



Impact of rigid contact lens use on visual acuity and vision-related quality of life in keratoconus

Gözde Şahin Vural · Selin Sav Ertürk

Received: 25 March 2026 / Accepted: 10 May 2026
© The Author(s), under exclusive licence to Springer Nature B.V. 2026

Abstract

Purpose To evaluate the relationship between visual acuity (VA) improvement and vision-related quality of life in patients with keratoconus using rigid gas-permeable (RGP) and scleral contact lenses (CLs).

Methods This observational study was designed as a cross-sectional study with retrospective collection of pre-contact lens clinical data. The best-corrected visual acuity (BCVA) before and after CL use was recorded. Pre-contact lens BCVA values were obtained retrospectively from medical records, which may introduce potential documentation bias. After CL usage, vision-related quality of life and CL adaptation were assessed using a validated Turkish version of the National Eye Institute Visual Function Questionnaire (VFQ-25) and a study-specific questionnaire developed by the investigators to explore practical aspects of contact lens use such as handling, adaptation, comfort, and concerns related to long-term use. The correlations between BCVA improvement and questionnaire responses were analyzed statistically.

Results A total of 26 patients (mean age 39.7 ± 13.6 years) were included. Mean BCVA improved significantly from 0.21 ± 0.20 to 0.83 ± 0.16 with contact lenses ($p=0.001$). The VA improvement showed significant positive correlations with

perceived visual improvement ($p=0.032$) and vision-related quality-of-life enhancement ($p=0.007$). These associations should be interpreted cautiously given the relatively small sample size and exploratory nature of the correlation analyses. The patients continued to express concerns regarding the long-term use of CL, despite the observed improvement in VA.

Conclusion The rigid contact lens use was associated with improvements in both visual acuity and vision-related quality of life in keratoconus. However, due to the limited sample size and cross-sectional design, the findings should be considered preliminary and interpreted as exploratory observations that may inform future prospective studies.

Keywords Keratoconus · Rigid gas-permeable contact lenses · Scleral lenses · Vision-related quality of life

Introduction

Keratoconus is a chronic, progressive corneal ectatic disorder characterized by stromal thinning and irregular corneal morphology, leading to significant visual impairment [1]. The disease typically manifests during adolescence or early adulthood and often progresses during the most productive years of life. The irregular astigmatism, increased higher-order aberrations, and reduced contrast sensitivity result in visual distortion that cannot be fully corrected with

G. Şahin Vural (✉) · S. Sav Ertürk
Department of Ophthalmology, Faculty of Medicine,
Balıkesir University, Balıkesir, Turkey
e-mail: gozdejcgrl@hotmail.com

spectacles, thereby substantially affecting patients' functional vision and daily activities [2].

The rigid gas-permeable (RGP) and scleral CLs remain the cornerstone of visual rehabilitation in keratoconus. They improve visual acuity significantly by providing a smooth refractive surface over the irregular cornea [3]. However, keratoconus is a lifelong condition, and long-term treatment success depends not only on objective visual improvement but also on patient comfort, adaptation, and quality of life. In published literature, the studies have predominantly focused on clinical outcomes such as visual acuity, corneal topography, or lens fitting parameters. In contrast, patient-reported outcome measures, including vision-related quality of life and treatment-related concerns, have received comparatively less attention. This gap is clinically relevant, as patients with similar visual outcomes may report markedly different levels of satisfaction and treatment adherence. This is consistent with recent evidence demonstrating that keratoconus significantly affects multiple dimensions of quality of life beyond visual acuity alone [4]. Therefore, evaluating both objective visual outcomes and subjective patient experiences is essential to fully understand the impact of contact lens therapy in keratoconus.

In the light of these information, this study aimed to assess visual acuity improvement alongside vision-related quality-of-life outcomes in keratoconus patients using rigid contact lenses. We hypothesized that improvement in objective visual acuity would be positively associated with patient-reported quality-of-life outcomes. Furthermore, although both rigid gas-permeable (RGP) and scleral lenses were included, these modalities differ in terms of comfort, optical performance, and patient experience; however, in this study they were evaluated collectively to reflect overall clinical practice.

