TRANSEPITHELIAL PRK CORRECTIONS


An update on efforts to improve the safety and efficacy of laser vision correction.

BY DAVID T.C. LIN, MD; AND SAMUEL ARBA MOSQUERA, PHD

CHANGES IN BIOMECHANICALLY CORRECTED INTRAOCULAR PRESSURE AND DYNAMIC CORNEAL RESPONSE PARAMETERS BEFORE AND AFTER TRANSEPITHELIAL PHOTOREFRACTIVE KERATECTOMY AND FEMTOSECOND LASER-ASSISTED LASER IN SITU KERATOMILEUSIS

Lee H, Roberts CJ, Kim TI, et al[1]

ABSTRACT SUMMARY

Lee and colleagues evaluated changes in biomechanically corrected IOP and new dynamic corneal response parameters, as measured by a dynamic Scheimpflug analyzer before and after transepithelial PRK (transPRK) and femtosecond laser-assisted LASIK. The investigators collected data from 129 normal healthy participants (129 eyes) who were 20 to 41 years of age.

There were no significant differences in preoperative dynamic corneal response parameters between the two groups. The differences between preoperative and postoperative parameter values were significant in both groups (all $P < .001$). Postoperative changes in deformation amplitude (DA) ratio 2.0 mm and integrated inverse radius were significantly smaller with transPRK than with femtosecond laser-assisted LASIK (all $P < .001$). The results were confirmed when other variables were taken as covariates.

STUDY IN BRIEF

- A small study assessed changes in biomechanically corrected IOP and new dynamic corneal response parameters before and after transepithelial PRK (transPRK) and femtosecond laser-assisted LASIK. A dynamic Scheimpflug analyzer showed stable biomechanically corrected IOP measurement before and after surgery. Changes in dynamic corneal response parameters were smaller with transPRK than with femtosecond laser-assisted LASIK, indicating a smaller biomechanical effect with transPRK.

WHY IT MATTERS

Ophthalmologists continually seek to improve the safety (risk of ectasia) and efficacy (uncorrected distance visual acuity and corrected distance visual acuity) of laser vision correction. No clear treatment algorithm exists, despite the development of many different procedures and techniques with or without wavefront- or topography-guided ablation. This study showed that corneas were less resistant to deformation after femtosecond laser-assisted LASIK than after transPRK.

DISCUSSION

Biomechanical response parameters of the cornea might be useful for characterizing susceptibility to ectatic progression and predicting refractive outcomes after corneal refractive surgery.[2]

An earlier study by Shen and colleagues evaluated differences in corneal deformation parameters after small-incision lenticule extraction, laser-assisted subepithelial keratectomy (LASEK), and femtosecond laser-assisted LASIK. The investigators adjusted for age, preoperative central corneal thickness, and manifest refraction spherical equivalent. They found that postoperative DA with femtosecond laser-assisted LASIK was significantly higher than with LASEK.[3]

In this study by Lee and colleagues, after adjustment for changes in refractive error, changes in DA ratio 2.0 mm, corneal thickness, or corneal volume were significantly smaller after transPRK than after femtosecond laser-assisted LASIK. Considering that DA ratio 2.0 mm represents the ratio between DA at the apex and the average of two points located 2 mm on either side of the apex, the results reported by Lee and colleagues are in line with those reported by Shen and colleagues. Both studies indicate that corneas were less resistant to deformation after femtosecond laser-assisted LASIK than after surface ablation procedures such as PRK and LASEK.

The major biomechanical effect of laser vision surgery is the amount of tissue removed to change refraction,

which is similar in transPRK and femtosecond laser-assisted LASIK when the intended correction is similar. This concept is supported by the reported preoperative to postoperative changes. The difference in the impact of tissue removed from the surface versus under a LASIK flap is secondary and smaller. The study by Lee and colleagues suggested that surface ablation has the smallest additional effect on corneal biomechanics, consistent with the literature and evidenced by smaller changes in DA ratio 2.0 mm and integrated inverse radius.

Most notably, corneal structural integrity is affected less by transPRK than by femtosecond laser-assisted LASIK, likely because of the additional effect of the flap.

TRANS ADVANCED SURFACE LASER ABLATION (TRANSPRK) OUTCOMES USING SMARTPULSETECHNOLOGY

Aslanides IM, Kymionis GD[4]

ABSTRACT SUMMARY

Aslanides and Kymionis evaluated early visual rehabilitation, including postoperative pain, epithelial healing, and haze, after transPRK using SmartPulseTechnology (SPT; Schwind Amaris, Schwind Eye-Tech-Solutions; not available in the United States). This study retrospectively compared a cohort of myopic patients undergoing transPRK with SPT to one matched control group of patients who underwent conventional transPRK. All patients completed 6 months of postoperative follow-up, including visual acuity and slit-lamp examination. Subjective evaluation of pain was recorded postoperatively. This study enrolled 49 eyes of 25 patients in the SPT group and 40 eyes of 20 patients in the control group.

