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Modern Scleral Lenses Part II: Patient Satisfaction

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Purpose. To evaluate the subjective performance of modern scleral lenses in patients of the clinics of Visser Contact Lens Practice. **Methods.** In this cross-sectional survey, all the necessary data were collected at the first follow-up visit during the 5-month study period. In accordance with the preformed fitting technique developed at Visser Contact Lens Practice, four types of scleral lenses were used: spherical, front-surface toric, back-surface toric, and bitoric. Subjective performance was investigated during an interview that included the use of a five-point Likert scale and by means of a questionnaire supplemented by a 100-mm visual analog scale (VAS). **Results.** The interview and questionnaire showed high scores for patient satisfaction with the current scleral lens in the 178 patients (284 eyes) (median score, 4; range Likert scale, 1–5; median score, ≥75; range VAS, 1–100). Significant increases in scores were seen with the current scleral lens compared to the former correction: 78.9% for comfort, 78.2% for visual quality, and 87.7% for overall satisfaction (n = 284 eyes) (P<0.001). In the 99 eyes that switched from back-surface spherical to back-surface toric designs, the following significant increases were seen: 61.6%, 37.4%, and 65.7%, respectively (P<0.001). **Conclusions.** High patient satisfaction was seen with all the modern scleral lens designs in the management of several forms of corneal abnormality. The interview showed differences in comfort, visual quality, and overall satisfaction in favor of the back-surface toric designs compared to the back-surface spherical designs.
Key Words: Irregular corneal surface—Keratoconus—Scleral lens—Subjective performance—Toric scleral lens.

Scleral lenses are effective in the management of corneal diseases because they have unique advantages: the retention of a precorneal fluid reservoir that affords simultaneous optical correction of the irregular corneal surface and corneal hydration. The rigidity of the material provides optical correction and mechanical protection.[1,2]

The clinical application of contact lenses began with the work of Fick and Muller in the 1880s.[3,4] These early contact lenses were all haptic or scleral and were made from glass. Several developments followed and included a preformed trial fitting set or molded glass scleral lenses and the introduction of polymethylmethacrylate (PMMA). Later, the application of scleral lenses stagnated because of the introduction of corneal and hydrogel lenses. The latter lenses were much easier to fit, and there were fewer contact lens–related complications, such as those from the hypoxia induced by the previous scleral lenses. However, in view of the therapeutic value of sclerals, Ezekiel[5] evaluated the use of these lenses made from a gas-permeable material in 1983. He reported greater acceptability and comfort of the oxygen-permeable scleral lenses than the PMMA versions. The development of highly gas-permeable materials, well-defined fitting techniques and technologic innovations in the design and manufacturing of scleral lenses led to better performance.[2,5–12]

Approximately by 1990, several milestones were reached in the development of scleral lenses. It became possible to apply a front-surface cylinder to improve vision. Second, a back-surface toric scleral part was lathed to avoid air bubbles being trapped underneath the lens and to prevent local blanching of the conjunctival scleral vessels that occurred with toric or irregular anterior scleral surfaces, causing tissue changes and discomfort.[13,14] Such fitting problems were described by Bier[15] in 1977, who advised the use of spherical oval lenses or toroidal shells in cases with higher scleral toricity. These problems can be resolved by maintaining a certain position of the back-surface toric scleral lenses on the eye. In addition, constant stabilization enables correction with a front-surface cylinder and other optical corrections, such as bifocal, prisms, and aberrations, if indicated.

These recent developments have led to four types of scleral lens and have enabled optimized fitting: spherical, front-surface toric, back-surface toric, and bitoric.

The authors performed a prospective study on the subjective performance of scleral lenses to determine the effectiveness of modern scleral lenses.

MATERIALS AND METHODS

Patients were recruited from the three scleral lens clinics of Visser Contact Lens Practice in Nijmegen, Utrecht and s-Hertogenbosch, The Netherlands between September 1, 2002 and January 31, 2003. Inclusion criteria were that the patient was of legal age, had been wearing one or two scleral lenses made by Procornea (Eerbeek, The Netherlands) for at least 3 months, and had been fitted at one of the authors' practices. Exclusion criteria were the inability to give written informed consent, inability to comply with the study, and making an emergency visit or refitting. All patients had been referred to the clinic by their ophthalmologist, because they had been diagnosed with one of the indications described in part I of the study: keratoconus (143 eyes, 50.4%), penetrating keratoplasty (PKP) (56 eyes, 19.7%), primary or secondary irregular astigmatism (36 eyes, 12.7%), keratitis sicca (15 eyes, 5.3%),

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corneal dystrophy (10 eyes, 3.5%), and multiple diagnoses (24 eyes, 8.5%).

