

IMPACT OF MEIBOMIAN GLAND WIDTH ON SUCCESSFUL CONTACT LENS USE

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INTRODUCTION

Meibomian glands (MG) are large sebaceous holocrine glands located within the tarsal plates of the upper and lower eyelids.¹

- MGs primarily produce a lipid secretion (meibum) that is expressed on to the ocular surface and forms the outer layer of the tear film.²
- Altered meibum production result in a tear film destabilization, ocular discomfort, and potentially contact lens dropout.³⁻⁵
- MG atrophy (structural change) has been associated with altered tear lipid production and altered tear film stability.^{6,7}
- Limited information exists on how other MG structural characteristics (e.g., MG width) are associated with ocular signs and symptoms.⁸

Purpose: To determine the impact of MG width on successful contact lens use and ocular surface health.

METHODS

This five-site case-control study recruited subjects 18-45 years of age.

- Cases ceased contact lens wear (dropouts) within the past 6-12 months due to discomfort.
- Age- and sex-matched controls were able to comfortably wear contact lenses for ≥8 hours/day and ≥5 days/week.

Subjective and objective measures.

- Surveys included a study-specific contact lens questionnaire and the SPEED questionnaire.
- Clinical testing included blepharitis evaluation, non-invasive tear break-up time (NITBUT), tear meniscus height (TMH), MG expressibility, and meibum quality (Table 1).
- Meibography evaluation included subjective grading of MG atrophy and MG tortuosity (Table 1), and objective grading of MG width with MATLAB (Figure 1).
- Dry eye was diagnosed if a subject had a SPEED score > 5.0 and a NITBUT of <10 s and/or a TMH of < 0.2 mm.

SAS Version 9.3 was used to complete statistical analyses of right eye data.

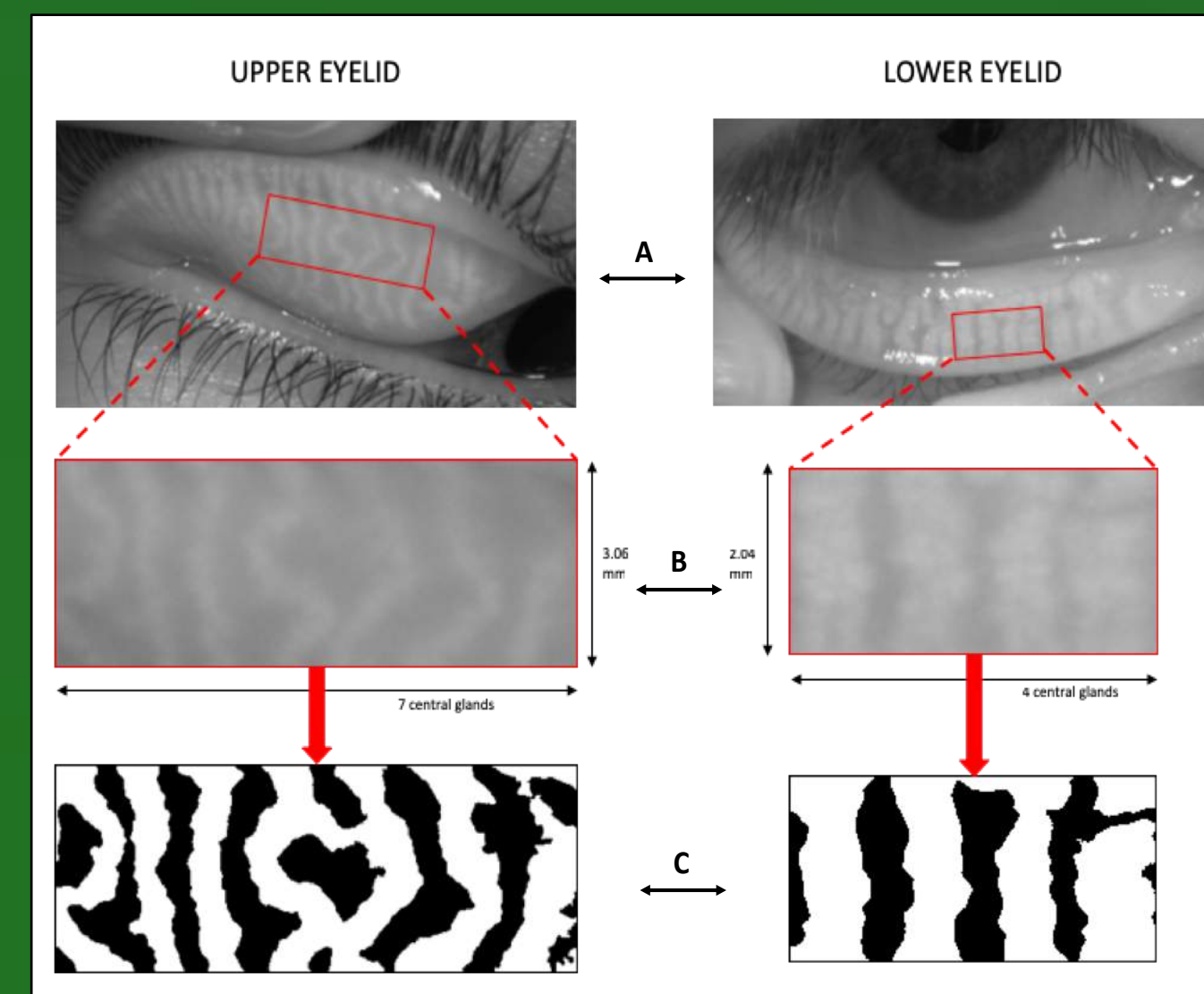
- T-tests evaluated between-group differences for continuous variables.
- McNemar’s test for 2 x 2 tables and Bowker’s Test of Symmetry for $n \times n$ tables evaluated categorical variables.
- Correlations with MG width were performed using Pearson’s correlation coefficients (continuous data) or Spearman’s correlation coefficients (categorical data).