Materials and methods

Keratoconus diagnosis was based on clinical examination and corneal topography findings. A structured questionnaire was distributed electronically to keratoconus patients between April and June 2025. The responses were collected and evaluated with Google Forms. All procedures performed in the study were in accordance with the ethical standards of the

Institutional Research Committee in Balıkesir University (Registration Number & Date: 2025/104; 18 February 2025). The study adhered to the tenets of the Declaration of Helsinki and its later amendments or comparable ethical standards.

The patients who were using either lens type were analyzed as a single group to evaluate the overall impact of rigid contact lens use on visual function and quality of life. Although RGP and scleral lenses differ in comfort, adaptation, and optical characteristics, they were analyzed as a single group because the primary aim of the study was to evaluate the overall impact of rigid contact lens-based visual rehabilitation rather than to compare lens modalities. The study was not designed to compare different rigid lens modalities; therefore RGP and scleral lens users were analyzed together to reflect the overall clinical impact of rigid contact lens-based visual rehabilitation in routine practice. Demographic data, including age and sex, were recorded. Best-corrected visual acuity (BCVA) was measured in decimal notation before contact lens use and with contact lenses. Pre-contact lens BCVA values were obtained retrospectively from medical records, which may introduce potential documentation bias. These values were extracted from clinical records rather than patient recall, minimizing recall bias but still carrying the limitations of retrospective data collection. The change in BCVA was calculated to quantify objective visual improvement.

Vision-related quality-of-life questionnaire

The participants completed a structured questionnaire designed to assess contact lens-related visual function and quality of life. In addition to the validated Turkish version of the National Eye Institute Visual Function Questionnaire (VFQ-25), participants completed a study-specific questionnaire developed by the investigators to explore practical aspects of contact lens use such as handling, adaptation, comfort, and concerns related to long-term use. This questionnaire was not formally validated and therefore its findings were interpreted descriptively. The questionnaire responses were recorded using ordinal scales and analyzed descriptively to explore patient-reported experiences. This represents a methodological limitation and the results derived from this questionnaire should be interpreted with caution. Therefore, the results derived from this questionnaire should be interpreted

as exploratory and hypothesis-generating rather than confirmatory.

The questionnaire included the following domains:

1. Visual performance
 - Perceived improvement in visual acuity with contact lens use
 - Ability to perform daily visual tasks (reading, driving, screen use)
2. Comfort and adaptation
 - Initial adaptation period to contact lenses
 - Comfort during prolonged wear
 - Presence of discomfort or foreign body sensation
3. Functional concerns
 - Fear of lens displacement or loss
 - Difficulty handling or inserting lenses
 - Perceived limitations during physical activities
4. Long-term concerns
 - Worry about potential long-term ocular side effects
 - Concerns regarding corneal health with prolonged lens use
5. Overall satisfaction and quality of life
 - Perceived impact of contact lens use on overall quality of life
 - Willingness to continue contact lens use
 - Overall satisfaction with visual rehabilitation

Additionally, vision-related quality of life was evaluated using the National Eye Institute Visual Function Questionnaire (VFQ-25).

Statistical analysis

Statistical analyses were performed using appropriate statistical software (SPSS 23.0, Inc, Chicago, Illinois, USA). Continuous variables were expressed as mean $\pm$ standard deviation. The normality of data distribution was assessed using the Shapiro–Wilk test. Paired comparisons of BCVA before and after contact lens use were performed using paired-samples t-tests. Correlations between visual acuity improvement and questionnaire responses were evaluated using Pearson

or Spearman correlation coefficients, depending on data distribution. No formal correction for multiple comparisons was applied; therefore, the correlation results should be interpreted as exploratory. Questionnaire items were treated as ordinal variables and correlation analyses were performed between BCVA improvement and questionnaire responses using Spearman rank correlation coefficients when appropriate. Given the relatively small sample size and the exploratory nature of multiple correlation analyses, the results were interpreted cautiously and primarily aimed at identifying potential associations rather than establishing definitive causal relationships. A p value < 0.05 was considered statistically significant.