The preformed fitting technique, designs, production methods, and lens care were described in part I of the study. Four different types of scleral lens design were being worn by the patients: 128 (45.1%) spherical scleral lenses, five (1.8%) front-surface toric scleral lenses, 71 (25.0%) back-surface toric scleral lenses, and 80 (28.2%) bitoric scleral lenses. This resulted in a 1:1.1 ratio of back-surface spherical designs (spherical and front-surface toric) to back-surface toric designs (back-surface toric and bitoric). Because of the size of the groups, spherical, back-surface toric, and bitoric scleral lenses were considered the three main types.

Demographic and anthropometric data were recorded, as were the details of diagnosis, previous (scleral) lens wear, scleral lens type, and parameters. During the interview, the patients were asked to state how many hours a day they had been wearing the lens(es), how many times a day they needed a break from wearing the scleral lens(es), the number of attempts they made before the scleral lens was inserted correctly, and the previous main type of correction before they had received the scleral lens(es).

The patients were also asked to rate their level of satisfaction verbally and on a written questionnaire. Scores were obtained for the current lens and the main type of correction before they started wearing the scleral lens(es). Patients wearing back-surface toric designs also rated their former scleral lens. Three topics were covered, namely comfort, visual quality, and overall satisfaction. The Likert scale with verbal descriptors ranged from 1 (very poor) to 5 (excellent).

After the examination, the patients were asked to complete a questionnaire on seven specific dimensions: comfort, lens dryness, visual quality, air bubbles while wearing the lens, debris behind the lens, lens cleanliness, and lens handling. They also gave a score for overall satisfaction. A visual analog scale (VAS) was used to obtain separate scores for the right and the left lenses, from 0 (unacceptable performance) to 100 (excellent performance) mm. The patient was required to sign the bottom of the form.

Scores on the VAS were measured to the nearest millimeter by hand using a ruler. The intersection with the VAS axis was used as the reference point, also in the case of oblique lines. A few of the patients had indicated their scores with a cross instead of a vertical line. In these cases, the middle of the cross was measured.

In addition to the statistical methods described in part I, the relationship between two continuous variables was assessed with the Spearman rank correlation coefficient.

Approval for the study was granted by the Research and Ethical Committee of the City University, London, United Kingdom.

RESULTS

In this study, 178 patients (284 eyes) were recruited. Demographic and anthropometric details and the distribution of diagnoses and scleral lens types were described in part I of the study.

Distributions of the former main types of correction are shown in Table 1. Eighty-seven (30.6%) eyes had not been corrected with contact lenses before the scleral lens. Rigid gas-permeable (RGP) corneal contact lenses formed the former type of correction in 142 (50%) eyes versus the remaining types of contact lenses in 55 (19.4%) eyes. The group "other" comprised three eyes that had formerly been corrected with SoftPerm and one eye with RGP corneal lenses and glasses.

TABLE 1. *Correction Before Scleral Lens Fitting*

Type of correction	No. of eyes	Percentage
No correction	32	11.3
Glasses	55	19.4
Soft contact lens	24	8.4
Rigid gas-permeable corneal contact lens	142	50.0
Piggyback	19	6.7
Semiscleral lens	8	2.8
Other	4	1.4

The median total duration of using scleral lenses was 33.9 months (range, 3.3–162.8 months); the median duration of using the current scleral lens type was 10.7 months (range, 3.1–160.0 months). There were significant differences in the total duration of using the scleral lenses among the three main lens groups ($P=0.005$, Kruskal–Wallis test). Spherical scleral lenses had a longer duration than did back–surface toric designs ($P=0.002$, Wilcoxon test).

The duration of using the current scleral lens type also varied significantly among the three main lens types ($P<0.001$, Kruskal–Wallis test). Spherical scleral lenses had been used continuously for longer than the back–surface toric designs ($P<0.001$, Wilcoxon test).

No differences were found in the total duration of using the scleral lenses or the duration of using the current lens type between the back-surface toric and bitoric scleral lenses.

