Topography-Guided PRK

The most common indications for this procedure are keratoconus, pellucid marginal degeneration, and post-LASIK ectasia.

BY RAYMOND STEIN, MD, FRCSC

Topography-guided PRK (TG-PRK) is a therapeutic breakthrough that allows surgeons to reduce irregular astigmatism and improve BCVA.[1,2] The procedure uses a customized excimer laser treatment guided by a topographic map. Preoperatively, multiple consecutive maps are obtained, and this information is transferred to an excimer laser. A sophisticated algorithm interprets the data and constructs a laser ablation pattern with a number of parameters that can be modified. They include adjusting optical zones, changing depth of treatment, and adding a refractive correction (sphere, cylinder, and axis) centered over the line of sight.

It is important to understand that TG-PRK is done primarily to reduce irregular astigmatism and not necessarily to improve UCVA. The laser treatment typically involves selected areas of myopic and hyperopic ablations that can have a therapeutic effect by regularizing the corneal surface. In a variety of challenging cases, this valuable surgical treatment helps to improve BCVA and/or quality of vision. They include

- keratoconus, pellucid marginal degeneration, and ecastia
- post-LASIK or PRK complications such as a central island, decentered ablation, small optical zone, or induced irregular astigmatism
- after radial keratotomy (RK)
- other causes of irregular astigmatism such as penetrating keratoplasty, lamellar keratoplasty, arcuate relaxing incisions, and corneal scars

KERATOCONUS, PELLUCID MARGINAL DEGENERATION, OR ECTASIA

TG-PRK in combination with corneal collagen cross-linking (CXL; not approved in the United States) appears to offer the best chance at reducing irregular astigmatism (Figure 1). Although CXL alone can decrease irregular astigmatism and improve BCVA, combining this procedure with TG-PRK can enhance the results. CXL is performed alone primarily to prevent progressive ectasia. However, TG-PRK can be offered to patients of almost any age, including those older than 40 years with stable keratoconus, to enhance vision with glasses or soft contact lenses.

Consecutive topographic images are transferred to the excimer laser. The surgical team reviews the images and discards any outliers. The software on the Allegretto Wave Eye-Q excimer laser system (Alcon) calculates a treatment pattern displayed in color. The goal of treatment is to flatten the steepest part of the cornea and to steepen the flattest area of the cornea. Essentially, in a typical keratoconic eye with inferior steepening, a myopic treatment is performed over the cone, and a hyperopic treatment is performed superiorly. Patients who benefit the most from this treatment have a dioptric difference across their corneas of 10.00 D or less. This results in a myopic treatment of 5.00 D or less and a hyperopic treatment of 5.00 D or less.

The corneal epithelium is removed using a 50-µm phototherapeutic keratectomy with a 6.5-mm optical zone and a transition zone to 8.3 mm. The stromal laser ablation is typically limited to 50 µm so as to allow a satisfactory residual thickness for the CXL procedure. My colleagues and I have found that larger optical zones of 6 or 6.5 mm are more effective at reducing irregular astigmatism. This is probably secondary to a more stable laser ablation similar to what we have observed over the years with standard PRK treatments.

After the laser ablation, we apply ice to the cornea using frozen BSS (Alcon) on a sponge (ie, the "popsicle" technique) for 10 seconds. In our experience, this step significantly reduces patients' postoperative pain. We then apply a disc soaked in mitomcyin C for 60 seconds, which, in our experience, decreases the incidence of postoperative corneal haze. We use BSS to irrigate the mitomycin C from the surface of the eye. The CXL procedure is then performed according to the Athens Protocol.[3] Eye drops are instilled (steroid, non-steroidal anti-inflammatory drug, and an antibiotic), and then a bandage soft contact lens is placed. The bandage soft contact lens is typically removed on the fifth post-operative day.

We find that the achievement of BCVA is similar to after PRK without CXL; the process may take up to 6 months to permit complete epithelial maturation. The epithelial cells undergo hyperplasia and hypoplasia to further smooth the corneal surface, which improves BCVA and quality of vision. The healing response is very similar to that seen after standard PRK.

