Prevalence and Impact of Undiagnosed Dry Eye and Meibomian Gland Dysfunction in Patients Undergoing Cataract Surgery: Insights from a Tertiary Care Center

Fahri Onur Aydin[1], Serkan Guler[1], Irem Onal[1], Ali Ceylan[1], Burak Mergen[2], Yusuf Yildirim[1]

ABSTRACT

Purpose: This study aimed to determine the prevalence of dry eye and meibomian gland dysfunction among patients with or without comorbidities undergoing cataract surgery.

Methods: The study included 388 patients who underwent cataract surgery at a tertiary center. Meibomian gland dysfunction was evaluated by assessing meibomian gland loss area (%) and meiboscore grading using meibography. Non-invasive tear break-up time (NI-BUT), corneal fluorescein staining (Oxford score), and symptom scores using the Ocular Surface Disease Index (OSDI) were employed to assess dry eye. Patients were divided into two groups according to their age: <70 and ≥70 years. Comorbidities (diabetes mellitus, hypertension, rheumatologic disease, and glaucoma) were also recorded.

Results: The mean age of the patients was 67.5 ± 10.4 years, with 208 (53.6%) being male. All patients had meibomian gland atrophy of ≥ grade 1, and 79.1% had corneal staining (Oxford ≥1). Age subgroup analysis revealed that patients <70 years exhibited less meibomian gland area loss and significantly better gland function compared to those aged 70 to 90 years (p=0.011). No significant differences were observed between tear film parameters. It was observed that patients with more than two comorbidities exhibited worse meiboscore results and more severe dry eye findings.

Conclusion: The study demonstrated that the coexistence of meibomian gland atrophy and dry eye is common in patients undergoing cataract surgery evaluation. To prevent undesirable postoperative outcomes, it is crucial to routinely assess the eyelids and ocular surface, including meibography, preoperatively.

Keywords: Meibography, cataract surgery, ocular surface disease, meibomian gland dysfunction

INTRODUCTION

Cataract surgery is one of the most common surgical procedures performed globally, especially among older patients.[1,2] The main goal of the surgery is to improve visual acuity and overall vision quality. To achieve accurate postoperative refractive outcomes, precise intraocular lens power determination is based on thorough preoperative measurements and a healthy ocular surface. Aging can cause changes in the structure and function of the eyelids and meibomian glands that lead to dry eye syndrome.[3,4] Dry eye can cause an increase in tear osmolarity and inflammatory cytokines, reduced corneal sensitivity, and a lack of aqueous layer, which can lead to ocular surface damage.[5,6] Dry eye and meibomian gland dysfunction (MGD) are among the primary patient-related factors that impact surgical outcomes.[7,8] MGD can cause an evaporative type of dry eye, which results from a compromised lipid layer.[9] Studies have shown that patients with preoperative chronic meibomian gland dysfunction and dry eye syndrome may experience a decrease in visual quality after surgery.[10]

1 Basaksehir Cam and Sakura City Hospital , Ophthalmology, Basaksehir, Türkiye

2 Care Vision Freiburg, Ophthalmology, Freiburg im Breisgau, Germany

Received: 10.04.2025
Accepted: 22.08.2025
First Online: 04.11.2025
TJ-CEO 2025; 20: 235-243
DOI: 10.37844/TJ-CEO.2025.20.31

Corresponding author:
Fahri Onur Aydin
Email: onuraydin90@hotmail.com

Meibography and non-invasive tear break-up time (NI-BUT), in conjunction with other tear function tests, facilitate the easy and non-invasive detection of dry eye and meibomian gland dysfunction, as well as additional ocular surface issues, particularly in individuals being prepared for cataract surgery.

The primary objective of this study was to evaluate the prevalence and severity of dry eye disease and meibomian gland dysfunction in patients undergoing cataract surgery, while exploring the influence of comorbidities and age-related changes on ocular surface parameters.

MATERIALS AND METHODS

In this study, we aimed to retrospectively review the medical records of patients who had vision loss due to cataracts and were referred for phacoemulsification between May 2022 and January 2023. The study adhered to the principles stated in the Declaration of Helsinki and received approval from the local ethics committee. (KAEK:2024-114)

In the study, all participants underwent a comprehensive biomicroscopic examination, meibography for visualizing glandular structure and measurements, symptom evaluation using the Ocular Surface Disease Index (OSDI), measurement of Non-Invasive Tear Break-Up Time (NI-BUT), and assessment of corneal staining via the Oxford scoring system before undergoing cataract surgery. To avoid bias from the correlation between eyes, only data from one eye were included in the analysis for patients with cataracts in both eyes. The right eye was consistently chosen for uniformity in the study.