All the lenses were being worn for a median of 16 hours per day (range, 3–19 hours). Small but nonsignificant differences were seen in the wearing time per day among the diagnosis groups and among the lens groups. Eyes in the keratitis sicca group showed a somewhat shorter median wearing time (14 hours) than the other eyes (15.5 or 16 hours).

Spherical scleral lenses were generally being worn for 1 hour longer per day (16 hours) than the other three scleral lens types (15 hours). The differences between the main three lens types did not reach significance ($P=0.052$, Kruskal–Wallis test).

The scleral lenses were being worn continuously during the day by 51.1% of the eyes, whereas 48.9% of the eyes needed one or more breaks.

Significant differences were found in the number of breaks between the six diagnosis groups ($P=0.005$, Kruskal–Wallis test). The relative frequency of one or more breaks was significantly higher ($P=0.017$, χ^2 test) in the eyes with keratitis sicca or multiple diagnoses (66.7% and 79.2%) than in all the other eyes in this sample (range, 30%–47.6%). The necessity to take one or more breaks during the day was higher with spherical scleral lenses (55.5%) than with the other three types (20.0%, 42.3%, and 46.2%, respectively).

The median number of attempts before the scleral lens was inserted correctly was one (range, 1–5). In 64.4% of the eyes, the lenses were inserted correctly on the first attempt, whereas in 35.6% of the lenses, more attempts were needed to achieve correct insertion. No significant differences could be detected in the number of attempts among the six diagnosis groups or the three main lens types.

The scores given by the patients during the interview are shown in Table 2. Scores of 3 or more were given with the former correction by 54.6% for comfort, by 51.8% for visual quality, and by 50.4% for overall satisfaction. Scores of 3 or more were given with the current scleral lens by 98.9% for comfort, by 97.9% for visual quality, and by 98.9% for overall satisfaction.

TABLE 2. *Scores Given by the Patients in the Interview for Former Correction, Former Scleral Lens, and Current Scleral Lens Type*

Interview dimension per correction type	No. of eyes	Minimum	q1	Median	q3	Maximum	Mean	No. of grades 1 and 2 (%)	No. of grades 3, 4, and 5 (%)
Former main type of correction									
Comfort	284	1.0	2.0	3.0	4.0	5.0	2.7	129 (45.4%)	155 (54.6%)
Visual quality	284	1.0	2.0	3.0	4.0	5.0	2.7	137 (48.2%)	147 (51.8%)
Overall satisfaction	284	1.0	2.0	3.0	3.0	5.0	2.6	141 (49.6%)	143 (50.4%)
Former scleral lens									
Comfort	99	2.0	3.0	4.0	4.0	5.0	3.5	10 (10.1%)	89 (89.9%)
Visual quality	99	2.0	3.0	4.0	4.0	5.0	3.8	1 (1.0%)	98 (99.0%)
Overall satisfaction	99	2.0	3.0	4.0	4.0	5.0	3.6	5 (5.1%)	94 (94.9%)
Current scleral lens									
Comfort	284	2.0	4.0	4.0	5.0	5.0	4.2	3 (1.1%)	281 (98.9%)
Visual quality	284	2.0	4.0	4.0	5.0	5.0	4.1	6 (2.1%)	278 (97.9%)
Overall satisfaction	284	2.0	4.0	4.0	5.0	5.0	4.3	3 (1.1%)	281 (98.9%)

Grade 1, very poor; grade 2, poor; grade 3, average; grade 4, good; and grade 5, excellent.
q1, first quartile; q3, third quartile.

In the 99 eyes with back-surface toric designs, scores were obtained for the former scleral lens type when it had been a spherical back-surface design. The former types of scleral lens received a score of 3 or more from 89.9%, 99.0%, and 94.9% of the patients for comfort, visual quality, and overall satisfaction, respectively.

In Table 3, comparisons are made of the scores for the current scleral lens, the former main type of correction, and, if applicable, the former scleral lens. Significant increases were found in the scores with the current lens for all three topics ($P<0.001$, signed rank test). Higher scores with the scleral lens were seen in 78.9% of the eyes for comfort, in 78.2% of the eyes for visual quality, and in 87.7% of the eyes for overall satisfaction. The increases in scores from the former scleral lens design to the current back-surface toric design were also significant (all $P<0.001$, signed rank test). The percentages of patients who gave increased scores with the current scleral lens were 61.6% for comfort, 37.4% for visual quality, and 65.7% for overall satisfaction.

