Machine Learning (ML) Prediction Model for Dry Eye Diagnosis

UNIVERSITY OF CALGARY
CUMMING SCHOOL OF MEDICINE

A. Al-Ghoul[1], T. Jarada[2]

[1]University of Calgary, Section of Ophthalmology

[2]University of Calgary, Foothills Medical Centre

CSI DRY EYE

INTRODUCTION

The Tear Film & Ocular Surface Society (TFOS), a non-profit organization, launched the TFOS Dry Eye Workshop II (TFOS DEWS II) in March 2015. This report has become the gold standard for dry eye diagnosis and management in the Ophthalmic world. [1]

Based on the DEWSII, clinicians are required to determine the type of dry eye disease pattern a patient has in order to objectively determine the right treatment baed on that pattern (Figure 1). There remains no clear consensus on how to exactly determine where a patient lies on that spectrum.[2]

PURPOSE

To evaluate the effectiveness of using Machine Learning (ML) algorithms in determining the type and severity of dry eye disease.

METHODS

- Retrospective analysis of fifty (50) patients presenting for dry eye disease management at a single practice
- All eyes underwent SPEED/OSDI screening, tear osmolarity testing, meibography, Non-invasive TBUT, Slit-lamp photography/videography, diagnostic MG expression, lagophthalmos/blinking analysis, Corneal esthesiometry, and epithelial mapping/Tear Meniscus Height (TMH) determination.
- Two clinicians analyzed the patient and determined the type of dryness based on categorization scheme (Figure 2).
- Dry eye diagnostic analysis software (CSIDryeye) was used independently and utilized the same data to determine the type and severity of dryness based on similar categorization scheme.

RESULTS

- There was 84% agreement between the ML prediction and clinician analysis on type of dry eye pattern (Figure 3)
- There was 86% agreement between the ML prediction and clinician analysis on severity of dry eye presentation (Figure 3)

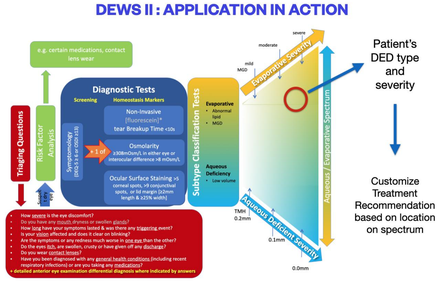

Figure 1. Recommended Protocol for dry eye diagnosis based on DEWS II

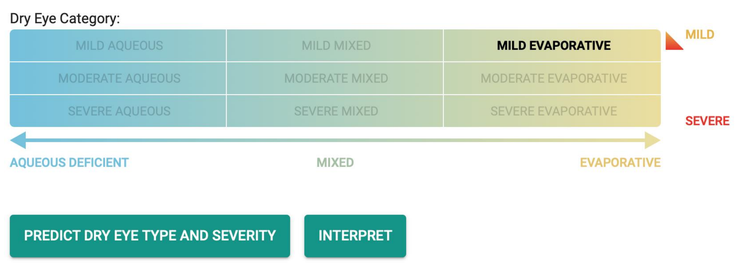

Figure 2. Diagnostic categorization of Dry Eye Disease based on DEWSII recommendation using CSIDryeye Software

- Of the 50 patients presenting with dry eyes, clinicians diagnosed predominant evaporative dry eye pattern in 62% of cases, predominant mixed dry eye pattern in 38% of cases, and no cases with predominant aqueous deficiency were noted in our cohort of patients
- Of the 50 patients presenting with dry eyes, the CSCdryeye software diagnosed predominant evaporative dry eye pattern in 64% of cases, predominant mixed dry eye pattern in 36% of cases, and no cases with predominant aqueous deficiency were noted in our cohort of patients

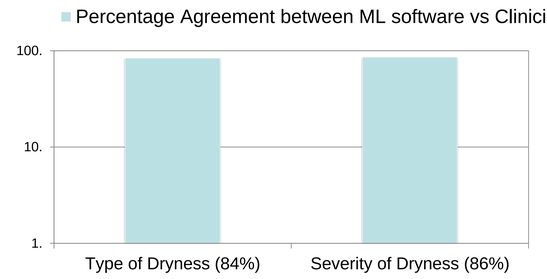

Figure 3. Percentage of cases where ML software and Clinician agreed on type and severity of dry eye presentation

DISCUSSION

Due to the multifactorial nature of dry eye disease and plethora of treatment options, it is crucial to establish proper baselines with our dry eye patients as advocated by DEWSII[1]. As treatment effectiveness can be impacted by the subtype of of dry eye disease, developing an agreed upon classification of dry eye disease is essential[3]. Machine Learning technology is an ideal solution for a multifactorial condition like dry eye disease in enabling clinicians to establish standardized classification of the various subtypes.

CONCLUSION

- Machine Learning technology has been shown to effectively predict the type and severity of dry eye diagnostic subtypes in majority of situations
- As more patients are introduced to the model, sensitivity and specificity of the system will continue improving, potentially allowing clinicians to focus more on treatment options for their patients
- Using the data gathered from ML analysis can provide clinician with better insight regarding effectiveness of various treatment options introduced in the market

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