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Low toric soft contact lens acceptance study

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ABSTRACT

Purpose: The aim of the study was to evaluate the objective and subjective visual performance of custom toric contact lenses (TL) and their spherical off-the-shelf counterparts (SL) in subjects with low amounts of astigmatism.
Methods: Twenty-three habitual soft lens wearers (40 eyes, 25–35 years) manifesting 0.50–1.00 DC and ≤±3.00 DS were recruited. Air Optix Aqua (Lotrafilcon B) was fit using the spherical equivalent of the manifest refraction. Intelliwave toric in Efrofilcon A (Definitive) was fit using the manifest refraction and keratometric data. Comprehensive visual performance tests were done through manifest refraction in a trial frame; in SL; and in TL. A subjective evaluation of quality of vision was also obtained.
Results: ANOVA revealed that, at the morning visit (AM), high contrast logMAR distance visual acuity (HCDVA) was significantly better ($p < 0.01$) in spectacles as compared to SL. A similar trend was noted at the afternoon visit (PM). In addition, at the PM visit, HCDVA was significantly better ($p < 0.01$) for TL as compared to their SL. ANOVA revealed that, at the PM visit, low contrast distance visual acuity (LCDVA) was significantly better ($p = 0.05$) in spectacles as compared to SL. None of these differences were clinically significant. In addition, no statistically significant difference ($p > 0.05$) in subjective vision rating scores was noted between SL and TL.
Conclusions: The present investigation found no clinically significant difference in visual performance between spherical and toric soft contact lenses in low astigmats.

1. Introduction

Many patients can benefit from toric contact lens correction. Holden [1] determined the relative percentage of the population that would need toric soft contact lens correction based on their magnitude of astigmatism. If all astigmatism of 0.50 diopters cylinder (DC) or more were corrected, 61.5% of wearers would require toric soft contact lens correction. If only astigmatism of 1.00 DC or more was corrected, 34.8% would require toric correction. Interestingly, there has been a steady increase in toric soft contact lens fitting as a proportion of all soft contact lens fitting for over a decade now. In 2008, toric soft contact lenses represented 34% of all soft contact lens fits [2] that is, astigmatism of 1.00 D or more is being routinely corrected in soft contact lenses.

Although toric lenses are used for many patients, the fitting convention for patients with low amounts of astigmatism still involves using spherical lenses in the spherical equivalent refraction. In fact, the lowest cylinder correction available in most off the shelf soft toric contact lenses is 0.75 DC [3]. It is assumed that the spherical equivalent provides adequate vision correction in contact lenses for low astigmats. However, this may not prove to be the case when visual performance is examined between spherical and toric correction. Efron et al. [4] suggest five possible reasons that eye care professionals do not routinely correct refractive cylinder of 0.75 DC or less: (1) The small visual improvement is not offset sufficiently by the increased chair time or potential for variability in vision due to axis mislocation. (2) The belief that higher modulus soft contact lenses mask astigmatism. (3) Patient concern over cost. (4) Limited parameter availability in daily disposable options. (5) Electing for the simplicity of bilateral spherical correction in cases of unilateral indication for toric correction. Interestingly, Holden [1] calculated the proportion of patients having greater than 0.50 DC to be 61.5%. This represents a tremendous potential in toric contact lens fitting if we changed the astigmatic threshold that is commonly considered to be significant.

One thought in dealing with low amounts of astigmatism is the use of increased lens thickness or a higher modulus material to mask astigmatism. However, Cho and Woo [5] found that lens thickness did not have a significant effect on visual acuity, in spite of residual astigmatism being lower in the thicker lenses. Similarly, Edmondson et al. [6] did not find a significant effect in

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masking astigmatism using a high modulus silicone hydrogel lens, compared to a low modulus hydrogel lens. Another theory is that using aspheric soft contact lenses corrects low amounts of astigmatism. However, Morgan et al. [2] found that toric lenses do this much more effectively. Therefore, when astigmatic patients are fit in non-toric soft lenses their refractive error is not fully corrected. Several studies have investigated the effect of uncorrected astigmatism on visual function. For example, Guo and Atchison [7] found that 0.28 ± 0.12 DC was necessary for a reduction of 0.1 logMAR of high contrast visual acuity. Similar decrement was observed at low contrast, and at near. In addition, astigmatic blur has also been shown to cause a reduction in contrast sensitivity [7]. Furthermore, the reduction in visual performance has been suggested to translate to functional difficulties as well.

Visual performance is usually better with toric soft contact lenses for prescriptions with cylindrical power. Richdale et al. [8] compared the visual acuity and wavefront aberrations in patients fit with spherical, aspheric and toric soft contact lenses and found that the latter yielded the best results. However, subjects had moderate cylindrical power that ranged between 0.75 and 2.00 DC. Interestingly, Lehman and Houtman [9] found that pseudophakic subjects with low levels of postoperative astigmatism benefited from full correction of their astigmatism as compared to spherical equivalent correction. This was evident for both high- and low-contrast visual acuity. More recently, using a wavefront sensor to detect the magnitude of astigmatism, Villegas et al. [10] investigated the effect of low cylindrical power on visual performance. They measured wavefront aberrations on selected patients with less than 0.50 diopters of cylinder. They corrected astigmatism using a cross cylinder device and performed several visual performance tests. The authors found a relative improvement in visual acuity when astigmatism greater than 0.30 DC was corrected. However, this assumed exact axis orientation, something that is not always achieved on the first try when fitting a soft toric contact lens. An error of 10° would cause residual astigmatism of 35% with an orientation 40° away from the intended axis [10]. Furthermore, there was additional defocus of half of the remaining astigmatism. Snyder [11] found that when a lens is rotated 30°, the entire cylindrical power is delivered at an axis oblique to that desired. Gaze direction and gravity may also have an effect on toric lens orientation and visual acuity. McIlraith et al. [12] studied Acuvue™cOasys® for Astigmatism, Purevision® Toric, Air Optix® for Astigmatism and Proclear® Toric and found that all lenses rotated with change in posture and head position. Rotation ranged from 11° to 29.1°, causing a consequent visual decrement of 0.05–0.15 logMAR.