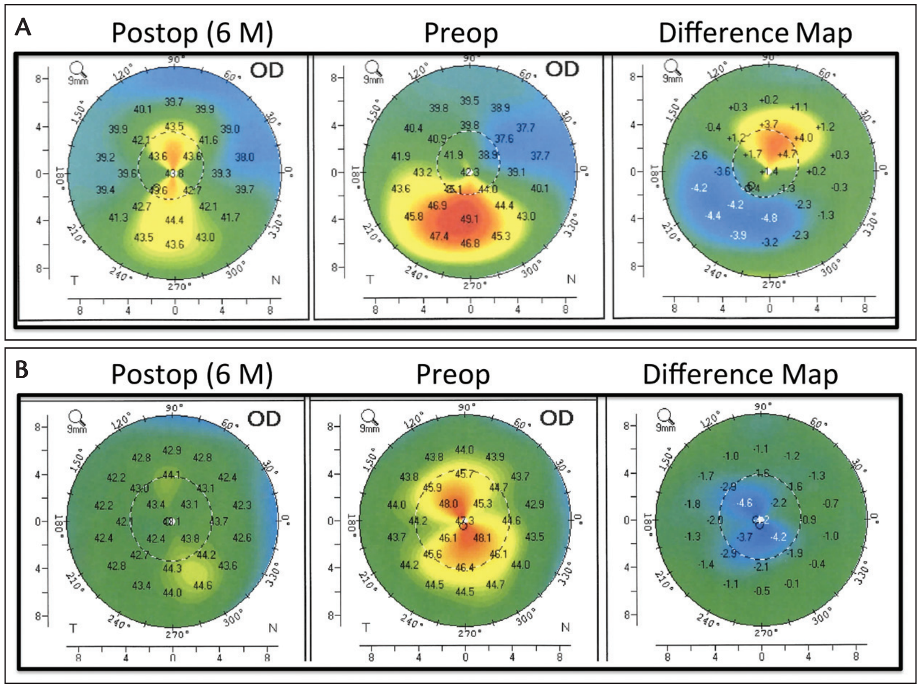

Figure 1. Keratoconic eye with inferior steepening treated with TG-PRK and CXL. Postoperative map shows a more regular pattern of astigmatism, accounting for the improvement in BCVA from 20/80 to 20/25 (A). Keratoconic eye with central corneal steepening treated with TG-PRK and CXL. Postoperative map shows central flattening with a reduction in irregular astigmatism and a resultant improvement in BCVA from 20/60 to 20/25 (B).

AFTER RK

Patients with irregular astigmatism or a small optical zone after RK can benefit from TG-PRK. In addition, prior to cataract surgery, TG-PRK can enhance the corneal contour of post-RK eyes, which can improve the quality of vision after cataract surgery. In our experience, the success of CXL at decreasing diurnal fluctuations in vision has been highly variable, especially in eyes with eight or more RK incisions. We tend to perform TG-PRK only without CXL in RK eyes.

AFTER LASIK OR PRK

Complicated eyes with stable corneas after LASIK or PRK may benefit from a TG-PRK treatment. Complications addressed include a central island, decentered ablation, small optical zone, or irregular astigmatism. TG-PRK can reduce the irregular astigmatism and/or enlarge an optical zone to improve either BCVA or quality of vision. It is important to recognize that UCVA may be reduced to improve the quality of vision. Patients may require a secondary refractive correction to improve their UCVA.

OTHER CONDITIONS

TG-PRK may be used for a variety of other causes of irregular astigmatism such as after penetrating keratoplasty, lamellar keratoplasty, arcuate relaxing incisions, and corneal scars. Every case must be considered individually to determine the risks and benefits of treatment.

CAUTION IN INTERPRETING TOPOGRAPHIC MAPS

Numerous epithelial conditions can masquerade on topography as keratoconus or other forms of irregular astigmatism. A diagnosis of irregular astigmatism requires both a careful slit-lamp examination and computerized topography or tomography. Epithelial conditions that can cause irregular corneas include epithelial basement membrane dystrophy, superficial punctate keratopathy, Salzmann nodular degeneration, and amiodarone

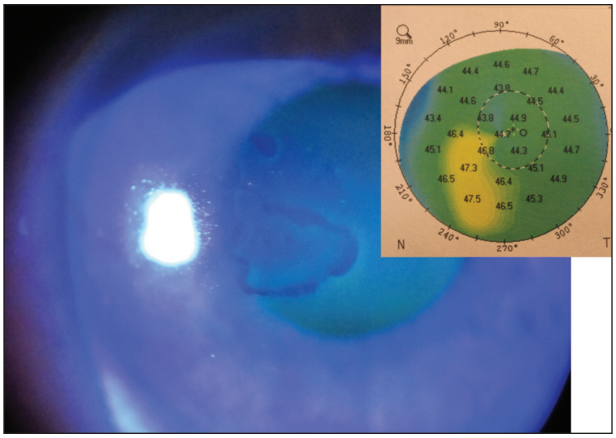

Figure 2. This patient presented with a decrease in BCVA and topography suggestive of keratoconus. A slit-lamp examination showed evidence of epithelial basement membrane dystrophy, accounting for the pseudokeratoconic topographic pattern.

keratopathy. TG-PRK is not indicated in these conditions. Pseudokeratoconus can be seen on topography secondary to epithelial basement membrane dystrophy (Figure 2). The treatment of choice in this situation is a mechanical epithelial debridement and not TG-PRK.

SUMMARY

TG-PRK allows for the reduction of irregular astigmatism and/or enhanced quality of vision. The most common indications are keratoconus, pellucid marginal degeneration, and post-LASIK ectasia. The TG-PRK treatment for these conditions is combined with CXL. Indications for TG-PRK alone include complications after LASIK or PRK and post-RK eyes. The applications of TG-PRK are expanding to include other causes of irregular astigmatism. Surgeons need to be cautious in interpreting corneal topographic maps to rule out epithelial causes of astigmatism that may be better managed with epithelial debridement and/or lubricating drops than TG-PRK. ■

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