Patients under 18 years of age, those who had undergone ocular surgery or had a history of contact lens use within the last 3 months, and those with active ocular infection or allergies were excluded from the study.[11] Patients who had previously been diagnosed and treated for dry eye were also excluded, along with those for whom meibography and NI-BUT data could not be properly measured. Only patients with low visual acuity due to cataracts were included in the study. For those included with advanced meibomian gland dysfunction and dry eye, surgery was planned only after successful treatment and rehabilitation.

Evaluated parameters

All patient evaluations involving non-contact meibography and non-invasive tear break-up time were performed using a modified Sirius® Scheimpflug Camera (C.S.O, Costruzione Strumenti Oftalmici, Florence, Italy) equipped with the Phoenix-Meibography Imaging software module.

In all patients, only the measurements of the lower eyelid were included in the analysis for ease of administration. Although upper and lower lid MG morphologies are different, they have been shown to correlate with each other.[12] The meibomian glands were then observed within a trapezoidal area on the eyelid. To calculate the extent of meibomian gland loss, the percentage of the gland-free area was determined relative to the total visible tarsal area. This calculation was automatically performed and assigned a grade when the flag icon was clicked. To further assess the extent of meibomian gland loss, subsequent grades (meibo-score) were used to indicate partial or complete loss. The Phoenix software provided measurements of dropout percentage, along with categorized dropouts graded on a scale within the area. In this context, the decrease in size of the meibomian glands located in the lower eyelid were divided into stages based on the percentage of tissue loss.

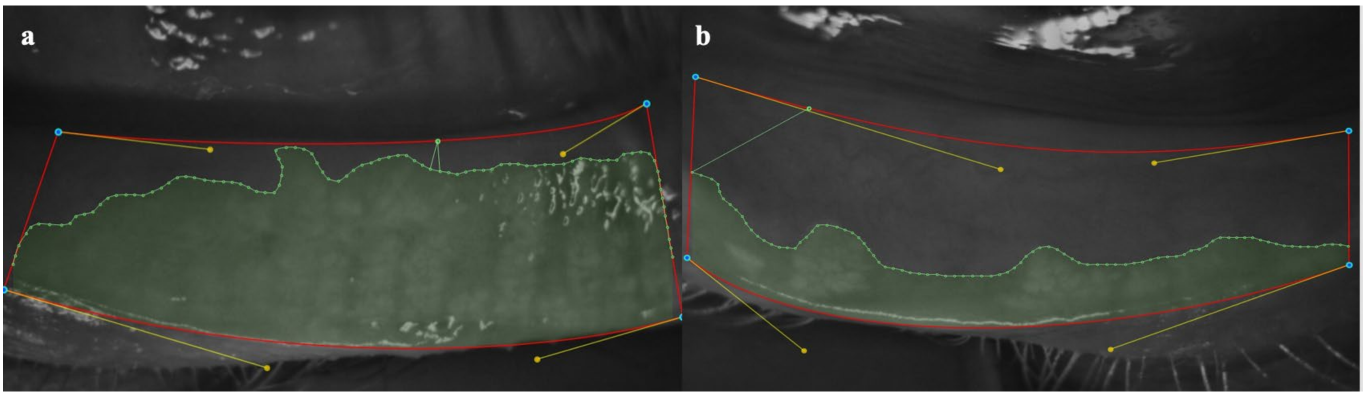

Figure 1: *Meibography measurement showing stage 1 meiboscore (a). Meibography measurement showing significant preoperative meibomian gland atrophy-stage 3 (b).*

Stage 0 indicates that there is no loss of glandular tissue, while stage 1 means that the loss is up to 25% (Figure 1a). If the loss ranges from 26% to 50%, it is categorized as stage 2, while stage 3 is assigned to loss ranging from 51% to 74% (Figure 1b). When the loss reaches or exceeds 75%, it is classified as stage 4.[13]

The non-invasive BUT was measured using the same device consistently during the same hours (9:00-12:00 AM).[14] Patients were instructed to blink twice and then keep their eyes open until the measurement was complete. Three consecutive measurements were taken, and the average NI-BUT was used in the analysis. After this, corneal and conjunctival staining was performed under cobalt blue light, after using a fluorescein strip, and graded on a scale of 0 to 5 based on the Oxford scoring system.[15]

The OSDI scores were calculated from responses to a 12-question survey, which is segmented into three categories. This test involves 12 questions, each with answers scored from 0 to 4, where 0 signifies 'never' and 4 represents 'always'. The total OSDI score ranges from 0 to 100, with higher scores indicating greater levels of disability.[16]

