**INTRODUCTION**

Dry eye disease (DED) is one of the most common pathological conditions in ophthalmology. It is a multifactorial disease where the stability of the tear film is reduced and is accompanied by increased osmolarity of the tears and inflammation of the ocular surface. Traditional clinical test used in DED diagnose are invasive and/or subjective, likewise there is a lack of agreement between them and patients symptoms. High speed videokeratometry (HSV) can assess the stability of the tear film by analyzing the structure of the reflected Placido disk pattern. Recently we have proposed a novel technique to automatically and objectively analyze the pattern regularity of HSV recordings by means of estimating its fractal dimension.\(^1\) From this analysis three dynamic descriptors are extracted for each recording in order to characterize the tear film:

- **Breaks Feature Indicator (BFI):** related to "holes" in the reflected Placido disk pattern.
- **Distortions Feature Indicator (DFI):** related to an uneven reflected Placido disk pattern.
- **Tear Film Surface Quality (TFSQ) index:** describes the quality of the tear film, is obtained from the weighted addition of BFI and DFI (30% and 70%, respectively).

**PURPOSE**

To assess the ability of the recently proposed automated method, which analyzes the texture of HSV images with a fractal dimension approach, to differentiate between normal and dry eye subjects.

**METHODS**

1. **ROC curve**

Three measurements per subject (nigh eye) in suppressed blinking conditions. Maximum time of measurement: 30 s

- Remove 1st second of recording (TF build-up phase)
- Compute FD for each frame of the raw data.
- Compute tear film surface quality index (TFSQ), breaks feature indicator (BFI) and distortions feature indicator (DFI).

2. **Calculate the receiver operating characteristics (ROC)**

Curves and extract numerical parameters that provide the discrimination performance of the method

1. Area under the ROC curve (AUC)
2. Cut-off value that optimizes the discrimination between dry eye and normal subjects
3. Sensitivity (true positive rate) and specificity (1 false positive rate)

3. **Youlden’s Index**

\[ γ = \text{sensitivity} + \text{specificity} - 1 \]

4. **Discriminant Power**

\[ DP = \frac{\sqrt{3}}{\pi} \left( \log \left( \frac{\text{sensitivity}}{1 - \text{sensitivity}} \right) + \log \left( \frac{1 - \text{specificity}}{\text{specificity}} \right) \right) \]

Where
- \( DP < 1 \) Poor discrimination
- \( DP < 2 \) Limited discrimination
- \( DP < 3 \) Fair discrimination

**RESULTS**

**Table 1. ROC effectiveness for the best performing parameter of each of the dynamics descriptors.**

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>AUC</th>
<th>Cut-off Value</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>( γ )</th>
<th>DP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean BFI</td>
<td>0.91</td>
<td>50.17</td>
<td>90%</td>
<td>86%</td>
<td>0.76</td>
<td>2.23</td>
</tr>
<tr>
<td>Mean TFSQ</td>
<td>0.76</td>
<td>59.77</td>
<td>68%</td>
<td>84%</td>
<td>0.52</td>
<td>1.33</td>
</tr>
<tr>
<td>BUT DFI</td>
<td>0.68</td>
<td>13.19</td>
<td>81%</td>
<td>50%</td>
<td>0.30</td>
<td>0.75</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

The proposed fractal dimension approach for the analysis of HSV recordings, has shown to achieve better discrimination results than previously proposed method\(^2\), bringing the performance of the HSV technology closer to that of the more sophisticated, but clinically unavailable, techniques such as the Lateral Sharing Interferometry.\(^3\) HSV may be an advantageous tool to aid clinicians in the diagnosis and monitoring of DED.

**REFERENCES**