Table 4 shows the scores given in the questionnaire (scale, 0–100). The median score was 75 for lens dryness, debris behind the lens, and lens cleanliness. Comfort and overall satisfaction had a median score of 84. The median score was 80 for visual quality, 85.5 for air bubbles behind the lens, and 87.5 for lens handling.

In Tables 5 and 6, the three items from the questionnaire, namely comfort, visual quality, and overall satisfaction, are scored per diagnosis group and scleral lens type. The median scores for comfort and overall satisfaction were higher than 80 in all the diagnosis groups, except for keratitis sicca, in which the median score was 74 for comfort and 77 for overall satisfaction. For visual quality, the median scores were 80 or higher in all the groups, except for keratoconus, in which the median score was 75.

The median score for comfort was 74 with the front-surface toric scleral lenses and 80 or more with the other three scleral lens types. The median score for visual quality varied from 64 with the front-surface toric lenses to 84 with the spherical scleral lenses. Overall satisfaction received a median score of 80 or more with the four lens types. No statistical differences could be detected in the three topics among the diagnosis groups or the three main lens types.

With the current scleral lens, Spearman correlation coefficients were all significant between the scores obtained for comfort, visual quality, and overall satisfaction in the interview and in the questionnaire: 0.59, 0.55 and 0.60, respectively (all $P<0.001$).

DISCUSSION

It has been well-established that scleral lenses can improve visual acuity in irregular corneal astigmatism and decrease the symptoms associated with ocular surface disorders.[1,6,7,12,16–21] The patient satisfaction results support these statements.

Scleral lenses had been fitted in patients because other treatment modalities, including contact lenses, had failed. Almost one third of the eyes had not been wearing any contact lens correction, whereas 50% of the eyes had been fitted with RGP corneal contact lenses before they received a scleral lens. The remaining types of contact lens were soft contact lenses, piggyback systems, semi-scleral lenses, and SoftPerm lenses.

A ratio of 1:1.1 was found between back-surface spherical designs (spherical [128 eyes] and front-surface toric [5 eyes]) and back-surface toric designs (back-surface toric [71 eyes] and bitoric [80 eyes]). Since the introduction of these back-surface toric designs at the authors' scleral lens practices, a shift has occurred

TABLE 3. *Increases in Scores Given by the Patients in the Interview for the Current Scleral Lens Compared to the Former Correction and Former Scleral Lens*

Interview dimension per correction type	No. of eyes	Minimum	q1	Median	q3	Maximum	No. of eyes with increase (%)
Increase compared to former correction							
Comfort	284	–2.0	1.0	1.0	2.0	4.0	224 (78.9%)
Visual quality	284	–2.0	1.0	1.0	2.0	4.0	222 (78.2%)
Overall satisfaction	284	–1.0	1.0	2.0	2.0	4.0	249 (87.7%)
Increase compared to former scleral lens							
Comfort	99	0.0	0.0	1.0	1.0	3.0	61 (61.6%)
Visual quality	99	–3.0	0.0	0.0	1.0	2.0	37 (37.4%)
Overall satisfaction	99	–2.0	0.0	1.0	1.0	3.0	65 (65.7%)

q1, first quartile; q3, third quartile.

TABLE 4. *Scores Given by the Patients in the Questionnaire*

Questionnaire dimension	No. of eyes	Minimum	q1	Median	q3	Maximum
Comfort	284	24.0	73.5	84.0	93.0	100
Lens dryness	284	14.0	63.0	75.0	85.0	100
Visual quality	284	17.0	66.0	80.0	90.0	100
Trapped air bubbles	284	27.0	77.0	85.5	95.0	100
Debris behind lens	284	14.0	63.0	75.0	90.0	100
Lens cleanliness	284	24.0	64.0	75.0	85.0	100
Lens handling	284	27.0	80.0	87.5	95.0	100
Overall satisfaction	284	13.0	75.0	84.0	94.0	100

q1, first quartile; q3, third quartile.

from refitting spherical scleral lenses toward these new designs. This is reflected in the scleral lens history of the patients in this series.

The lens age and the total duration of lens use was longer with the spherical scleral lenses than with the back-surface toric designs. Median total duration was 33.9 months (range, 3.3–162.8 months). Durations were longer in the studies by Tan et al. (mean, 11.8 years; range, 3 months–56 years) and Foss et al. (range, 1–40 years).[16,17] In these studies, PMMA materials had mainly been used, which may explain these discrepancies, because PMMA has been available for longer than the modern gas-permeable materials.