Table 1: Subjective Grading Scales⁹

Test	Descriptions				
Blepharitis					
Scale	0	1	2	3	4
Number of Collarettes	None	1-5	6-20	21-40	>40
Number of Plugged Meibomian Glands					
Scale	0	1	2	3	
Number of Plugged Glands	None	1-2	3-4	≥5	
Meibum Quality					
Scale	0	1	2	3	4
Meibum Quality	Clear	Granular	Semisolid	Solid	None Expressed
Meibomian Gland Atrophy (Meiboscore)					
Scale	0	1	2	3	
Percentage of Gland Loss	None	1 to <33	33 to 67	>67	
Meibomian Gland Tortuosity					
Scale	0	1	2	3	4
Percentage of Tortuous Glands	None	<25	26 to 50	51 to 74	>75

METHODS (CONTINUED)

Figure 1: Grading of upper and lower eyelid meibography images (OCULUS Keratograph 5M) to determine meibomian gland widths: Selection of meibomian glands (A); Enhanced binarized image of meibomian glands (B); Data extraction (C).



RESULTS

56 matched-pairs were recruited across all study sites (60.7% female).

- Successful contact lens wearers and contact lens dropouts had a mean ± SD age of 28.5 ± 7.1 years and 28.6 ± 7.0 years, respectively (p = 0.66).
- Contact lens dropouts and successful contact lens wearers had worn contact lenses for 7.82 ± 6.74 years and 10.86 ± 6.52 years, respectively (p = 0.01).
- Contact lens dropouts and successful contact lens wearers wore their contact lenses 7.82 ± 6.74 and 13.47 ± 2.92 hours/day, respectively (p <0.001).

Table 2: Ocular Factors by Subject Group (Right Eye)

