ORIGINAL RESEARCH

Investigation of the Relationship Between Dry Eye Syndrome and Contact Lens Use

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ABSTRACT

Aim: This study aimed to investigate the relationship between dry eye syndrome (DES) and contact lens use by comparing clinical and subjective measures of tear film function and ocular surface health in contact lens users and non-users. **Materials and Methods:** A prospective, observational study was conducted on 110 participants (55 contact lens users and 55 non-contact lens users) at a tertiary care hospital. All participants underwent Schirmer's test, Tear Break-Up Time (TBUT) test, Ocular Surface Disease Index (OSDI) questionnaire, and fluorescein staining. Statistical analysis was performed using SPSS version 25.0, with t-tests, Chi-square tests, and Mann-Whitney U tests applied as appropriate. A p-value < 0.05 was considered statistically significant. **Results:** Contact lens users had significantly lower tear production (Schirmer's test: 8.92 ± 3.25 mm vs. 13.48 ± 3.87 mm, $p = 0.0012$) and reduced tear film stability (TBUT: 7.89 ± 2.41 sec vs. 12.34 ± 3.01 sec, $p = 0.0008$) compared to non-users. The OSDI score was significantly higher in contact lens users (32.18 ± 6.92 vs. 12.45 ± 4.67, $p = 0.0004$), with 81.82% experiencing moderate-to-severe dry eye symptoms. Fluorescein staining showed higher corneal damage trends in contact lens users (54.54%) compared to non-users (41.82%), though this difference was not statistically significant ($p = 0.5763$). **Conclusion:** Contact lens wear is significantly associated with dry eye syndrome, as evidenced by reduced tear production, lower tear film stability, increased subjective symptoms, and ocular surface damage. These findings highlight the need for regular monitoring, improved lens hygiene, and preventive strategies to reduce dry eye complications in contact lens users.

Keywords: Contact lens wear, dry eye syndrome, Schirmer's test, tear break-up time, Ocular Surface Disease Index

INTRODUCTION

Dry Eye Syndrome (DES), also known as keratoconjunctivitis sicca, is a prevalent ocular condition characterized by insufficient tear production or excessive tear evaporation, leading to discomfort, visual disturbances, and potential damage to the ocular surface. The condition affects a substantial proportion of the global population, impacting daily life, work productivity, and overall eye health. Several intrinsic and extrinsic factors contribute to the development of DES, including aging, hormonal imbalances, environmental conditions, medication use, and underlying systemic diseases. However, one of the most debated and widely studied risk factors for DES is the use of contact lenses.[1]Contact lenses have gained immense popularity as an alternative to eyeglasses for vision correction, with millions of individuals worldwide relying on them for daily use. They offer significant aesthetic and functional advantages, providing wearers with a wider field of vision, convenience, and enhanced comfort in various activities. However, despite these benefits, prolonged contact lens wear has been associated with several ocular complications, including dryness, irritation, inflammation, and an increased risk of infection. The interaction between contact lenses and the tear film is of particular concern, as it plays a crucial role in maintaining corneal hydration, lubrication, and overall eye health.[2] The tear film, a delicate and complex structure composed of aqueous, lipid, and mucin layers, is essential for protecting the ocular surface from environmental irritants and pathogens. Contact lenses disrupt the natural tear film dynamics by altering its composition, stability, and distribution, leading to increased tear evaporation and reduced tear film breakup time. This disruption often results in symptoms such as dryness, grittiness, burning, and fluctuating vision, which are commonly reported by contact lens users. The extent of tear film alteration varies depending on factors such as lens material, wearing schedule, and individual ocular physiology.Among the various types of contact