On postoperative day 1, uncorrected distance visual acuity of 20/40 or better was achieved in 56% of SPT eyes and 14% of control eyes ($P < .05$). A distinctive difference between the two groups was a mean difference of 5 Snellen lines of uncorrected distance visual acuity ($P < .05$) 7 days after surgery. From 1 month after treatment onward, this difference was not significant.

The epithelial defect size was significantly smaller on postoperative days 1 and 2 for the SPT group (8.6 vs 12.3 mm^2 and 0.73 vs 1.89 mm^2, respectively; $P < .05$ in both cases). Re-epithelialization was complete by 3 days after surgery in all eyes.

The mean pain score was consistently lower in SPT patients compared to controls (2.1 vs 3.0 on the operative day, respectively; 1.0 vs 1.8 on postoperative day 1; 0.1 vs 0.8 on postoperative day 2; all $P < .05$).

STUDY IN BRIEF

- Investigators evaluated the 6-month outcomes of transPRK using SmartPulseTechnology. The results of this retrospective case-matched series suggest that using this technique to smooth the stromal bed can significantly improve uncorrected and corrected distance visual acuity in the early postoperative period.

WHY IT MATTERS

Improving postoperative corneal smoothness appears to accelerate visual recovery.

DISCUSSION

Performing laser vision correction without manual, chemical, or mechanical removal of the epithelium is a subject of renewed interest, but short-term results with transPRK approaches have not been comparable to LASIK results. That said, LASIK can increase the risk of postoperative ectasia, and ocular trauma after LASIK may lead to flap dislocation. Moreover, surface ablation avoids flap complications related to epithelial basement dystrophy.

Compared to the control group treated with transPRK without SPT, patients who received transPRK using SPT had smoother residual stromal beds and more transparent corneas immediately after ablation. In 1998, Vinciguerra and colleagues described the importance of a smooth stromal bed after surgery. Specifically, they studied the decrease in stromal irregularity when smoothing phototherapeutic keratectomy was performed immediately after PRK or LASIK.[5] A rabbit study by Netto and colleagues supported these findings. They reported a strong relationship between the formation (and severity) of corneal haze after PRK and stromal irregularities.[6]

This study by Aslanides and Kymionis showed encouraging results with SPT in the early postoperative period. Both visual recovery and the re-epithelialization rate were significantly shorter in SPT-treated eyes, contributing to a reduction in postoperative inflammation. In addition, postoperative pain was significantly less in SPT-treated eyes.

Longer recovery, worse short-term visual acuity, and initially hazy vision are often cited as drawbacks of surface ablation compared to LASIK. In this study, transPRK with SPT achieved good visual acuity immediately after treatment. The SPT algorithm seemed to significantly accelerate healing and visual rehabilitation compared to conventional transPRK treatment. ■

1. Lee H, Roberts CJ, Kim TI, et al. Changes in biomechanically corrected intraocular pressure and dynamic corneal response parameters before and after transepithelial photorefractive keratectomy and femtosecond laser-assisted laser in situ keratomileusis. *J Cataract Refract Surg*. 2017;43(12):1495-1503.
2. Ambrósio R Jr, Lopes B, Faria-Correia F, et al. Ectasia detection by the assessment of corneal biomechanics. *Cornea*. 2016;35(7):e18-20.
3. Shen Y, Chen Z, Knorz MC, et al. Comparison of corneal deformation parameters after SMILE, LASEK, and femtosecond laser-assisted LASIK. *J Refract Surg*. 2014;30(5):310-318.
4. Aslanides IM, Kymionis GD. Trans advanced surface laser ablation (TransPRK) outcomes using SmartPulseTechnology. *Cont Lens Anterior Eye*. 2017;40(1):42-46.
5. Vinciguerra P, Azzolini M, Airaghi P, et al. Effect of decreasing surface and interface irregularities after photorefractive keratectomy and laser in situ keratomileusis on optical and functional outcomes. *J Refract Surg*. 1998;14(2 suppl):S199-203.
6. Netto MV, Mohan RR, Sinha S, et al. Stromal haze, myofibroblasts, and surface irregularity after PRK. *Exp Eye Res*. 2006;82(5):788-797.

SECTION EDITOR **EDWARD MANCHE, MD**
- Director of Cornea and Refractive Surgery, Stanford Laser Eye Center, Stanford, California
- Professor of Ophthalmology, Stanford University School of Medicine, Stanford, California
- edward.manche@stanford.edu
- Financial disclosure: None

DAVID T.C. LIN, MD
- Medical Director, Pacific Laser Eye Centre, Vancouver, Canada
- Clinical Associate Professor, Department of Ophthalmology, The University of British Columbia, Vancouver and Kelowna, Canada
- davlintc@gmail.com
- Financial disclosure: Consultant (Schwind Eye-Tech-Solutions)

SAMUEL ARBA MOSQUERA, PHD
- Optical and Visual Researcher, Schwind Eye-Tech-Solutions
- samuel.arba.mosquera@eye-tech.net
- Financial disclosure: None