Paralysis of the Orbicularis Oculi is Associated with Pathologic Changes in Meibomian Gland Morphology on Infrared Meibography

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BACKGROUND

Tears are composed of aqueous, mucous, and lipid layers. The lipid layer of tears is produced by meibomian glands located within the tarsal plate of the eyelid. Meibomian gland dysfunction (MGD) leads to abnormal tear function resulting in ocular irritation and surface disease. The orbicularis oculi primarily protracts the eyelid during the blink cycle. Although the mechanism responsible for inducing the meibomian glands to secrete lipids is unknown, previous studies suggest that a secondary function of the orbicularis oculi is compression of the glands during muscle contraction. Consequently, the orbicularis may play a dual role in ocular health by facilitating eyelid blink and promoting normal tear function.

Orbicularis weakness is seen in various conditions including myotonic dystrophy, chronic progressive external ophthalmoplegia, periorbital toxin injections, and facial nerve palsy. Patients with orbicularis weakness commonly complain of dry eye presumably due to exposure keratopathy; however, MGD would aggravate any dry eye condition.

Purpose: To determine whether or not there is an association between orbicularis weakness and meibomian gland dysfunction.

MATERIALS AND METHODS

Design: Non-randomized, cross-sectional study.

Methods:
- **Population:** Patients with a unilateral facial nerve palsy. Involved eyelids served as the experimental group. Fellow normal eyelids served as controls.
- **Exclusion criteria:** Any history of eye surgery, ocular allergies, use of eye drops, pre-existing facial nerve palsy.
- **Data collected:** Patient age, sex, date of diagnosis of facial nerve palsy.
- **IR meibography:** A 1 inch IR probe was used to evert and transilluminate the eyelid which was recorded by an IR camera (Fig. 1). Meibography images were captured using Adobe Premiere Elements.
- **Analysis:** Meibomian gland images were quantitated using the meibograde method. The meibograde scores meibomian glands based on three categories: distortion, shortening, and dropout. Each category is scored 0-3.

RESULTS

**Infrared Meibography Imaging**

**Infrared Meibography Meibograde**

**Upper Eyelids**

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<thead>
<tr>
<th>Any Followup</th>
<th>&lt; 6 mo</th>
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**Lower Eyelids**

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**Figure 1:** IR meibography materials. Image A, B, IR probes for eyelid illumination. Image C, IR camera.

**Figure 2:** IR meibography of the lower eyelids in a patient with facial nerve palsy at 6 year follow up. Meibomian gland lipids scatter IR light causing the glands to appear as dark streaks along the palpebral conjunctiva. A, B, Images of the control and affected eyelids. The control eyelid (A) corresponds to a meibograde of 0. The affected eyelid (B) corresponds to a meibograde of 5. Note that the affected eyelid shows signs of glandular distortion (black arrow) and shortening (yellow arrow) as well as gland dropout (circled white).

**Figure 3:** Graph of mean meibograde scores in control and facial nerve palsy eyelids at any, less than 6 months, and greater than 6 months follow up time. Graph on left shows upper eyelid meibogrades. Graph on right shows lower eyelid meibogrades.

**Table 1:** Results of the study demonstrate an association between orbicularis weakness and pathologic changes in meibomian gland morphology compared to controls (Fig. 3).

1. **At any follow up, there was no statistically significant difference in mean meibogrades between the upper eyelids of patients with facial nerve palsy and control groups in both the upper and lower eyelids.** (p = 0.264)
2. **At less than 6 months follow up, there was no statistically significant difference in mean meibogrades between the facial nerve palsy and control groups in either the upper eyelids (p = 0.931) or lower eyelids (p = 0.211).**
3. **At greater than 6 months follow up, there was no statistically significant difference in mean meibogrades between the facial nerve palsy and control groups in the lower eyelids (p = 0.211).**

DISCUSSION

Meibomian glands are located in the tarsal plate of the eyelid and produce lipids involved in tear function. The mechanism inducing meibomian gland release lipids is unknown but dysfunction can lead to ocular irritation and surface disease. Studies suggest that a region of the orbicularis oculi called the muscle of Riolan contracts around the meibomian glands causing them to expel lipids into the tear film. We hypothesize that orbicularis weakness secondary to facial nerve palsy would therefore lead to loss of meibomian gland activity and changes in gland morphology over time.

Results of this study demonstrate an association between orbicularis weakness and pathologic changes in meibomian gland morphology compared to controls (Fig. 3). Morphologic changes observed in the meibomian glands included distortions, shortening, and dropout (Fig. 2).

Interestingly, we found that patients with >6 months of orbicularis weakness had a significant difference in greater meibomian gland dropout but not upper eyelids. This may reflect anatomical differences in the muscle of Riolan between the upper and lower eyelids. It could also result from a greater meibomian gland density in the upper eyelids which would require more time for changes to have a significant effect.

CONCLUSIONS

1. **Patients with orbicularis weakness for less than 6 months are not likely to show pathologic changes in meibomian gland morphology.**
2. **Pathologic changes in meibomian gland morphology in the setting of orbicularis weakness for greater than 6 months preferentially involve the lower eyelids.**
3. **Meibomian gland dysfunction should be included in the differential diagnosis for patients presenting with orbicularis weakness and ocular irritation.**