

# Patients with High Astigmatism Contact Lens Study

Kelly E. Deering, BS<sup>1</sup>, Julie DeKinder, OD<sup>1</sup>, Jonathan Chen, OD<sup>1</sup>, Vinita Henry, OD<sup>1</sup>, Jessica Tu, OD<sup>1</sup>, Elizabeth Voss, BS<sup>1</sup>, Edward S. Bennett, OD<sup>1</sup>, Richard A. Deering, Jr, BS<sup>2</sup>

<sup>1</sup>UMSL College of Optometry and <sup>2</sup>University of Illinois – Urbana Champaign



## Introduction

Astigmatism is a common aberration in the human cornea and lens, making up about 40% of refractive errors in adults.<sup>1</sup> All causes of astigmatism result in a point source of light focusing at multiple locations within the eye causing perception of blur or monocular diplopia. Any astigmatism, even at low amounts, can have a significant impact on a patient's vision and quality of life.<sup>2</sup>

Prompt detection and correction of astigmatism is imperative for proper visual and intellectual development.<sup>3-5</sup> In the United States, 10% of people with astigmatism have high astigmatism  $\geq 2.25D$ .<sup>6</sup> Most Americans with high astigmatism are corrected with spectacles alone; however, many new contact lens technologies have been developed to correct high astigmatism.<sup>7</sup> Contact lenses have many benefits over spectacles at all ages. Contact lenses improve peripheral vision, do not fog up like spectacle lenses when temperature conditions change, stay centered on the eye, and lack the optical aberrations and varying vergence and accommodative demands induced by spectacle lenses at different working distances.<sup>8</sup> Despite recent advancements and the benefits of contact lenses over glasses, many patients with high astigmatism who would make great contact lens candidates are told they are poor candidates based on their prescription.<sup>9</sup> In 2018, only 33% of patients worldwide fitted with contact lenses were prescribed at least one toric lens to correct for astigmatism, but patients with high astigmatism continue to be excluded as contact lens candidates.<sup>10</sup>

Current literature explains advantages and disadvantages of each contact lens modality for high astigmatism. Corneal gas permeable lenses have been shown to provide greater quality of vision compared to soft toric lenses for these patients with the lowest risk of infection, optimum tear exchange, good lens durability, and acceptable cost.<sup>11</sup> Soft toric contact lenses are another good alternative for high astigmatism correction, offering a shorter adaptation period and greater immediate lens comfort compared to gas permeable lenses. Silicone-hydrogel soft contact lens materials exhibit high oxygen permeability, and complications are reduced with frequent lens replacement.<sup>12</sup> Many mechanisms exist for stabilizing soft toric contact lenses.<sup>13</sup> However, patients with high astigmatism often suffer from vision fluctuations with soft toric contact lens movement upon blinking. Scleral gas permeable lenses are often indicated for patients with high astigmatism because they create a neutralizing tear lens masking corneal astigmatism with no to limited lens movement on the eye, providing optimum vision with no visual fluctuations.

**Two out of seven participants were told by prior optometrists that they were poor contact lens candidates based on their astigmatism alone.**

## Methods

Seven participants were admitted into the study. All participants were under the age of 40, had between +8.00 and -10.00D of spherical prescription, and had at least -2.00D of corneal cylinder. All participants were good candidates for contact lens wear, had a baseline ocular anterior segment evaluation that was free of disease, and were willing to follow study protocols with proper lens care and wear. Participants were fit diagnostically in Custom Stable Elite Optimum Extra scleral gas permeable lenses and empirically in Art Optical Optimum Comfort back surface or bitoric gas permeable lenses, CooperVision Biofinity Toric XR soft contact lenses, and Art Optical Intelliwave toric soft contact lenses. Lenses were dispensed to patients once 1) visual acuities reached or surpassed spectacle best-corrected visual acuity monocularly and binocularly, 2) fits were optimized, 3) participants reported clear and comfortable lens vision and fit, and 4) participants demonstrated safe insertion and removal of each lens and knowledge of disinfection system. ClearCare was provided as the disinfecting solution for each lens design, and Addipak preservative-free saline was used for scleral lens insertion. Participants wore each pair of lenses daily for four weeks, followed by a one-week wash-out period of glasses wear before starting the next pair. Weekly surveys regarding ease of care, insertion and removal challenges, visual clarity, lens comfort, and overall lens satisfaction were collected. At the study conclusion, patients completed an exit survey during which they shared their preferred lens modality.

## Results

This particular study population valued specific contact lens characteristics over others (weighted average out of 5): visual clarity (4.86), comfort (4.43), average wear time (4.29), and ease of care (3.71).