All the lens types were being worn for a median of 16 hours per day (range, 3–19 hours; mean, 14.3 hours). Various studies on scleral lenses used different methods to assess the wearing time. Prolongation of lens wearing time has been reported with gas-permeable materials.[1,5–8,11,18,22,23] Foss et al.[16] reported shorter wearing times in their study on PMMA scleral lenses, whereas Tan et al.[11] reported increased wearing times in 85% of the eyes that switched from PMMA to gas-permeable materials. The tendency toward a shorter wearing time in the patients with keratitis sicca in the current study (median, 14 hours per day) supported the study on 76 eyes diagnosed with ocular surface disease by Romero-Rangel et al.[18] In their review, the mean wearing time was 13.7 hours per day (range, 4–18 hours). In contrast, Foss et al.[16] found median values of 8.5 hours in their visual group and 11 hours in their therapeutic group in their PMMA study. The mean wearing time by all the eyes in the current study was lower than the 16.2 hours (range, 3–18 hours) reported by Segal et al.[19] In the study by Kok and Visser,[6] 83% of the 50 eyes were wearing the lenses for more than 8 hours, which was the longest duration that could be indicated on the questionnaire. Tan et al.[17] reported wearing times between 8 and 11 hours in 15 of 66 eyes and more than 15 hours in 33 eyes. In the latest report by Pullum et al.,[21] 59% ($n = 538$) of patients were wearing the lenses for an average of 10 hours or more. Results can be affected by the diagnoses included in the study groups and may also depend on the definition of wearing time in patients who wear their lenses all day long.

TABLE 5. *Scores Given in the Questionnaire per Diagnosis*

Questionnaire dimension per diagnosis	No. of eyes	Minimum	q1	Median	q3	Maximum
Keratoconus						
Comfort	143	24.0	73.0	82.0	93.0	100
Visual quality	143	24.0	64.0	75.0	87.0	96.0
Overall satisfaction	143	30.0	74.0	84.0	94.0	96.0
Penetrating keratoplasty						
Comfort	56	24.0	80.0	86.0	94.0	100
Visual quality	56	36.0	75.0	85.0	94.0	100
Overall satisfaction	56	46.0	80.0	90.0	95.0	100
Irregular astigmatism						
Comfort	36	25.0	66.5	80.0	86.5	100
Visual quality	36	17.0	55.5	80.0	85.0	96.0
Overall satisfaction	36	13	74.5	80.0	85.5	100
Keratitis sicca						
Comfort	15	55.0	67.0	74.0	94.0	99.0
Visual quality	15	45.0	54.0	84.0	85.0	98.0
Overall satisfaction	15	54.0	74.0	77.0	85.0	98.0
Corneal dystrophy						
Comfort	10	83.0	84.0	84.0	94.0	94.0
Visual quality	10	36.0	84.0	87.0	94.0	95.0
Overall satisfaction	10	64.0	76.0	93.5	94.0	95.0
Multiple diagnoses						
Comfort	24	24.0	65.0	81.5	91.5	100
Visual quality	24	30.0	80.0	87.0	93.0	96.0
Overall satisfaction	24	26.0	74.5	80.0	91.0	94.0

q1, first quartile; q3, third quartile.

TABLE 6. *Scores Given in the Questionnaire per Scleral Lens Type*

Questionnaire dimension per scleral lens type	No. of eyes	Minimum	q1	Median	q3	Maximum
Spherical						
Comfort	128	24.0	73.5	84.0	94.0	100
Visual quality	128	24.0	70.0	84.0	90.0	100
Overall satisfaction	128	26.0	75.0	84.0	94.0	100
Front-surface toric						
Comfort	5	35.0	50.0	74.0	74.0	93.0
Visual quality	5	40.0	64.0	64.0	73.0	75.0
Overall satisfaction	5	73.0	80.0	85.0	85.0	94.0
Back-surface toric						
Comfort	71	24.0	74.0	85.0	94.0	100
Visual quality	71	17.0	65.0	80.0	93.0	96.0
Overall satisfaction	71	13	75.0	85.0	94.0	100
Bitoric						
Comfort	80	25.0	72.0	80.0	89.0	100
Visual quality	80	34.0	65.0	75.0	90.0	100
Overall satisfaction	80	34.0	74.0	80.0	90.0	95.0

q1, first quartile; q3, third quartile.

