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Comparison of fitting stability of the different soft toric contact lenses

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ABSTRACT

Purpose: To compare lens orientation and rotational recovery of five currently available soft toric lenses.
Methods: Twenty subjects were recruited and trialed with each of the study lenses in a random order. Study lenses were PureVision® Toric (B&L), Air Optix® for Astigmatism (Alcon), Biofinity® Toric (CooperVision), Acuvue® Advance for Astigmatism (Vistakon), and Proclear® Toric (CooperVision). Lens orientation in primary position to determine the lens rotation form the vertical position and rotational recovery to primary gaze orientation following a 45° manual misorientation for the different lenses was compared.
Results: The Biofinity Toric showed the lowest rotation from the vertical position and the Proclear Toric the highest. Also, the highest and the lowest reorientation speed were related to the Biofinity Toric and the Acuvue Advance for Astigmatism, respectively. The Repeated Measures ANOVA showed a significant difference in the lens rotation ($P = 0.004$) and rotational recovery ($P < 0.001$) among different contact lenses and the performed multiple comparisons indicated differences in rotation and also in reorientation speed were only seen between the Biofinity Toric when compared to four other lenses ($P < 0.05$).
Conclusion: Although there was appropriate fitting, based upon lens orientation and reorientation speed, with each of the study lenses it would appear that the optimized ballast technique used in the design of the Biofinity Toric helps reduce lens rotation and improve rotational recovery compared to others.

1. Introduction

Approximately 50% of patients have significant astigmatism (≥0.75DC) [1] and about one-third of contact lens patients need astigmatic correction. These patients are sometimes fitted with spherical lenses, resulting in less than optimal vision correction, so toric soft contact lenses can use as a corrective option in this group of patients [2].

Factors influencing toric soft contact lenses fit can be split into patient related factors and the contact lens related ones. The patient related factors can include palpebral aperture, lids position, lid tightness, inter-canthal angle, refractive errors, horizontal visible iris diameter and corneal topography. The factors related to the contact lens include fitting profile (optimal, steep, flat), lens movement after blink, lens modulus and toric soft lens stabilization design [3,4].

Although many advances have been made in toric contact lens development, lens rotation continues to affect vision and can occur when the patient blinks or rubs their eyes. Stabilization techniques used in the design of the toric soft lens rely on the interaction between lids and the lens to achieve stabilization and resultantly the lens axis coincide as much as possible to the axis of astigmatism of the eye and the lens rotation minimize post-blinking [5,6]. These designs include two commonly used methods; Prism-ballasted design that involve interaction primarily from the upper lid and Non prism-ballasted design which both eyelids play an active role in stabilization [6,7].

The stabilization methods used in some of the toric soft contact lenses are: prism ballast (Pure Vision Toric), precision balance (Air Optix for astigmatism), prism ballast (Proclear Toric), optimized ballast design or equi ballast design or horizontal iso-thickness design (Biofinity Toric), accelerated stabilization design (ASD) (Acuvue Advance for Astigmatism) [8]. The first four lenses have prism stabilized designs, two of which (Air Optix for Astigmatism (Alcon) and Biofinity Toric (CooperVision)) incorporate modifications to

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avoid interaction with the bottom lid. The other lens has a dual-thin design with centrally placed stabilization zones [8]. This study was designed to compare lens orientation and rotational recovery of five currently available soft toric lenses.

2. Methods

In this study, participants were 20 students of Zahedan University of Medical Sciences (mean age of 21.4 ± 2.0 years) who were experienced soft contact lens wearers.

The nature, purposes and methods of this research work were clearly explained to the participants in advance, and their voluntary cooperation and informed consent was obtained from all participants. The study was conducted in accordance with the tenets of the Declaration of Helsinki. The study was approved by the University ethics committee.

Those who met inclusion criteria were entered into the study. The inclusion criteria included:

- Experienced soft contact lens wearers.
- Normal tear quality and quantity. Tears were assessed with Tear Break-Up Time (TBUT) (normal results: 15 s or greater [9]) and tear prism height (normal results: 0.2–0.4 mm at the center [9]).
- No corneal infiltration and infection.
- No pathology in lids and conjunctiva (bulbar and tarsal) [10].
- Normal external anatomical position of the lids.
- Refractive errors in a range of plano to −6.00 dioptres (mean spherical equivalent) [6].

The exclusion criteria were:

- Presence of irregular astigmatism.
- Cases suspected to have keratoconus using the Pentacam (Oculus Optikgeräte GmbH, Germany).
- History of refractive surgery.
- Presence of systemic diseases such as diabetes, connective tissue involvements Subjects taking medications which could interfere with contact lens wear such as antihistamines, antidepressants and oral contraceptives [10].

Refractive errors and the horizontal visible iris diameter only in the right eye were determined using a Topcon KR.8800 autokeratorefractometer (Topcon, Japan). A millimeter ruler was used to measure the vertical palpebral aperture.

Study lenses were PureVision® Toric (Bausch and Lomb), Air Optix® for Astigmatism (Alcon), Biofinity® Toric (CooperVision), Acuvue® advance for astigmatism (Vistakon), and Proclear® Toric (CooperVision). The first four contact lenses were silicone-hydrogel and the last one was a traditional hydrogel. The characteristics and parameters of each lens [6] are shown in Table 1.

Subjects were fitted with the various toric contact lenses in a randomized order. The selected lens was fitted and the initial assessment was performed after 5 min. The assessed fitting characteristics using the slit lamp biomicroscope were full corneal coverage in all positions of gaze with about 1 mm conjunctival overlap and good centration. Following these tasks, the dynamic assessment (post blink and version lag movements and the push-up test) was performed. After a settling time of 20 min, the subject positioned behind the slit lamp and gazed into primary position, the location of the toric lens marking(s) was identified for recording of lens orientation and rotational recovery [11].

Lens orientation was evaluated by narrowing the width of the slit lamp beam to approximately 0.5 mm and focusing on the lens surface at the 6 o'clock position on the lens axis marking(s). The vertical beam was slowly rotated to align lens marking and

Table 1
Parameters of study lenses.

Product name	Pure Vision Toric	Acuvue Advance for Astigmatism	Air Optix for astigmatism	Biofinity Toric	Proclear Toric
Manufacturer	Bausch and Lomb	Vistakon	Alcon	Cooper Vision	Cooper Vision
[a]DK	91	60	110	128	27
DK/t	91	86	108	116	25
CT@-3.00 (mm)	0.1	0.07	0.102	0.11	0.11
Water content (%)	36	47	33	48	62
Base curve (mm)	8.70	8.60	8.70	8.70	8.5
Diameter (mm)	14.0	14.5	14.50	14.50	14.0
Lens axis marking (s)	At 5, 6, 7 o'clock	At 6, 12 o'clock	At 3, 6, 9 o'clock	One at 6 o'clock	3 radial lines at 6 o'clock and 15° either side
Surface treatment	Plasma oxidation	Internal wetting agent	Plasma treatment	Inherently wettable	PC Technology
Material	Balafilcon A	Galyfilcon A	Lotrafilcon B	Comfilcon A	Omafilcon
Modulus	1.5	0.43	1.00	0.8	Low
Design	Back surface toric, Prism ballast (Lo-torque)	Back surface toric, accelerated stabilization design (ASD)	Back surface toric, modified prism ballast design (8/4 precision balance design)	Toric design, modified prism ballast design (equi ballast or Horizontal iso-thickness design)	Back surface toric, prism ballast

[a]DK unit: $(cm^2/s)\ (mlO_2/ml \times mmHg)\ 10^{-11}$.