Scleral gas permeable contact lenses provided the most consistently clear vision, followed by Biofinity toric soft contact lenses, Intelliwave toric soft contact lenses, and corneal gas permeable contact lenses (Figure 1). Participants who rated Intelliwave lower than Biofinity remarked inconsistent vision upon blinking based on both weekly and exit surveys.

Biofinity toric soft contact lenses were the most comfortable, followed by Intelliwave toric soft contact lenses, scleral gas permeable contact lenses, and corneal gas permeable contact lenses (Figure 2). Five out of seven participants remarked corneal gas permeable contact lenses felt dry and gritty at the end of the day. However, corneal gas permeable contact lenses became statistically more comfortable from week one to week four ( $p=0.07$ , Figure 2). Weekly comfort ratings from week one to week four were reduced for Biofinity toric soft contact lenses (Figure 2). As soft lenses approach the end of their wear schedule, they often perform worse in terms of comfort and vision. However, exit survey results revealed that soft contact lenses reduced subjective symptoms of dryness, followed by scleral gas permeable contact lenses. Scleral lenses were more comfortable during screen time, in reduced blinking environments, followed by soft toric contact lenses and corneal gas permeable contact lenses.

Participants enjoyed greater average wear time with Biofinity toric soft contact lenses (13 hours), followed by Intelliwave lenses (11.3), scleral lenses (10.9), and corneal gas permeable lenses (8).

Both soft toric contact lenses provided the easiest care regimen, followed by sclerals and then corneal gas permeable lenses (Figure 3). At the end of four weeks, ease of care ratings tended to converge around the same data point for all lens modalities. The average adaptation period for all lenses was around two weeks. Scleral lenses got statistically easier to insert from week one to week four ( $p=0.05$ , Figure 3).

Exit survey results showed participants preferred scleral lenses over glasses more than they preferred Biofinity, Intelliwave, then corneal gas permeable lenses over glasses (Figure 4). Scleral lenses and Biofinity lenses tied for meeting overall daily visual needs the best, followed by Intelliwave and corneal gas permeable lenses (Figure 5). However, the lens that offered the best combination of visual clarity, comfort, average wear time, and ease of care was Biofinity toric soft contact lenses, followed by scleral lenses, Intelliwave toric soft lenses, and corneal gas permeable contact lenses. Biofinity and Intelliwave toric soft lenses were rated strikingly different from one another, based on vision instability in this particular study population.



Figure 4. Participants' average weekly survey results

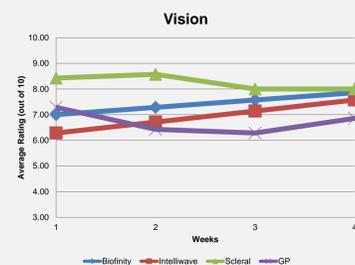


Figure 1. Average vision score (across all participants) from weekly survey results during the study

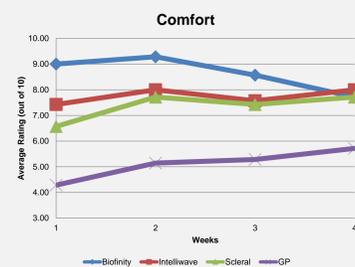


Figure 2. Average comfort score (across all participants) from weekly survey results during the study. \* $p=0.07$

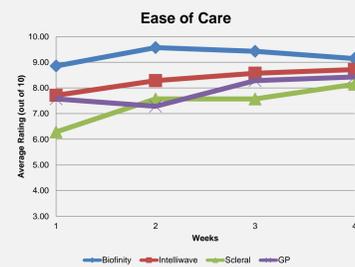


Figure 3. Average ease of care score (across all participants) from weekly survey results during the study. \* $p=0.05$

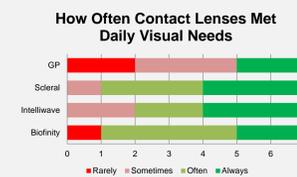


Figure 5. Participants' average weekly survey results

## Conclusions

Many contact lens modalities exist for correcting high astigmatism. A thorough analysis of patient corneal topography, manifest refraction, eye and lid health, motivation, and visual needs should be conducted before discussing contact lens options. Soft toric contact lenses offer easier lens handling; however, in rotationally unstable situations, scleral lenses offer superior vision. Striking differences in soft toric contact lens preference based on vision and comfort were found in this study, supporting the idea that multiple soft lens options should be available in optometry offices; lenses from one manufacturer will not fit all patients. For patients who value peak visual acuity and stability, scleral and corneal gas permeable contact lenses should be considered, even for the regular and healthy cornea. Biofinity soft toric lenses were the preferred lens modality in this particular study population, considering all lens characteristics important to each participant. Ultimately, lens selection should be a joint decision after discussing the unique needs of the patient.

**“It was so exciting to experience new lenses and to know that crisp vision was a possibility for me. I didn't think that was an option with high astigmatism.”**  
– Participant #3

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