Results

A total of 37 keratoconus patients using contact lenses received the study questionnaire. Twenty-seven patients (72.9%) responded, and 26 met the inclusion criteria and were included in the final analysis. Of the included patients, 24 used rigid gas-permeable lenses and 4 used scleral lenses. The response rate and final sample size reflect the real-world clinical setting of the study. Because not all contacted patients completed the questionnaire, a degree of non-response bias cannot be excluded. The mean duration of rigid contact lens use was 5.6 ± 6.9 years. Mean BCVA improved significantly from 0.21 ± 0.20 before contact lens use to 0.83 ± 0.16 with contact lenses (mean difference = 0.62, 95% CI: 0.53–0.71, $p = 0.001$), representing a clinically meaningful improvement. Post-contact lens BCVA and the change in BCVA were analyzed separately to distinguish between absolute visual performance and the magnitude of improvement.

The analysis of the questionnaire responses demonstrated that the majority of patients reported a clear subjective benefit from contact lens use, including improvements in visual performance, overall quality of life, adaptation and comfort. However, given the relatively small sample size, these findings should be interpreted with caution. Concerns related to handling and safety were also reported. Detailed frequency distributions of questionnaire responses are summarized in Table 1.

The mean National Eye Institute Visual Function Questionnaire (VFQ-25) score was 75.2 ± 22.3 among

Table 1 Results of the contact lens–related questionnaire in keratoconus patients using rigid gas-permeable and scleral contact lenses ($n=26$)

	Questionnaire item	n (%)
Visual performance	Perceived improvement in visual acuity	22 (84.6)
	Positive impact on daily activities	20 (76.9)
Overall quality of life	Improved overall quality of life	21 (80.8)
Adaptation	Successful adaptation within a short period	18 (69.2)
	Prolonged adaptation period	6 (23.1)
Comfort	Discomfort during prolonged lens wear	8 (30.8)
	Acceptable or good comfort during daily use	18 (69.2)
Handling and safety concerns	Fear of lens displacement or loss	11 (42.3)
	Difficulty with lens insertion or removal	10 (38.5)
Long-term concerns	Concern about potential long-term ocular side effects	12 (46.2)
Treatment continuation	Willingness to continue contact lens use	19 (73.1)

all patients. No significant correlations were found between the VFQ-25 score and BCVA before contact lens use ($p=0.159$), BCVA after contact lens use ($p=0.176$), or the change in BCVA with contact lens use ($p=0.915$). Notably, no significant correlation was observed between VFQ-25 scores and BCVA parameters, suggesting that subjective visual function may not directly reflect objective visual acuity outcomes. Post–contact lens BCVA showed a significant negative correlation with concern about discontinuing contact lens use due to high cost ($r=-0.46$, $p=0.015$). In contrast, post–contact lens BCVA was positively correlated with the perceived improvement in visual quality ($r=0.56$, $p=0.002$), overall satisfaction with contact lens use ($r=0.48$, $p=0.011$), and perceived improvement in quality of life resulting from improved vision with contact lenses ($r=0.52$, $p=0.005$). The change in post–contact lens BCVA showed a significant negative correlation with concern about discontinuing contact lens use due to high cost ($r=-0.43$, $p=0.021$). In contrast, BCVA change was positively correlated with overall satisfaction with contact lens use ($r=0.41$, $p=0.040$), perceived improvement in quality of life due to improved vision with contact lenses ($r=0.44$, $p=0.029$), and successful adaptation to contact lens use within two weeks ($r=0.40$, $p=0.040$).