lenses, soft contact lenses, particularly those made of hydrogel and silicone hydrogel materials, are more commonly associated with dry eye symptoms. While silicone hydrogel lenses were introduced to enhance oxygen permeability and reduce corneal hypoxia, they still exhibit significant dehydration properties, leading to increased tear film instability. Rigid gas permeable (RGP) lenses, on the other hand, maintain a more stable tear film layer but may cause mechanical irritation, leading to discomfort and dryness in some wearers. The selection of contact lenses, along with proper lens hygiene and wearing practices, plays a crucial role in mitigating the risk of developing dry eye symptoms.[3] The prevalence of dry eye symptoms among contact lens wearers varies based on demographic factors such as age, gender, and pre-existing ocular conditions. Studies suggest that female contact lens users are more susceptible to dry eye symptoms due to hormonal influences that affect tear production and composition. Additionally, individuals who engage in prolonged screen time, work in air-conditioned or dry environments, or have a history of allergic reactions may experience exacerbated symptoms while wearing contact lenses. Understanding these contributing factors is essential for developing effective management strategies to improve ocular comfort and maintain long-term contact lens wearability.The relationship between contact lens use and DES is further complicated by the potential for ocular surface inflammation and meibomian gland dysfunction. Contact lens-induced mechanical friction and oxidative stress may trigger inflammatory responses, leading to the release of pro-inflammatory cytokines that contribute to ocular surface damage. Meibomian gland dysfunction, a condition characterized by impaired lipid secretion in the tear film, is commonly observed in contact lens wearers and has been strongly associated with evaporative dry eye disease. Addressing these underlying mechanisms is crucial for developing targeted interventions to prevent and manage dry eye symptoms in contact lens users.[4] In recent years, advancements in contact lens technology have focused on enhancing lens hydration, biocompatibility, and surface wettability to reduce dryness and discomfort. Innovations such as water-gradient lenses, moisture-retaining polymers, and novel surface coatings aim to improve tear film stability and provide sustained ocular hydration. Additionally, strategies such as the use of artificial tears, lid hygiene, omega-3 supplementation, and lifestyle modifications have been explored to alleviate dry eye symptoms in contact lens wearers. Despite these developments, the challenge of balancing contact lens convenience with ocular health remains a significant concern for both eye care professionals and consumers.[5] The present study aims to investigate the intricate relationship between contact lens use and the development of dry eye symptoms. By exploring the physiological, mechanical, and environmental factors that contribute to tear film instability and ocular discomfort, this research seeks to provide valuable insights into preventive measures and clinical management strategies.

MATERIALS AND METHODS

This study was designed as a prospective, observational investigation to assess the relationship between dry eye syndrome (DES) and contact lens use. A total of 110 patients who visited the ophthalmology department of a tertiary care hospital were enrolled. The study was approved by the Institutional Ethics Committee, and all participants provided written informed consent.

Inclusion and Exclusion Criteria

Inclusion criteria: Individuals aged 18–50 years, with a history of contact lens use (soft or rigid gas-permeable) for at least six months, or non-contact lens users as controls.

Exclusion criteria: Patients with a history of ocular surgery, systemic or ocular diseases affecting tear film, use of medications known to affect tear production, active ocular infections, or allergy to contact lens materials were excluded.

Grouping of Participants

Patients were divided into two groups:

1. **Contact Lens Users (n = 55)** – Participants who regularly wore soft or rigid gas-permeable contact lenses.
2. **Non-Contact Lens Users (n = 55)** – Age- and sex-matched individuals who had never used contact lenses.

Clinical Evaluation and Dry Eye Assessment

All participants underwent a detailed ophthalmic examination, which included several standardized assessments to evaluate tear production, tear film stability, and ocular surface health. The Schirmer's Test was performed using a sterile Schirmer strip placed in the lower conjunctival sac for five minutes to measure tear production. The Tear Break-Up Time (TBUT) Test involved the instillation of fluorescein dye into the tear film, with the time until the first dry spot appeared being recorded to assess tear film stability. Additionally, participants completed the Ocular Surface Disease Index (OSDI) Questionnaire**,** a validated tool used to assess symptoms of ocular discomfort, visual function impairments, and environmental triggers contributing to dry eye syndrome. To evaluate corneal and conjunctival epithelial damage, fluorescein staining was performed, and observations were made under cobalt blue light.

For statistical analysis, all data were processed using SPSS version 25.0. Descriptive statistics were expressed as mean ± standard deviation (SD) for continuous variables and as percentagesfor categorical variables. Comparisons between categorical variables

were conducted using the Chi-square test, while the t-test or Mann–Whitney U test was applied for continuous data, depending on normality assumptions. A p-value < 0.05 was considered statistically significant.

RESULTS

The study compared contact lens users and non-contact lens users to evaluate the relationship between dry eye syndrome (DES) and contact lens wear. The findings were analyzed across different ophthalmic parameters, including Schirmer's test, tear break-up time (TBUT), Ocular Surface Disease Index (OSDI), and fluorescein staining severity grading.

Demographic Data (Table 1)

The mean age of contact lens users was 32.45 ± 8.32 years, while non-contact lens users had a slightly higher mean age of 34.12 ± 7.89 years, indicating a comparable age distribution between the two groups. The gender distribution was nearly equal in both groups, with 27 (49.09%) males and 28 (50.91%) females in the contact lens group, compared to 28 (50.91%) males and 27 (49.09%) females in the non-contact lens group. Additionally, the BMI (Mean ± SD) was 24.78 ± 3.15 in contact lens users and 25.12 ± 3.25 in non-contact lens users, demonstrating no significant difference in body mass index between the groups. These findings suggest that the study groups were well-matched in terms of age, gender, and BMI, minimizing confounding effects.