Improving stability has been an important principle in the evolution of toric soft lens development. In fact, rotational stability has been shown to be the main factor that determines whether a patient is successful in toric contact lenses [13]. Stabilization methodology can influence this, as can the fitting relationship. There are many factors that contribute to the fit of a contact lens, such as palpebral aperture size, lid position, lid tension, inter-canthal angle, horizontal visible iris diameter and corneal topography. Although there have been significant advances in contact lens design, lens rotation and instability continues to be problematic in some cases. Momeni-Moghaddam et al. [14] compared the rotation and rotational recovery in several off-the-shelf lenses: Purevision toric (Bausch + Lomb, Rochester), Air Optix for Astigmatism (Alcon, Fort Worth), Acuvue Advance for Astigmatism (Johnson and Johnson Vision Care, Jacksnoville), Biofinity toric (Coopervision, Pleasanton) and Proclear toric (Coopervision, Pleasanton). Lenses ranked from least to most stable are: Proclear Toric, Acuvue Advance for Astigmatism, Purevision Toric, Air Optix for Astigmatism and Biofinity toric.

In the presence of increased stability, it is more likely to correct astigmatism of any magnitude successfully. Practitioners are more apt to see the value in correcting low amounts of astigmatism if there is evidence of improvement in visual performance. Thus, the purpose of the present investigation is to compare the objective and subjective visual performance of spherical silicone hydrogel lenses to custom toric silicone hydrogel lenses in patients with manifest astigmatism of 0.50–1.00 DC.

2. Methods

A total of 24 subjects (40 eyes) between the ages of 22 and 35 years completed the study. Subjects were recruited from the university population to participate in this study. The research followed the tenets of the Declaration of Helsinki and was approved by the Midwestern University Institutional Review Board (IRB). Potential subjects were briefed on the study, including risks, both verbally and in writing. Informed consent was obtained from every subject.

The investigators then performed auto-refraction, auto-keratometry, and subjective refraction. The latter performed by the same examiner for all subjects, for consistency. Refractions were examined to ensure that manifest astigmatism was 0.50, 0.75 or 1.00 DC in one or both eyes. The spherical aspect of the refractive error ranged between +3.00 and −3.00, to make the astigmatic component a significant portion of the overall refractive error. Only those patients who met the refractive state requirements either monocularly or binocularly were allowed to participate in the study. The anterior segment health was evaluated to ensure that subjects were free of pathology and had no history of previous corneal surgery. The upper age limit was set to 35 years in an attempt to limit age-related tear film changes, as well as to exclude presbyopic subjects.

Once the subject qualified to participate in the study, two sets of soft contact lenses were ordered based on their prescription. One set was made up of multi-packaged spherical silicone hydrogels, as would be customarily used for a subject with this magnitude of cylinder. The second set was made up of custom toric silicone hydrogels. The materials for the spherical and toric lenses were lotrafilcon B (Alcon, Fort Worth, TX) and efrofilcon A (Art Optical, Grand Rapids, MI), respectively. Lotrafilcon B (AIR OPTIX AQUA, Fort Worth, TX) lenses were ordered in the standard 8.6 mm base curve and 14.2 mm diameter, using the spherical equivalent of the subject's manifest refraction. Efrofilcon A "Definitive" (Contamac, Grand Junction, CO) lenses in the Intelliwave Aspheric Toric (Art Optical, Grand Rapids, MI) design were ordered empirically. This was done using the subject's keratometry values and manifest refraction. Lenses were ordered for both eyes for equilibrium, regardless of whether one or both eyes met the inclusion criteria. However, data was only collected for qualifying eyes.

Once lenses arrived, subjects were scheduled for a dispensing visit. Subjects were randomized to determine whether they were fit into the spherical or toric lenses that day. Lenses were applied to the subjects' eyes and the following visual performance tests were administered: high and low contrast logMAR (log of the minimum angle of resolution) acuity at distance and near and contrast sensitivity using the CSV-1000 (Precision-vision, La Salle, IL). The fit of the lenses was assessed, judging coverage, centration and movement. If applicable, rotation and stability were documented as well. Rotation was measured using a slit lamp biomicroscope and rotating a bright, narrow optic section to coincide with the toric lens scribe mark.

Subjects were asked to wear the lenses for 6 h and return to the clinic for another evaluation. They were asked to subjectively rate their vision in each eye while wearing the lenses on a scale of 0 (worst) to 10 (best). Visual performance tests administered were high and low contrast acuity at distance, high and low contrast acuity at near and contrast sensitivity using the CSV-1000. The fit