts CJ, Dupps WJ Jr, Krueger RR. Response of the posterior corneal surface to myopic laser in situ keratomileusis with different ablation depths. *J Cataract Refract Surg* 2012; 38:1222–1231
5. Dupps WJ Jr, Roberts C. Effect of acute biomechanical changes on corneal curvature after photokeratectomy. *J Refract Surg* 2001; 17:658–669

Effectiveness of corneal collagen crosslinking in vivo for corneal stiffening



Tomita et al.¹ investigated shorter duration ultraviolet light exposure in corneal collagen crosslinking (CXL) based on the assumption that higher power delivered over shorter time periods can provide the same corneal strengthening as lower power over longer time periods. The authors concluded that both techniques are effective, as no significant differences were observed in the measured parameters between the accelerated and conventional corneal CXL. However, regardless of the surgical protocol, no statistical difference between several biomechanical parameters could be recorded before and after CXL by 2 different instruments: the dynamic bidirectional applanation device (Ocular Response Analyzer, Reichert Technologies) and the dynamic Scheimpflug analyzer (Corvis ST, Oculus Optikgeräte GmbH). Similar results have been reported in recent publications in which no change in corneal biomechanical parameters indicative of corneal stiffening could be detected after CXL in patients with progressive keratoconus.^{2,3}

As the purported purpose of CXL is to increase the rigidity of the treated cornea by creating chemical bonds between collagen fibers, the lack of documented biomechanical improvement, as in the present study, should be regarded as ineffectiveness. Curvature changes, visual acuity, and topographic changes are secondary effects of what is primarily intended, which is a biomechanical effect of increased resistance. Hence, the absence of postoperative measureable corneal stiffening should logically lead to the conclusion that CXL is not effective on corneas with progressive keratoconus. One could argue the possibility that biomechanical changes induced by CXL are too subtle to be measured by clinically available diagnostic tools or have characteristics not measured well by these technologies. However, such a hypothesis should be verified in situations in which corneal stiffening and weakening are expected. The dynamic bidirectional applanation device and dynamic Scheimpflug analyzer instruments have demonstrated the capability to identify subtle biomechanical differences in untreated keratoconus corneas of different ectatic degree.^{4,5} The reduction in corneal hysteresis and resistance factor values after laser in situ keratomileusis and surface ablation has also been reported. This

strongly suggests that if CXL would significantly improve the biomechanics of the progressive keratoconus corneas (ie, stiffen the cornea), these instruments would be able to measure this change, unless it is suggested that this technique does not induce a simple reversal of the particular biomechanical deficits that characterize keratoconus.

The variation in keratometric readings and visual quality observed after CXL may be due to nonbiomechanical changes such as epithelial remodeling. The prevalent role of the epithelium in observed post-CXL changes is underlined by the fact that the effects of transepithelial CXL appear to be less pronounced than after CXL with deepithelialization, as reported in the literature.

The absence of measurable biomechanical change in living keratoconus corneas after CXL contrasts with the results of ex vivo experimentations, which show significant stiffening effects with standard and some modified CXL protocols, including evidence of increased elastic modulus and increased stiffness. This discrepancy could be due to the fact that CXL results in insignificant mechanical strengthening compared with the weakening caused by the preexisting alteration of the collagen structure. The disorganization of collagen fiber intertwining and compromised structural-mechanical homogeneity induced by the keratoconus disease may be too overwhelming in progressive keratoconus corneas to be improved by CXL in any of its current (ie, accelerated or conventional) in vivo modalities.

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REFERENCES

1. Tomita M, Mita M, Huseynova T. Accelerated versus conventional corneal collagen crosslinking. *J Cataract Refract Surg* 2014; 40:1013–1020
2. Bak-Nielsen S, Pedersen IB, Ivarsen A, Hjortdal J. Dynamic Scheimpflug-based assessment of keratoconus and the effects of corneal cross-linking. *J Refract Surg* 2014; 30:408–414
3. Goldich Y, Marcovich AL, Barkana Y, Mandel Y, Hirsh A, Morad Y, Avni I, Zadok D. Clinical and corneal biomechanical changes after collagen cross-linking with riboflavin and UV irradiation in patients with progressive keratoconus: results after 2 years of follow-up. *Cornea* 2012; 31:609–614
4. Saad A, Lteif Y, Azan E, Gatinel D. Biomechanical properties of keratoconus suspect eyes. *Invest Ophthalmol Vis Sci* 2010; 51:2912–2916. Available at: <http://www.iovs.org/content/51/6/2912.full.pdf>. Accessed August 15, 2014
5. Ali NQ, Patel DV, McGhee CNJ. Biomechanical responses of healthy and keratoconic corneas measured using a noncontact Scheimpflug-based tonometer. *Invest Ophthalmol Vis Sci* 2014; 55:3651–3659

Indirect evidence of cataract surgery in ancient Egypt



We believe that the article by Blomstedt¹ on cataract surgery in ancient Egypt needs some discussion. The majority of previous publications on this subject, not referenced by Blomstedt, report no direct evidence that cataract surgery was performed in ancient Egypt.^{2,3} On the other hand, at least some of the references cited in Blomstedt's paper¹ to show the opposite point of view are of low scientific value; for example, the article by Keeler et al. has no references and Osler's book contains no information about cataract surgery that we could identify.

Although there is little or no direct evidence of cataract surgery in ancient Egypt (which does not mean it was not performed), there is some indirect evidence. In 2001, near the Saqqara pyramid complex (built c.2630 BC) about 19 miles south of Cairo, archeologists discovered the tomb of Skar, the chief physician of one of Egypt's fifth dynasty rulers. Dating back more than 4000 years, this is the oldest known tomb of a Pharaonic surgeon. In the writing on the tomb walls



Figure 1. A: Wall painting in the tomb of the master builder Ipwy at Thebes (about 1200 BC) showing an oculist treating the eye of a workman. B: Illustration of an ocular surgical procedure using a long, sharp instrument. Taken from the late 12th century Anglo-Norman illuminated manuscript entitled *Practica Chirurgiae* (The Practice of Surgery), also called *Chirurgiae Magistri Rogerii* (The Surgery of Master Rogerius), by Roger Frugard of Salerno (c.1140–1195) (British Library, London, United Kingdom).