In the study, we recorded data from patients with systemic comorbidities that could affect the ocular surface, such as diabetes, hypertension, and rheumatic disease, and they were categorized based on their comorbidities. Those without comorbidities were classified as group 1, those with one comorbidity as group 2, and those with two or more comorbidities as group 3. Additionally, we documented patients diagnosed with glaucoma who had been using antiglaucomatous drops for more than three months. Notably, all of the antiglaucomatous drops used by these patients contained preservatives. We included these comorbidities because of the increasing prevalence of these diseases, especially in the elderly population in our patient group, and the reliability of obtaining this data through retrospective screening. [17,18]

Statistical analysis

The statistical analysis of the data was conducted using SPSS (Statistical Package for the Social Sciences) for Windows, version 25.0 (SPSS Inc., Chicago, IL, USA). To assess the normality of the variables, histogram plots and the Shapiro-Wilk test were utilized. Descriptive data analyses were presented with median, minimum, and maximum values. For comparing 2x2 tables, Pearson's Chi-Square and Fisher's Exact tests were employed. The Mann-Whitney U test was applied to compare nonparametric data in paired groups. Non-parametric data across multiple groups were compared using the Kruskal–Wallis test, with post hoc pairwise comparisons adjusted using the Bonferroni correction. P values below 0.05 were accepted as statistically significant.

RESULTS

The study included 388 patients. Of these, 208 (53.6%) were male and 180 (46.4%) were female. The mean age of patients was 67.9 ± 9.51 years (range: 34–87 years). The mean NI-BUT was 9.8 ± 5.4 seconds. Only 193 (49.7%) of the patients had NI-BUT ≥ 10 seconds. In 25.3% of the patients, NI-BUT was less than 5 seconds (Figure 2a). The mean meibomian gland area loss was 32.9 ± 11.2%. While grade 2 area loss was observed in 68.3% of the patients, grade 4 area loss was not observed in any patient (Figure 2b). Corneal fluorescence staining was observed in 79.1% of the cases. There was an inverse correlation between meibography area loss and NI-BUT ($p<0.001$, r:-0.403) (Figure 3). The mean Oxford score was 1.96±1.4 and the mean OSDI score of the patients was 41.4±28.2.

When the patients were divided according to gender, no significant difference was observed between the groups in any of the parameters. As the patients were divided into two subgroups according to their age, those above and below 70 years of age, meibomian area loss was significantly higher in the group above 70 years of age. In addition, although NI-BUT and OSDI values were worse in patients aged 70 years and older, no statistical difference was observed. (Table 1)

When examining comorbidities, there were 60 (15.5%) patients with glaucoma, 52 (13.4%) patients with rheumatological diseases, 148 patients with diabetes (38.1%), and 172 (44.3%) patients with hypertension. There was a significant increase in the frequency with age. Additionally, patients with two or more comorbidities showed a higher meiboscores and a significantly greater field loss compared to those without comorbidities. (Table 2). Detailed distribution of comorbidities in the groups and the relationship

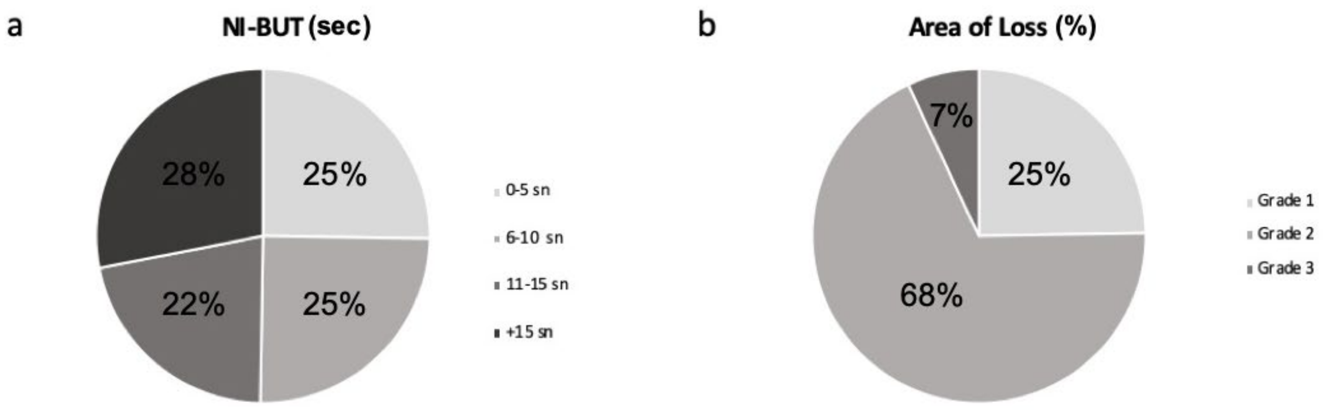

Figure 2: *Pie chart graph of NI-BUT at preoperative evaluation (a) and meibomian gland loss with meiboscore (b).*

