Differences in Toric Lens Performance:

Lens Orientation and Orientation Recovery

Gerard Cairns PhD MCOptom FAAO, Paul China OD BS, Tim Green MS, Bill Reindel OD MS.
Bausch & Lomb, Incorporated, Rochester, NY

Introduction

Orientational stability is fundamental to providing clear, stable vision for toric contact lens wearers. Toric contact lenses are therefore designed with ballasted geometries which are intended to stabilize the lens on the eye. Two designs currently available utilize either a uniformly increasing thickness gradient from the superior portion of the lens to the inferior portion of the lens (Lo-Torque®) or dual thickness regions either side of the optic zone (Accelerated Stabilization Design (ASD)). The purpose of this evaluation was to conduct two clinical studies to assess the orientational stability of these two toric lens design geometries.

Methods

In each of the two studies, 32 healthy subjects were randomly assigned a power/axis-matched Test and Control lens pairing on each eye. There were a total of eight power/axis combinations over a diverse range of powers. The lens powers used were -1.00D and -5.00D spherical power, each with -0.75D and -2.25D cylinder power at 90° and 180° axes.

The two studies compared the Lo-Torque design of PureVision Toric (PVT) to the Accelerated Stabilization Designs of Acuvue Advance for Astigmatism (AA) and Acuvue Oasys for Astigmatism (OA). The power/axis-matched Test and Control lenses were inserted in random order onto the subject's eye and were given 3 minutes to settle. After this time, the lens fit was evaluated for movement and centration. Additionally, the Primary Gaze Orientation (PGO) of the lenses were assessed using the slit lamp reticule marked in 5° increments.

Orientation Recovery (OR) was assessed 1 minute after the lens was mis-orientated 45° temporally from PGO. OR was taken as the absolute angular difference between the PGO and the recovered position.

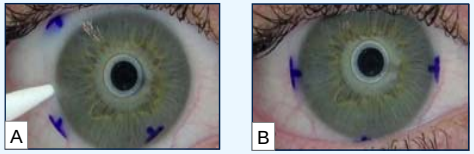


Figure1. A) For assessment of rotation recovery, the lens was manually rotated temporally by 45° using a surgical sponge. B) A lens demonstrates good rotational recovery when it returns to the primary gaze position within 1 minute. Note: These images are for demonstration only. Study lenses were not marked or photographed.

Results

There was no statistically significant difference between PVT and AA with respect to mean movement (PVT = 0.17mm; AA = 0.15mm; ANOVA, $p>0.05$). There was a statistically significant difference between PVT and AO for movement, (PVT = 0.15mm; AA = 0.20mm; ANOVA, $p<0.05$). There was no statistically significant difference between PVT and AA or AO with respect to mean horizontal decentration (ANOVA, $p>0.05$).

The mean (+/-SD) absolute PGO and OR values for the
study of PVT and AA lenses are presented in Table 1. The mean (+/-SD) absolute PGO and OR values for the study of PVT and AO lenses are presented in Table 2. All PGO means were significantly different from a 0° PGO position (T-test; $p<0.05$).

There was a statistically significant difference in favor of the PVT lens in both studies for OR (T-test; $p<0.05$ in all cases). Furthermore, in both studies there was significantly greater consistency of recovery with PVT (Levene's Homogeneity of Variance Test; $p<0.05$ in all cases) and the proportion of lenses that returned to within 10° of PGO was significantly greater for the PVT lens (χ^2 Test $p<0.05$ in all cases) (Figure 2).

Study #1	n	Mean (°)	Std Dev (°)	Range (°)
PGO AA	64	7.2	8.9	0 - 45
PGO PVT	64	11.6	9.4	0 - 45
OR AA	64	10.7	13.5	0 - 70
OR PVT	64	5.8	7.3	0 - 30

Table 1. Rotational stability results from the study comparing PVT and AA lenses. Values reported are absolute.

Study #2	n	Mean (°)	Std Dev (°)	Range (°)
PGO AO	64	9.0	9.3	0 - 45
PGO PVT	64	10.6	10.0	0 - 45
OR AO	64	7.7	7.8	0 - 35
OR PVT	64	4.3	4.3	0 - 20

Table 2. Rotational stability results from the study comparing PVT and AO lenses. Values reported are absolute.

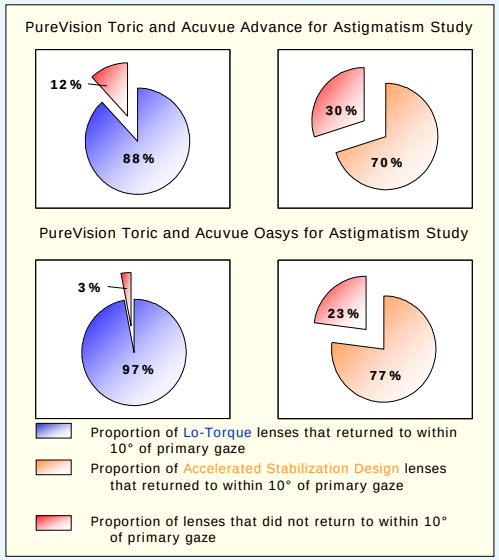
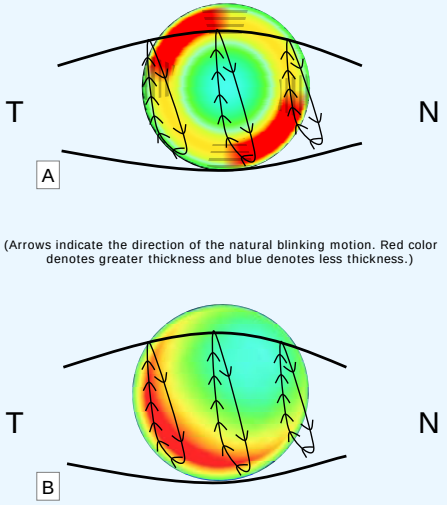


Figure 2. Proportions of lenses returning to within 10° of primary gaze orientation within 1 minute.

Conclusion

While Primary Gaze Orientation for Lo-Torque and ASD designs were similar, differences in Orientation Recovery were significant. Mis-rotation of the ASD design, that could occur for a variety of reasons, appears to reduce the effectiveness of the stability mechanism resulting in the slower recovery. The interaction of lid and blink force with the lens ballast geometry may account for these differences, Figure 3.



(Arrows indicate the direction of the natural blinking motion. Red color denotes greater thickness and blue denotes less thickness.)

Figure 3. Schematic of rotated lens design interaction with eyelids. A) Dual thickness design. B) Vertical thickness tapered design. Note: These images are for demonstration only and may not represent the actual thickness profiles of the study lenses.

A greater portion of ASD lenses, did not re-orientate within 10° of PGO within 60 seconds. This sizable misalignment of toric optics, and the resulting residual astigmatism, can have a significant effect on vision.

Continued work related to the lid force and lens designs interactions should further define the factors that contributed to the Lo-Torque design demonstrating a greater propensity to return the lens to its original position.

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