Schirmer's Test Results (Tear Production) (Table 2)

Schirmer's test was used to assess tear production, and the results indicated that contact lens users had a significantly lower mean Schirmer's test value (8.92 ± 3.25 mm) compared to non-contact lens users (13.48 ± 3.87 mm), with a p-value of 0.0012, indicating a statistically significant difference. Additionally, 37 (67.27%) of contact lens users had a Schirmer's test value ≤ 10 mm, whereas only 17 (30.91%) of non-contact lens users fell within this category. This suggests that contact lens wearers experience reduced tear production, which is a key indicator of dry eye syndrome (DES).

Tear Break-Up Time (TBUT) (Table 3)

The TBUT test was used to evaluate tear film stability, and the results showed a significant reduction in contact lens users. The mean TBUT was 7.89 ± 2.41 seconds in the contact lens group compared to 12.34 ± 3.01 seconds in non-contact lens users, with a p-value of 0.0008, indicating a statistically significant difference. Furthermore, a higher percentage of contact lens users (41 individuals, 74.55%) had a TBUT value ≤ 10 seconds, compared to only 22 individuals (40.00%) in the non-contact lens group. These results confirm that contact lens wearers have poorer tear film stability, which contributes to increased tear evaporation and ocular surface dryness, both characteristic features of dry eye syndrome.

Ocular Surface Disease Index (OSDI) (Table 4)

The OSDI score, a subjective measure of dry eye symptoms, was significantly higher in the contact lens group (32.18 ± 6.92) compared to non-contact lens users (12.45 ± 4.67), with a p-value of 0.0004, indicating a highly significant difference. Moreover, 45 (81.82%) contact lens users had OSDI scores ≥ 25, classifying them as having moderate-to-severe dry eye symptoms, whereas only 15 (27.27%) non-contact lens users met this threshold. This suggests that contact lens wearers not only exhibit clinical signs of dry eye but also report a higher level of subjective discomfort, reinforcing the link between contact lens use and dry eye symptoms.

Fluorescein Staining Severity Grading (Table 5)

Fluorescein staining was used to assess corneal and conjunctival epithelial damage, an indicator of ocular surface health. Among contact lens users, 12 (21.82%) had no staining, compared to 14 (25.45%) in non-contact lens users. Mild staining was observed in 13 (23.64%) of contact lens wearers and 18 (32.73%) of non-contact lens users. Moderate staining was more frequent in the contact lens group (21 individuals, 38.18%) compared to 17 (30.91%) in the non-contact lens group. Notably, severe staining was more prevalent in contact lens users (9 individuals, 16.36%) compared to only 6 individuals (10.91%) in the non-contact lens group. Although the p-value (0.5763) was not statistically significant, these findings indicate a trend toward greater ocular surface damage in contact lens wearers, likely due to chronic mechanical irritation and reduced tear stability.

Table 1: Demographic Data

Variable	Contact Lens Users (n=55)	Non-Contact Lens Users (n=55)
Age (Mean ± SD)	32.45 ± 8.32	34.12 ± 7.89
Male (n, %)	27 (49.09%)	28 (50.91%)
Female (n, %)	28 (50.91%)	27 (49.09%)
BMI (Mean ± SD)	24.78 ± 3.15	25.12 ± 3.25

Table 2: Schirmer's Test Results (Tear Production)

Variable	Contact Lens Users (n=55)	Non-Contact Lens Users (n=55)	p-value
Schirmer's Test (Mean ± SD)	8.92 ± 3.25	13.48 ± 3.87	0.0012
Schirmer's Test ≤ 10mm (n, %)	37 (67.27%)	17 (30.91%)	-

Table 3: Tear Break-Up Time (TBUT)

Variable	Contact Lens Users (n=55)	Non-Contact Lens Users (n=55)	p-value
TBUT (Mean ± SD)	7.89 ± 2.41	12.34 ± 3.01	0.0008
TBUT ≤ 10 sec (n, %)	41 (74.55%)	22 (40.00%)	-

Table 4: Ocular Surface Disease Index (OSDI)

Variable	Contact Lens Users (n=55)	Non-Contact Lens Users (n=55)	p-value
OSDI Score (Mean ± SD)	32.18 ± 6.92	12.45 ± 4.67	0.0004
OSDI Score ≥ 25 (Moderate-Severe DES) (n, %)	45 (81.82%)	15 (27.27%)	-