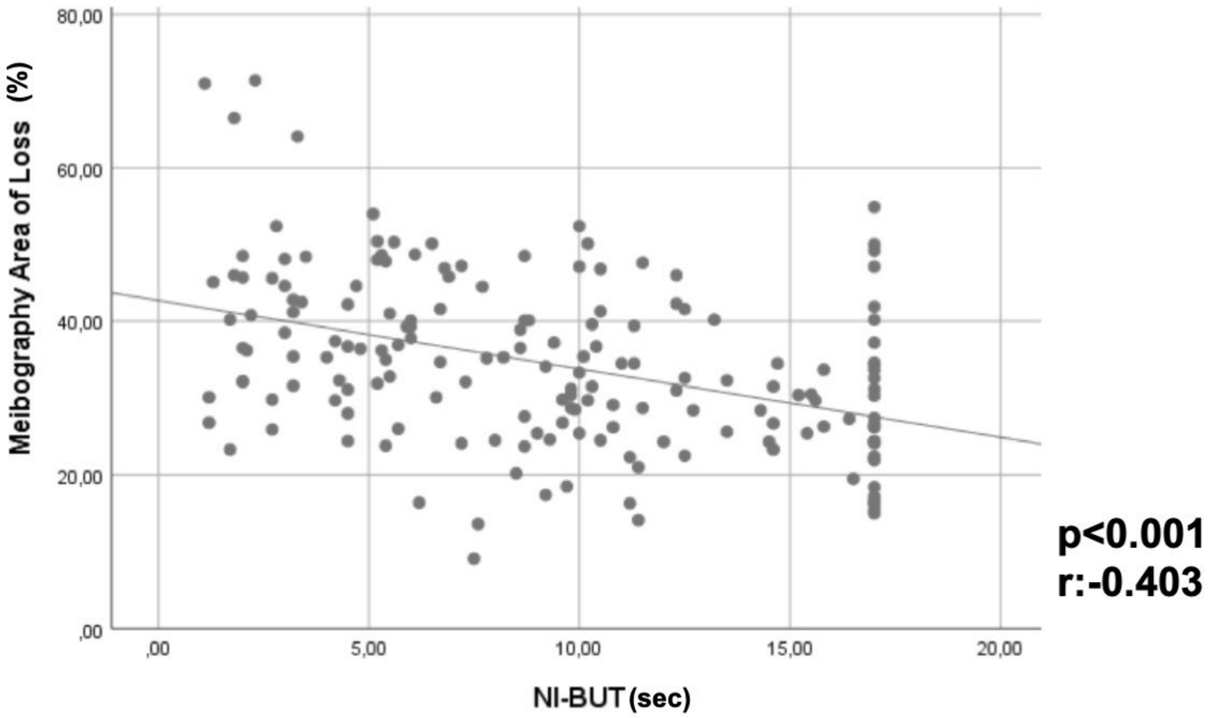

Figure 3: *Scatter plot of the relationship between meibomian gland area loss and NI-BUT.*

NI-BUT: Non-invasive tear breakup time

Table 1: *The clinical parameters and symptom scores of patients were compared according to gender and age groups*

Median (min/max)	n	NI-BUT (sec)	Area of loss (%)	Meiboscore	Oxford score	OSDI
Total	388	9.9 (1.1/17.0)	31.2 (3.8/74.3)	2 (1/3)	2 (0/5)	38.2 (0/97.7)
Sex						
Male	208	10.2 (1.1/17.0)	30.9 (3.8/71.4)	2 (1/3)	2 (0/5)	36.9 (0/94.4)
Female	180	8.7 (1.2/17.0)	32.0 (13.6/74.3)	2 (1/3)	2 (0/5)	38.7 (0/97.7)
p-value		0.311	0.378	0.610	0.585	0.371
Age						
<70 (30-69)	198	10.5 (1.2/17.0)	30.3 (3.8/74.3)	2 (1/3)	2 (0/5)	35.0 (0/97.7)
≥70 (70-90)	190	9.5 (1.1 /17.0)	32.4 (9.1/71.4)	2 (1/3)	2 (0/5)	44.9 (0/96.7)
p value$^{\Psi}$		0.127	0.011*	0.058	0.498	0.092

