The Effects of Red Light Technology on Dry Eye Disease Due to Meibomian Gland Dysfunction

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Abstract

Objective: To present data on the effectiveness of a red light technology (RLT) in treating Evaporative Dry Eye due to Meibomian Gland Dysfunction (MGD).

Methods: This prospective study measured tear break up time (TBUT) before and after treatment with red light technology with wavelengths of light between 600 and 650nm. Patients were selected based on dry eye symptoms, TBUT less than 10sec, and clinical observation of MGD. Patients were instructed to place the RLT over closed eyes for 3 minutes on each eye at least twice a week. Patients could not use the RLT more than once a day. 52 patients were included in the study and were treated for 3 months.

Results: TBUT data before and after treatment was achieved on 81 eyes. The mean TBUT before treatment was 3.62sec with a standard deviation of 2.05. Values ranged from 0.9sec to 8.54sec. Mean TBUT post treatment was 5.87sec with a standard deviation of 2.95. Values ranged from 1.5sec to 16.19sec. T-test results show the difference to be statistically significant (P <0.001). No statistical significance found between right eyes (N=41) and left eyes (N=40) before treatment (P=0.53) or after treatment (P=0.75).

Conclusion: On average, treatment with RLT shows a statistically significant improvement in TBUT. This may be a future light treatment for the improvement of dry eye disease. Over 90% of patients reported improvement in their dry eye symptoms.

Keywords: Dry eye disease; Meibomian gland dysfunction; Red light technology

Abbreviations: RLT: Red Light Technology; MGD: Meibomian Gland Dysfunction; TBUT: Tear Break-Up Time; IPL: Intense Pulsed Light; LED: Light Emitting Diodes

Introduction

The use of light in modern medicine is evidenced by the UN declaring 2015 as the «International Year of Light and Light-based Technologies». Light technologies are being utilized to treat a wide range of conditions including skin disorders like psoriasis and atopic dermatitis [1], seasonal affective disorder [2], neonatal jaundice [3], and retinal conditions like macular edema and diabetic retinopathy [4]. Another important use of light is in the treatment of meibomian gland dysfunction (MGD). MGD is the leading cause of dry eye disease [5] and involves the production of abnormally viscous meibum instead of the usual olive-oil like secretion which stabilizes the tear film. Patients with MGD generally have severe inflammation along the lid margin and an overgrowth of bacteria which exacerbate the condition. Abnormal meibum secretions lead to abnormally fast tear film evaporation, which is measured by tear break-up time (TBUT).

A TBUT of under 10 seconds is considered abnormal and is diagnostic for dry eye when combined with clinical signs and symptoms [6]. Many treatments exist to combat MGD from artificial tears and lid scrubs to anti-inflammatory and antibiotic medications. One way light has been used to treat MGD is Intense Pulsed Light Therapy (IPL). For a full description of IPL for MGD see the authors’ cited work [7]. For patient safety IPL must be performed in office by a physician and one must wait weeks in between treatments. Theoretically IPL could cause harm to the eye if used directly without protection. For this cause we have sought light wavelengths and modalities that would be safe for the patient to use at home and could not cause harm to the eye. The purpose of this study is to demonstrate the effectiveness of a hand-held red light technology (RLT) that can be used by the patient at home to combat the chronic symptoms of dry eye.
Methods

Ethical statement
This study was conducted in accordance with the guidelines of the Declarations of Helsinki with informed consent for treatment obtained for each patient.

Device
The device used for this study consists of light-emitting diodes (LED) which produce a red light of wavelength between 600 and 650nm. The light does not pulse and produces only mild warmth to the touch.

Patient selection
Patients considered for the study presented to a single clinic for treatment of dry eye symptoms. To be considered for the study each eye had to have a TBUT of less than 10 seconds as measured by the Oculus Keratograph and had to have clinical signs of MGD as well as symptoms of dry eye. Patients had to be 18 years of age or older and be able to give consent to treatment. No exclusion from the study was based upon prior dry eye treatment. 52 patients were included in the study before and after data was achieved on 81 eyes.

Study protocol
Initial TBUT was measured with the Oculus Keratograph. Patients were given instructions for use and a demonstration was provided by a single technician. Patients were to place the red light technology over closed eyelids for 3 minutes, each eye, at least twice per week. Patients returned after 3 months of treatment for TBUT to be re-measured.

Results
TBUT data before and after treatment was achieved on 81 eyes. The mean TBUT before treatment was 3.62sec with a standard deviation of 2.95. Values ranged from 1.5sec to 16.19sec. T-test results show the difference to be statistically significant (P<0.001). No statistical significance was found between right eyes (N=41) and left eyes (N=40) before treatment (P=0.53) or after treatment (P=0.75).

Discussion
Red light therapy using LED has been proposed as a treatment for many physical ailments and has been studied for many years. It has been shown in the literature that LED applied to the skin «provides an analgesic affect and modifies the expression of COX-2, PGE2, and pro inflammatory cytokines in incised skin» [8]. Patients currently are doing warm compresses in the home to help MGD by creating heat in the glands to melt thickened secretions. LED applied to the skin can generate enough heat in the glands to melt secretions like a warm compress. In addition to providing this heat it is possible that the RLT is modifying these pro inflammatory factors along the lid margin, thus a promising treatment for MGD. While we currently do not know all the mechanisms of action on why LED helps patients with MGD, our current study is encouraging in that it demonstrates an observed improvement in a measure of dry eye disease. Further study is warranted on varying wavelengths of light as well as duration and location of treatment. Additional research is warranted into the biochemical properties of the meibum secretions themselves and if the RLT is affecting them in factors other than temperature.

Conclusion
On average, treatment with RLT shows a statistically significant improvement in TBUT. This may be a future light treatment for the improvement of dry eye disease, either on its own or in conjunction with other therapies.

Conflict of Interest
Dr. Rolando Toyos is a paid consultant with Lumenis and Shire, Dr. Briscoe has no conflict of interest to report, Dr. Melissa Toyos is a paid consultant for Shire.

References