The performance of a scleral lens is also reflected in the necessity to take a break from wearing the lens during the day. The interview did not ask about the length of the breaks, because a break normally entails lens removal and cleaning, directly followed by reinsertion.

Most (51.1%) patients were wearing their lenses continuously. Tan et al. found that fewer patients with gas-permeable lenses needed to take a break than did patients with PMMA scleral lenses. In their first study, 61.7% of the eyes needed a break, compared to 45.5% in their gas-permeable study.[11,17] Other investigators also mentioned alleviation of discomfort by taking breaks during the day, but they did not investigate exact numbers.[6,16,18,19]

The current study showed that the relative frequency of one or more breaks was significantly higher in the eyes with keratitis sicca (66.7%) and multiple diagnoses (79.2%) than in all the other eyes in the sample (range, 30%–47.6%). This is in accordance with the advice given to the patients with dry eyes by Kok and Visser (i.e., to take the lens out during the day, to refill the lens with saline or a lubricant).[6] Patients with dry eyes tend to experience more debris and deposits, which may be alleviated by cleaning the lens more frequently. In the questionnaire, these patients gave lower scores for comfort and overall satisfaction than did the patients in the other diagnosis groups.

When asked how many attempts were needed to achieve correct lens insertion, 64.4% of the patients reported that they were successful the first time. The most frequently reported difficulty during lens insertion was a trapped air bubble behind the lens.

High scores were given for patient satisfaction with the current scleral lens in the interview and in the questionnaire. These scores correlated significantly between the two rating methods of the three main topics, comfort, visual quality, and overall satisfaction.

A lower median score had been given for comfort and overall satisfaction by the patients with keratitis sicca than by the remaining diagnosis groups. The median score for visual quality was 80 or more in all the groups, except for the keratoconus group, in which the median was 75.

Other studies that reported on the subjective performance of scleral lenses used different methods of assessment. In the first report on gas-permeable scleral lenses, Ezekiel[5] stated that these lenses were more comfortable than lenses made from non gas-permeable materials. The results of the study by Pullum and Buckley confirmed this finding; 36% of the patients reported improvements in comfort with gas-permeable materials, whereas an additional 30% reported increases in the wearing time per day compared to PMMA. There were also improvements in vision in 11% of the cases.[7] Romero-Rangel et al.[18] concluded on the basis of their questionnaire analysis that scleral lenses led to marked relief of ocular discomfort in 40 (82%) patients. Improvements in visual function and quality of life were reported by 45 (92%) patients. These authors also evaluated photophobia and found reduced levels in 37 (75%) patients with scleral lenses. Segal et al.[19] published similar results; 35 (81.4%) patients reported marked relief of discomfort and 37 (86%) patients experienced marked improvement in daily activities.

In this series, the current scleral lens received a significantly higher score than the former correction before the scleral lens had been fitted (including no correction). Higher scores were seen for comfort, visual quality, and overall satisfaction in more than 75% of the eyes.

In the 99 eyes that had switched from back-surface spherical designs to back-surface toric scleral lenses, significant increases were observed in comfort, visual quality, and overall satisfaction. The results of the study on back-surface toric designs confirmed this finding; median comfort and median wearing time increased significantly after changing from spherical scleral lenses to the toric designs (from 7 to 8 [range, 1–10]) and from 14 to 16 hours, both $P<0.001$, $n = 27$ eyes).[14] Because of the more balanced distribution of pressure on the sclera, the back-surface toric designs may be less stressful to the eye and more easily tolerated than the spherical designs.

Several aspects may explain the discrepancy between findings on the basis of the interpatient comparison of the results of the questionnaire. The back-surface toric designs included complicated spherical lenses that were switched to these new designs, and the relatively recent availability of these new designs means that the patients have only short experience with them. It is the authors' experience that the wearing times increase, whereas the number of breaks and insertion problems decrease in the first half year of receiving a scleral lens. In this study setup, it was not possible to investigate differences between the two designs at the same lens age in the same patient. Prospective research on homogenous groups in the longer term therefore may be recommended.

In conclusion, modern materials, fitting techniques, designs, and production methods have added an extended role of scleral lenses in the management of several corneal abnormalities. The availability of four types of scleral lenses has enabled more precise scleral lens fitting. Optimized physical fitting of back-surface toric scleral lenses with toric bulbi resulted in greater patient satisfaction. In the interview, patients reported significant improvements in visual quality, comfort, and overall satisfaction with their scleral lenses.

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