$^{\Psi}$Mann-Whitney *U* Test
NI-BUT: Non-invasive tear breakup time, OSDI: Ocular Surface Disease Index
*p value <0.05 was considered statistically significant

Table 2: *The relationship between comorbidities and dry eye, meibography parameters, and symptom scores in groups*

Median (min-max)	Age (years)	NI-BUT (sec)	Area of loss (%)	Meiboscore	Oxford score	OSDI
Group 1 (n=120)	66 (34/85)	10.1 (1.5/17.0)	30.9 (3.8/64.1)	2(1/3)	2(0/5)	33.7 (0/94.4)
Group 2 (n=144)	70 (44/87)	10.3 (1.2/17.0)	31.8 (13.6/63.2)	2(1/3)	2(0/5)	34.7 (0/96.7)
Group 3 (n=124)	71 (53/87)	8.8 (1.1/17.0)	31.3 (13.8/74.3)	3(1/3)	2(0/5)	45.0 (0/97.7)
p value (1-2)^{a}	0.006*	0.506	0.364	0.688	0.993	0.670
p value (2-3)^{a}	0.097	0.303	0.330	0.030*	0.105	0.175
p value (1-3)^{a}	<0.001*	0.131	0.046*	0.014*	0.096	0.095

NI-BUT: Non invasive tear breakup time, OSDI: Ocular Surface Disease Index
*p^{a} value <0.05 was considered statistically significant (adjusted p value due to Bonferroni correction)

Table 3. *Detailed distribution of comorbidities in the groups and the relationship between dry eye, meibography parameters, and symptom scores*

Median (min/max)	n	NI-BUT (sec)	Area of loss (%)	Meiboscore	Oxford score	OSDI
Group 2	140					
DM	38	10.2 (1.2/17.0)	28.8 (14.1/47.8)	2 (1/2)	2 (0/5)	36.2 (2.0/92.6
HT	56	10.3 (1.2/17.0)	31.4 (14.5/63.2)	2 (1/3)	2 (0/4)	34.0 (0/96.7)
RhD	24	9.7 (1.2/17.0)	30.3 (13.6/53.6)	2 (1/3)	1 (0/5)	21.4 (4/81)
Glc	22	10.8 (1.2/17.0)	36.6 (16.2/60.8)	2 (1/3)	2 (0/5)	42.7 (3.3/87.4)
Group 3	128					
DM + HT	68	9.1 (1.2 /17.0)	30.4 (16.6/74.3)	2 (1/3)	2 (0/5)	38.5 (3/94.5)
DM + RhD	4	4.2 (1.8/14.7)	41.2 (31.6/66.5)	2 (2/3)	2.5 (1/4)	69.3 (19.3/76.3)
DM + Glc	6	12.6 (5.6/17.0)	33.8 (29.7/37.4)	2 (2/2)	2.5 (0/3)	49.2 (11.1/67.2)
HT + RhD	4	7.9 (3.0 /10.2)	34.5 (29.7/48.1)	2 (2/2)	2.5 (2/3)	62.5 (45.0/72.4)
HT + Glc	12	9.7 (2.5 /17.0)	29.2 (15.4/50.4)	2 (1/3)	2 (0/4)	42.0 (7.6/97.7)
Glc + RhD	2	3.8 (3.0 /4.7)	29.9 (26.0/33.8)	2 (2/2)	1.5 (1/2)	36.2 (35.8/36.6)
DM + HT + RhD	14	6.2 (1.1/17.0)	41.7 (13.8/71.4)	2 (1/3)	2.5 (0/5)	59.4 (0/93.2)
DM + HT + Glc	14	11.5 (1.5/17)	30.7 (20.3/59.4)	2 (1/3)	2 (0/4)	39.6 (3.0/82.4)
DM + HT + Glc + RhD	4	4.2 (1.3/11.0)	38.0 (29.5/46.0)	2 (2/2)	4 (2/5)	80.3 (44.4/95.6)

Diabetes Mellitus (DM), Glaucoma (Glc), Hypertension (HT), NI-BUT: Non invasive tear breakup time, OSDI: Ocular Surface Disease Index, Rheumatological diseases (RhD)

between dry eye, meibography parameters, and symptom scores. (Table 3)

DISCUSSION

A healthy ocular surface is crucial for successful outcomes following cataract surgery. This requires proper morphology and function of the meibomian glands, as well as adequate tear distribution.[19] MGD and dry eye syndrome are prevalent, particularly in older populations. While MGD commonly leads to evaporative dry eye, tear deficiency dry eye can also occur in older individuals due to various factors unrelated to meibomian gland function.[5] In our study, we examined the prevalence of dry eye and MGD, focusing on gland atrophy and its correlation with symptom scores in patients prior to cataract surgery.