Discussion

This study demonstrates that rigid contact lens use results in substantial improvements in visual acuity and vision-related quality of life in patients with

keratoconus. The questionnaire analysis revealed that visual acuity improvement was significantly associated with patient-perceived visual benefit ($p=0.032$) and improved vision-related quality of life ($p=0.007$). Notably, despite substantial visual gains, patients continued to report concerns regarding long-term contact lens use, indicating that visual improvement alone does not fully alleviate treatment-related anxiety. Importantly, the findings suggest that objective visual gains translate into meaningful functional benefits in daily life, reinforcing the role of rigid contact lenses as a primary visual rehabilitation strategy. However, given the exploratory design and limited sample size, the strength of these associations should be interpreted cautiously. This is particularly important given the multiple correlation analyses performed without formal adjustment, which may increase the risk of type I error.

In addition to the quantitative improvement in BCVA, the present findings emphasize the functional relevance of visual rehabilitation in keratoconus. The absence of correlation between VFQ-25 scores and objective visual acuity measures further highlights the complex and multifactorial nature of patient-reported outcomes in keratoconus. The improvements in visual acuity achieved with rigid CLs are clinically meaningful only when they translate into enhanced performance in daily activities such as reading, driving, and digital screen use. The strong association between visual acuity gains and patient-reported functional benefits observed in this study supports the concept that rigid and scleral lenses not only correct refractive error but also improve overall visual quality, which is particularly important in ectatic corneal

disorders characterized by irregular astigmatism and higher-order aberrations. The observed improvement in BCVA is consistent with previous studies reporting the optical superiority of rigid and scleral lenses in neutralizing corneal irregularity [5–7]. Recent systematic evidence further supports that scleral lenses provide substantial improvements in both visual acuity and vision-related quality of life in keratoconus patients [5]. However, our results extend beyond visual acuity by demonstrating a strong association between visual improvement and patient-reported quality-of-life outcomes. This underscores the importance of integrating patient-reported outcome measures into routine keratoconus management.

The rigid and scleral CLs provide visual improvement by masking corneal surface irregularities through the formation of a stable tear lens, thereby reducing higher-order aberrations and improving retinal image quality. The rigid lens designs offer superior optical regularization while spectacle correction remains limited in addressing these aberrations [8]. The present findings reinforce that such optical advantages are perceived by patients and reflected in subjective assessments of visual quality and daily functioning, suggesting the multidimensional impact of contact lens therapy. An interesting finding of this study is the persistence of long-term concerns related to contact lens use, even among patients achieving significant visual improvement. This suggests that patient education and counseling play a critical role in optimizing treatment satisfaction and adherence. Adequate patient education regarding potential difficulties during or after contact lens use may help reduce fears related to corneal damage, lens tolerance, and long-term safety, thereby improving patient confidence and long-term compliance. These persistent concerns may reflect the chronic nature of keratoconus and the long-term dependency on CL wear for functional vision. The fear of lens displacement, discomfort during prolonged wear, and uncertainty about potential corneal complications may contribute to treatment-related anxiety, even in visually successful cases. Addressing these concerns proactively through structured education, realistic expectation setting, and regular follow-up may improve patient reassurance and foster sustained adherence to contact lens therapy.

The decision to analyze RGP and scleral lens users as a single group reflects real-world clinical

practice, where the primary goal is functional visual rehabilitation rather than comparison between lens modalities [9]. Although this approach reflects real-world clinical practice, it may limit the interpretation of lens-specific effects, particularly given known differences in comfort and adaptation between these modalities. In daily ophthalmic practice, lens selection is often individualized based on disease severity, corneal morphology, comfort, and patient preference, rather than rigid categorization by lens type [4]. The present study captures the overall impact of rigid lens-based visual rehabilitation strategies and reflects pragmatic clinical decision-making by evaluating rigid contact lens users as a unified cohort. This perspective may be particularly relevant when assessing patient-reported outcomes, which are influenced by perceived visual benefit and daily functionality rather than by technical distinctions between lens designs.