Test	Overall Group (Mean ± SD)	Contact Lens Wearers (Mean ± SD)	Contact Lens Dropout (Mean ± SD)	Wearer vs. Dropout (P-Value)
SPEED Score (units)	4.52 ± 4.40	2.62 ± 2.66	6.42 ± 4.96	< 0.0001
Diagnosed Dry Eye	18.8%	5.4%	32.1%	< 0.001
Non-Invasive Tear Break-Up Time (seconds)	12.06 ± 9.30	12.53 ± 9.93	11.58 ± 8.68	0.44
Tear Meniscus Height (mm)	0.29 ± 0.09	0.29 ± 0.09	0.28 ± 0.09	0.31
Blepharitis				
Upper Eyelid (0-4 scale)	0.58 ± 0.74	0.46 ± 0.66	0.70 ± 0.81	0.09
Lower Eyelid (0-4 scale)	0.29 ± 0.59	0.20 ± 0.52	0.39 ± 0.65	0.05
Meibomian Gland Expressibility				
Upper Eyelid (0-3 scale)	0.92 ± 0.95	0.61 ± 0.80	1.24 ± 0.98	<0.001
Lower Eyelid (0-3 scale)	0.91 ± 0.98	0.73 ± 0.94	1.09 ± 0.99	0.04
Meibum Quality				
Upper Eyelid (0-4 scale)	1.00 ± 1.31	0.66 ± 1.01	1.35 ± 1.49	<0.001
Lower Eyelid (0-4 scale)	0.79 ± 1.16	0.73 ± 1.18	0.85 ± 1.15	0.64
Meibomian Gland Atrophy (Meiboscore)				
Upper Eyelid (0-3 scale)	0.91 ± 0.42	0.91 ± 0.29	0.91 ± 0.52	1.00
Lower Eyelid (0-3 scale)	0.96 ± 0.67	0.89 ± 0.59	1.04 ± 0.74	0.22
Meibomian Gland Tortuosity				
Upper Eyelid (0-3 scale)	1.61 ± 0.89	1.46 ± 0.74	1.76 ± 1.02	0.07
Lower Eyelid (0-3 scale)	0.74 ± 0.68	0.75 ± 0.69	0.75 ± 0.67	0.89
Mean Meibomian Gland Width				
Upper Eyelid (mm)	0.45 ± 0.08	0.45 ± 0.07	0.45 ± 0.08	0.92
Lower Eyelid (mm)	0.61 ± 0.11	0.62 ± 0.10	0.61 ± 0.12	0.97

- Lower eyelid MG plugging was negatively correlated (p =0.01) with lower MG width suggesting that thinner MG widths were associate with increased MG plugging.
- No other subjective or objective factors were associated with MG width (all p > 0.05).

RESULTS (CONTINUED)

Table 3: Upper and Lower Eyelid Comparison of Ocular Factors (Right Eye)

Test	Overall Group (Mean ± SD)	Upper vs. Lower Eyelid Mean (P-Value)	Upper vs. Lower Eyelid Correlation (r)
Blepharitis			
Upper Eyelid (0-4 scale)	0.58 ± 0.74	<0.001	0.69
Lower Eyelid (0-4 scale)	0.29 ± 0.59		
Meibomian Gland Expressibility			
Upper Eyelid (0-3 scale)	0.92 ± 0.95	0.92	0.56
Lower Eyelid (0-3 scale)	0.91 ± 0.98		
Meibum Quality			
Upper Eyelid (0-4 scale)	1.00 ± 1.31	0.12	0.36
Lower Eyelid (0-4 scale)	0.79 ± 1.16		
Meibomian Gland Atrophy (Meiboscore)			
Upper Eyelid (0-3 scale)	0.91 ± 0.42	0.42	0.25
Lower Eyelid (0-3 scale)	0.96 ± 0.67		
Meibomian Gland Tortuosity			
Upper Eyelid (0-3 scale)	1.61 ± 0.89	<0.001	0.09
Lower Eyelid (0-3 scale)	0.74 ± 0.68		
Mean Meibomian Gland Width			
Upper Eyelid (mm)	0.45 ± 0.08	0.03	0.23
Lower Eyelid (mm)	0.61 ± 0.11		

CONCLUSION

- Lower eyelid MGs were wider than upper eyelid MGs. Narrower lower eyelid MGs were associated with MG blockage, which suggests that MG width may be a risk factor for the development of MG dysfunction.
- MG width was not associated with contact lens success, suggesting MG width alterations are not a precipitating factor for contact lens dropout.
- Few between-eyelid differences were detected, though it still may be worth evaluating each eyelid to fully characterize a patient’s dry eye status.
- Additional work is needed to improve understanding of the various stages and mechanisms leading to MG width alterations, tortuosity, and atrophy in contact lens wearers and dropouts.

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