MGD is characterized by changes in the lipid composition of the glands with age, alterations in lid commensals, and inflammatory signs at the lid margin due to elevated levels of pro-inflammatory cytokines and bacterial exotoxins.[9,20] Additionally, acinar atrophy and hyperkeratinization of the terminal ducts compromise the effective spreading of the lipid layer across the ocular surface.[21] These changes lead to altered distribution and increased osmolarity of the underlying aqueous layer, resulting in evaporative dry eye. Furthermore, with advancing age, aqueous deficiency dry eye may occur due to decreased tear production from atrophic changes in the lacrimal gland and the increased use of systemic medications that cause reflex hyposecretion.[5]

Numerous studies highlight the prevalence of MGD based on age and ethnicity.[4,22–24] These studies indicate that the severity of meibomian gland atrophy increases with age, while gland function diminishes.[4,25] In our study, patients were categorized into two age groups; the highest incidence of meibomian gland atrophy accompanied by dry eye symptoms was noted in the 71-90 age group, aligning with broader literature findings. Similar to our research, Lin et al. analyzed meibomian gland atrophy and tear function before cataract surgery, revealing that grade 2 and more extensive gland atrophy typically develops with age and is linked to worsening tear distribution parameters.[22] Prevalence studies on MGD prior to cataract surgery have shown that 95% of older patients exhibited gland atrophy,[24] while another study found 56% of the participants had meibomian gland atrophy and noted a decrease in lipid layer thickness and an increase in MGD among patients with higher dry eye symptom scores.[23] The variation in prevalence observed between studies may be attributed to differences in ethnicity, the number of patients in each group, and age.

We also found that corneal staining is associated with MGD. While other studies on MGD may report mild to moderate corneal-conjunctival punctate epitheliopathy, severe corneal staining due to increased evaporative dry eye is often noted in advanced cases.[3,26] Additionally, age-related dry eye, along with systemic conditions such as diabetes, hypertension, thyroid disorders, rheumatological diseases, and systemic treatments, contribute to these findings.[9,22] Notably, the use of topical eye drops, particularly anti-glaucomatous eye drops, is known to cause irregularities in both the meibomian gland structure and primarily the ocular surface.[27] In our study, a significant difference in meibomian gland loss and meiboscore was observed in the group with no risk factors (Group 1) and the group with two or more comorbidities (Group 3). It was also noted that the incidence of comorbidities increased with age, and the degree of gland atrophy increased accordingly. Analyzing the comorbidities separately, it was observed that the dry eye parameters of patients with rheumatologic diseases were worse than the other comorbidities in our study, but statistical analysis could not be performed because the number of subgroup samples was small. Rheumatologic diseases are risk factors for dry eye as supported by the study of Bustamante-Arias et al.[28]

It is well-established that androgens have a positive influence on meibomian gland function by promoting lipogenesis and reducing hyperkeratinization, whereas estrogens have a negative impact.[5,20,29] In older men, the decline in androgens leads to goblet cell dysfunction and tissue atrophy around the gland.[29] Conversely, hormone replacement therapies that include estrogen in women result in similar outcomes.[30] However, in our study, no differences were observed between age groups based on gender. This anomaly may be attributed to the broader age range of the included patients, extending toward younger individuals.

Evaluating the ocular surface before cataract surgery is essential, particularly for patients who will receive toric and multifocal intraocular lenses, as this allows for accurate keratometric measurements and precise lens calculations.[31,32] Moreover, cataract surgery can exacerbate dry eye due to surgical stress and the use of preservative drops in the postoperative period.[33,34] Studies have shown that patients with high OSDI scores preoperatively tend to have persistent dry eye symptoms postoperatively.[35] Treating MGD and related dry eye symptoms before surgery can improve refractive outcomes postoperatively and reduce vision-quality issues, such as high-order aberrations.[7,10,36] A recent study by Yeu et al. found gland dysfunction through meibography in patients without a history of dry eye or clinically normal meibomian gland evaluations, supporting the recommendation for routine assessment of these factors before surgery.[24]

The limitations of the study include its retrospective design, which restricted the ability to document semiquantitative assessments such as meibomian gland secretion quality, gland expressibility, and eyelid margin alterations. Another limitation of the study is the anatomical difference between the upper and lower eyelids, which suggests that they should ideally be analyzed separately.[37] However, due to the retrospective design of the study and the difficulty in obtaining reliable upper eyelid eversion in elderly patients, measurements from the upper eyelid were not included. In addition, the variety of comorbidities is another limitation. Further studies that integrate clinical findings with symptom scores are needed to enable a more comprehensive evaluation and enhance the generalizability of the results.