Limitations of this study include the relatively small sample size and the subjective nature of questionnaire-based assessments. The limited sample size restricts the statistical power of correlation analyses and may increase the risk of type I or type II errors. In addition, the cross-sectional design and reliance on self-reported data may introduce recall bias and response bias. The cross-sectional design precludes causal inference. In addition, potential selection bias may be present, as only current contact lens users were included. Another limitation is that a portion of the questionnaire was study-specific and not formally validated, which may limit comparability with other studies. Furthermore, RGP and scleral lens users were analyzed as a single group; therefore, the present study does not allow conclusions regarding differences between lens modalities. Nevertheless, combining objective clinical data with patient-reported outcomes represents a major strength and provides a comprehensive perspective on treatment effectiveness. Furthermore, although validated instruments such as the NEI VFQ-25 were incorporated, longitudinal assessment of changes in quality of life over time would provide further insight into the long-term impact of rigid contact lens use. Future studies with larger cohorts and prospective designs may help clarify how visual, functional, and psychosocial outcomes evolve throughout the course of keratoconus management.

Conclusion

Rigid gas-permeable and scleral contact lenses are associated with improvements in visual acuity and vision-related quality of life in keratoconus patients. However, the results of this cross-sectional study should be interpreted cautiously because of the relatively small sample size, exploratory correlation analyses, and the use of a study-specific questionnaire. Future studies with larger cohorts and prospective designs may help clarify how visual, functional, and psychosocial outcomes evolve throughout the course of keratoconus management.

Author contributions G.S.V. and S.S.E. contributed to the conception and design of the study. S.S.E. collected the data. G.S.V. supervised the study. G.S.V. performed the statistical analysis and drafted the manuscript. G.S.V. and S.S.E. interpreted the data and wrote the main manuscript text. All authors reviewed and approved the final version of the manuscript.

Funding The authors have not disclosed any funding.

Data availability The datasets generated and/or analyzed during the current study are not publicly available due to the inclusion of patient data and ethical restrictions but are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

References

1. Singh RB, Koh S, Sharma N et al (2024) Keratoconus. *Nat Rev Dis Prim*. <https://doi.org/10.1038/S41572-024-00565-3>
2. Shneor E, Piñero DP, Doron R (2021) Contrast sensitivity and higher-order aberrations in keratoconus subjects. *Sci Rep* 11(11):12971. <https://doi.org/10.1038/s41598-021-92396-5>
3. Downie LE, Lindsay RG (2015) Contact lens management of keratoconus. *Clin Exp Optom* 98:299–311. <https://doi.org/10.1111/CXO.12300>
4. Rafizadeh SM, Ghochani G, Narooie-Noori F, Khorrami-Nejad M (2025) Keratoconus and quality of life: an updated comprehensive review. *BMC Ophthalmol*. <https://doi.org/10.1186/S12886-025-04320-4>
5. Mushtaq A, Alvi I (2025) Long-term effectiveness of scleral lens treatment in the management of keratoconus: a systematic review. *Cureus*. <https://doi.org/10.7759/CUREUS.77102>
6. Hadimani SR, Kaur H, Shinde AJ, Chottopadhyay T (2023) Quality of life and vision assessment with scleral lenses in keratoconus. *Saudi J Ophthalmol* 38:173. https://doi.org/10.4103/SJOPT.SJOPT_157_23
7. Moschos MM, Nitoda E, Georgoudis P et al (2017) Contact lenses for keratoconus- current practice. *Open Ophthalmol J* 11:241–251. <https://doi.org/10.2174/1874364101711010241>
8. Ruiz-Lozano RE, Gomez-Elizondo DE, Colorado-Zavala MF et al (2022) Update on indications, complications, and outcomes of scleral contact lenses. *Med Hypothesis Disco Innov Ophthalmol* 10:165–178. <https://doi.org/10.51329/MEHDIOPTHAL1435>
9. Uysal BS, Akcay E, Kilicarslan A et al (2020) Tear function and ocular surface changes following corneal collagen cross-linking treatment in keratoconus patients: 18-month results. *Int Ophthalmol* 40:169–177. <https://doi.org/10.1007/s10792-019-01161-1>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.