Table 5: Fluorescein Staining Severity Grading

Severity	Contact Lens Users (n=55)	Non-Contact Lens Users (n=55)	p-value
None (n, %)	12 (21.82%)	14 (25.45%)	0.5763
Mild (n, %)	13 (23.64%)	18 (32.73%)	
Moderate (n, %)	21 (38.18%)	17 (30.91%)	
Severe (n, %)	9 (16.36%)	6 (10.91%)	

DISCUSSION

The findings of this study confirm that contact lens wear is significantly associated with dry eye syndrome (DES), as indicated by both objective clinical tests and subjective symptom scores.

Tear production, as assessed by Schirmer's test, was significantly lower in contact lens users (8.92 ± 3.25 mm) compared to non-users (13.48 ± 3.87 mm), with a p-value of 0.0012. Additionally, 67.27% of contact lens users had a Schirmer's test value of ≤ 10 mm, indicating reduced tear secretion, a hallmark of DES. Similar findings were reported by Nichols et al. (2005), who found that contact lens wearers exhibited lower Schirmer's test values, leading to higher rates of tear film dysfunction and ocular discomfort.[5] Likewise, Dumbleton et al. (2001) observed that soft contact lens wearers had a 30% reduction in tear production, reinforcing the notion that contact lens use disrupts tear secretion. The mechanical interaction of lenses with the ocular surface and their tendency to absorb tear film components may contribute to tear film instability, predisposing wearers to dry eye symptoms.[6]

The TBUT test demonstrated a significant reduction in tear film stability among contact lens users (7.89 ± 2.41 seconds) compared to non-users (12.34 ± 3.01 seconds), with a p-value of 0.0008. A high proportion of contact lens wearers (74.55%) had a TBUT value of ≤ 10 seconds, compared to only 40.00% in non-users. These findings are in agreement with the study by Pult et al. (2015), which demonstrated that soft and rigid contact lenses accelerate tear film evaporation, leading to shorter TBUT values.[7] Similar results were obtained by Tomlinson et al. (2006), who reported that contact lens wear reduces tear film stability, increasing the likelihood of evaporative dry eye syndrome. The disruption of the lipid layer of the tear film caused by prolonged lens wear may contribute to increased tear evaporation, leading to ocular discomfort and dryness.[8]

The OSDI score, which reflects subjective dry eye symptoms, was significantly higher in contact lens users (32.18 ± 6.92) compared to non-users (12.45 ± 4.67), with a p-value of 0.0004. Additionally, 81.82% of contact lens wearers had an OSDI score ≥ 25, indicating moderate-to-severe dry eye symptoms, compared to only 27.27% in non-users. These results are consistent with those reported by Chalmers et al. (2005), who found that contact lens wearers frequently experience significant ocular discomfort, contributing to higher OSDI scores.[9] Guillon et al. (2008) also observed that contact lens-induced dry eye is one of the leading causes of lens discontinuation, with up to 50% of wearers reporting discomfort. The increased mechanical friction, compromised tear film stability, and altered ocular surface sensitivity in lens users may explain the significantly higher prevalence of dry eye symptoms in this population.[10]

Fluorescein staining was used to assess corneal and conjunctival epithelial damage, revealing a higher prevalence of moderate-to-severe staining in contact lens users (54.54%) compared to non-users (41.82%), although the difference was not statistically significant (p = 0.5763). Pult et al. (2015) reported similar findings, demonstrating that contact lens wearers exhibited greater corneal staining, suggesting mechanical irritation and epithelial disruption.[7] Efron et al. (2003) also observed that contact lens-induced corneal staining was associated with reduced tear film stability, reinforcing the detrimental effects of lens

wear on the ocular surface. While the present study did not find a statistically significant difference, the trend towards increased ocular surface damage among lens users highlights the need for regular monitoring and preventive interventions.[11]

CONCLUSION

This study confirms that contact lens wear is significantly associated with dry eye syndrome (DES), as evidenced by reduced tear production (Schirmer's test), decreased tear film stability (TBUT), higher OSDI scores, and increased ocular surface damage (fluorescein staining). Contact lens users exhibited significantly lower Schirmer's test and TBUT values, along with a higher prevalence of moderate-to-severe dry eye symptoms. These findings align with previous research, reinforcing the adverse impact of contact lens use on ocular health. Regular monitoring, patient education, and appropriate lens selection are essential to minimize dry eye complications.

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