In conclusion, the prevalence of dry eye and MGD is notably high among patients seeking cataract surgery, particularly within the elderly demographic. Given the potential unreliability of patients' symptom scores alone, it is advisable to routinely employ meibography to assess gland structure during preoperative evaluations. This approach helps prevent missed diagnoses of MGD in these patients. Early detection and treatment of MGD and related dry eye conditions can significantly enhance postoperative visual outcomes and overall ocular surface health.

STATEMENTS AND DECLARATIONS

Conflicts of Interest: *The authors declare that there is no conflict of interest to disclose.*

Financial interests: The authors declare that the study received no funding.

Presented In: The abstract was presented as oral presentation at the 56th Congress of TOA.

REFERENCES

1. Jaycock P, Johnston RL, Taylor H, et al. The Cataract National Dataset electronic multi-centre audit of 55 567 operations: Updating benchmark standards of care in the United Kingdom and internationally. *Eye*. 2009;23(1):38-49.
2. Gollogly HE, Hodge DO, St. Sauver JL, Erie JC. Increasing incidence of cataract surgery: Population-based study. *J Cataract Refract Surg*. 2013;39(9):1383-1389.
3. Pult H. Relationships Between Meibomian Gland Loss and Age, Sex, and Dry Eye. *Eye Contact Lens*. 2018;44:S318-S324.
4. Den S, Shimizu K, Ikeda T, Tsubota K, Shimmura S, Shimazaki J. Association between meibomian gland changes and aging, sex, or tear function. *Cornea*. 2006 Jul;25(6):651-5.
5. Lemp MA, Baudouin C, Baum J, et al. The definition and classification of dry eye disease: Report of the definition and classification subcommittee of the international Dry Eye WorkShop (2007). In: *Ocular Surface*. Vol 5. ETHIS COMMUNICATIONS, INC.; 2007:75-92.
6. Craig JP, Nichols KK, Akpek EK, et al. TFOS DEWS II Definition and Classification Report. *Ocul Surf*. 2017;15(3):276-283.
7. Kieval JZ, Al-Hashimi S, Davidson RS, et al. Prevention and management of refractive prediction errors following cataract surgery. *J Cataract Refract Surg*. 2020;46(8):1189-1197.
8. Röggla V, Leydolt C, Schartmüller D, et al. Influence of Artificial Tears on Keratometric Measurements in Cataract Patients. *Am J Ophthalmol*. 2021;221:1-8.
9. Tomlinson A, Bron AJ, Korb DR, et al. The international workshop on meibomian gland dysfunction: Report of the diagnosis subcommittee. *Invest Ophthalmol Vis Sci*. 2011;52(4):2006-2049.
10. Liu RJ, Ma BK, Gao YF, Liu YY, Qi H. Evaluations of wavefront aberrations and corneal surface regularity in dry eye patients measured with OPD Scan III. *Int J Ophthalmol*. 2022;15(3):407-412.
11. Ifrah R, Quevedo L, Gantz L. Topical review of the relationship between contact lens wear and meibomian gland dysfunction. *J Optom*. 2023;16(1):12-19.
12. Pult H, Riede-Pult BH, Nichols JJ. Relation Between Upper and Lower Lids' Meibomian Gland Morphology, Tear Film, and Dry Eye. *Optometry and Vision Science*. 2012;89(3):E310-E315.
13. Pult H, Nichols JJ. A Review of Meibography. *Optometry and Vision Science*. 2012;89(5):E760-E769.
14. Lee YB, Koh JW, Hyon JY, Wee WR, Kim JJ, Shin YJ. Sleep deprivation reduces tear secretion and impairs the tear film. *Invest Ophthalmol Vis Sci*. 2014;55(6):3525-3531.
15. Bron AJ, Evans VE, Smith JA. Grading Of Corneal and Conjunctival Staining in the Context of Other Dry Eye Tests. *Cornea*; 2003 Oct;22(7):640-50
16. Schiffman RM, Murray ;, Christianson D, Gordon Jacobsen F;, Hirsch JD, Reis BL. Reliability and Validity of the Ocular Surface Disease. *Arch Ophthalmol.* 2000 May;118(5):615-21.
17. Lin HC, Chien CW, Hu CC, Ho JD. Comparison of Comorbid Conditions between Open-Angle Glaucoma Patients and a Control Cohort. *Ophthalmology*. 2010;117(11):2088-2095
18. Viso E, Rodríguez-Ares MT, Abelenda D, Oubiña B, Gude F. Prevalence of Asymptomatic and Symptomatic Meibomian Gland Dysfunction in the General Population of Spain. *Investigative Opthalmology & Visual Science*. 2012;53(6):2601.
19. Matossian C, Chang DH, Whitman J, et al. Preoperative Treatment of Meibomian Gland Dysfunction with a Vectored Thermal Pulsation System Prior to Extended Depth of Focus IOL Implantation. *Ophthalmol Ther*. 2023;12(5):2427-2439.
20. Bron AJ, Tiffany JM. The contribution of meibomian disease to dry eye. *Ocular Surface*. 2004;2(2):149-164.
21. Bron AJ, Benjamin L, Snibson Oxford GR. Meibomian Gland Disease. Classification and Grading of Lid Changes*. Eye (Lond).* 1991;5 (Pt 4):395-411.
22. Lin X, Wu Y, Chen Y, et al. Characterization of meibomian gland atrophy and the potential risk factors for middle aged to elderly patients with cataracts. *Transl Vis Sci Technol*. 2020;9(7):1-11.
23. Cochener B, Cassan A, Omiel L. Prevalence of meibomian gland dysfunction at the time of cataract surgery. *J Cataract Refract Surg*. 2018;44(2):144-148.

24. Yeu E, Koetting C, Calvelli H. Prevalence of Meibomian Gland Atrophy in Patients Undergoing Cataract Surgery.; *Cornea.* 2023 Nov 1;42(11):1355-1359
25. Gupta R, Kumar R, Chauhan L. Anterior chamber morphology changes in eyes with narrow angles by Scheimpflug imaging: Pilocarpine versus laser peripheral iridotomy. *Int Ophthalmol*. 2021;41(6):2099-2108.
26. Giannaccare G, Barabino S, Di Zazzo A, Villani E. Preventing and Managing Iatrogenic Dry Eye Disease during the Entire Surgical Pathway: A Study Focusing on Patients Undergoing Cataract Surgery. *J Clin Med*. 2024;13(3).
27. Lajmi H, Chelly Z, Choura R, Mansour KB, Hmaied W. Relationship between OSDI score and biomicroscopic ocular surface damages in glaucomatous patients treated with preserved antiglaucomatous eye drops. *J Fr Ophtalmol*. 2021;44(9):1326-1331.
28. Bustamante-Arias A, Ruiz Lozano RE, Rodriguez-Garcia A. Dry eye disease, a prominent manifestation of systemic autoimmune disorders. *Eur J Ophthalmol*. 2022;32(6):3142-3162.
29. Sullivan DA, Sullivan BD, Evans JE, et al. Androgen Deficiency, Meibomian Gland Dysfunction, and Evaporative Dry Eye. *Ann N Y Acad Sci*. 2002 Jun;966:211-22
30. Schaumberg DA, Sullivan DA, Buring JE, Dana MR. Prevalence of dry eye syndrome among US women. *Am J Ophthalmol*. 2003;136(2):318-326.
31. Gauthier A, Awidi AA, Noble PM, Daoud YJ. Factors Predictive of Refractive Error After Toric Lens Implantation. *Clinical Ophthalmology*. 2023;17:1813-1821.
32. Kim P, Stephen Plugfelder F, Slomovic AR. *Top 5 Pearls to Consider When Implanting Advanced-Technology IOLs in Patients With Ocular Surface Disease*. Vol 52. Lippincott Williams & Wilkins; 2012. www.internat-ophthalmology.com|51
33. Lu Q, Lu Y, Zhu X. Dry Eye and Phacoemulsification Cataract Surgery: A Systematic Review and Meta-Analysis. *Front Med (Lausanne)*. 2021;8.
34. Ban Y, Ogawa Y, Ibrahim OMA, et al. *Morphologic* Evaluation of Meibomian Glands in Chronic Graft-versus-Host Disease Using in Vivo Laser Confocal Microscopy. *Mol Vis*. 2011;17:2533-43. Epub 2011 Sep 29.
35. Choi YJ, Park SY, Jun I, Choi M, Seo KY, Kim EK, Kim TI. Perioperative Ocular Parameters Associated With Persistent Dry Eye Symptoms After Cataract Surgery. Cornea. 2018 Jun;37(6):734-739.
36. Nilsen C, Gundersen M, Jensen PG, et al. The Significance of Dry Eye Signs on Preoperative Keratometry Measurements in Patients Scheduled for Cataract Surgery. *Clinical Ophthalmology*. 2024;18:151-161.
37. Dogan AS, Kosker M, Arslan N, Gurdal C. Interexaminer Reliability of Meibography: Upper or Lower Eyelid? *Eye & Contact Lens: Science & Clinical Practice*. 2018;44(2):113-117.