Treating Patients with Intense Pulsed Light for Severe Evaporative Dry Eye, Reducing Ocular Inflammation and Demodex Management

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Keywords

dry eye disease, intense pulsed light therapy, IPL therapy, literature review, optometric education, optometry

Dry eye disease (DED) remains one of the most common conditions encountered in clinical practice and is increasingly recognized as a chronic, multifactorial disorder involving tear film instability, ocular surface inflammation, neurosensory abnormalities and meibomian gland dysfunction. As our understanding of the underlying mechanisms of DED has evolved, so too have treatment options. As of 2021, Intense Pulsed Light (IPL) has been approved by the Food and Drug Administration for the treatment of DED due to Meibomian Gland Dysfunction (MGD) and has emerged as a valuable adjunctive treatment for patients with MGD and evaporative dry eye disease. Originally developed for dermatologic applications, IPL has demonstrated benefits that extend beyond cosmetic indications, including improvement in meibomian gland function, stabilization of the tear film, reduction of ocular surface inflammation, and management of Demodex infestation. Over the past 5 years, the use of IPL has continued to expand within eye care, and clinicians are increasingly seeking evidence-based guidance regarding treatment protocols, expected outcome and long-term management.

The following literature review examines recent studies evaluating the role of IPL in severe evaporative dry eye disease, ocular surface inflammation and Demodex management, highlighting both the therapeutic potential of this technology and the questions that remain regarding optimal treatment strategies and long-term care.

Managing Severe Evaporative Dry Eye with Intense Pulsed Light Therapy[1]

Authors: Guanghao Qin, Jiayan Chen, Liangzhe Li et al.

***Ophthalmology and Therapy* (2023)**

Dry eye disease (DED) has been well established as a chronic, multifactorial condition that results in disruption to the tear film and ocular surface. Patients with dry eye disease experience a wide range of signs and symptoms, including but not limited to ocular pain, blurred vision, foreign body sensation and contact lens intolerance. Historically, treatment options have been limited to tear supplementation, warm compresses and prescription eye drops. Better understanding of the disease etiology has led to new treatment and management options for these patients, including the use of intense pulsed light (IPL). This study compared IPL treatment in patients with severe dry eye disease vs. a control group.

Forty-nine participants were recruited for this study. Inclusion criteria comprised of the following: (i) age over 18 years, (ii) Fitzpatrick skin types I–IV, (iii) capable and willing to comply with the treatment and follow-up obligations, and (iv) a determination of severe DED. Fitzpatrick skin typing is a classification

system to categorize skin based on its melanin content. The grading systems ranges from I to VI, with the higher number correlating to more melanin. The dry eye severity was based on either a score of greater than 33 on the ocular surface disease index (OSDI), a non-invasive tear film breakup time (NITBUT) of less than 5 seconds or a conjunctivocorneal staining score (CS) of greater than three points according to the Asian Dry Eye Consensus. Participants were excluded if they had skin defects or scars to the treatment area, autoimmune conditions, history of cancer or a Fitzpatrick skin type of V or VI. All participants were required to refrain from using dry eye treatments (lubricants, etc.) during the study. The participants were randomly assigned to either the IPL group or the control group. The mean age of the IPL group (n=56 eyes) was 28.05 ± 3.41 years, while the mean age of the control group (n=42 eyes) was 28.14 ± 3.53 years.

Baseline measurements from non-invasive to invasive included best corrected visual acuity (BCVA), OSDI, NITBUT, tear film lipid layer (TFLL), endothelial cell count (ECC), intraocular pressure (IOP), meibomian gland (MG), and conjunctivocorneal staining score (CS). Baseline measurements were repeated at all visits prior to either IPL or sham-IPL (control) treatment. Both treatment groups consisted of the same IPL procedure, based on the Toyos protocol. Ultrasound gel and ocular shields were placed on the participant, and 12 pulses were delivered from temple to temple. For the control group, the device was applied to the participant, but no pulses were delivered. Another IPL device in the room was used to simulate the sounds and lights of the procedure. Each participant received three treatments separated by 3 weeks, with the study lasting 12 weeks.

Statistically significant changes were seen between the IPL group and the control group in mean OSDI score, NITBUT, TFLL, MG score and quality, and MG expression at the 12 week follow up. There was no significant difference in conjunctivocorneal staining.

These findings suggest that IPL can be clinically beneficial in managing severe evaporative dry eye in young patients. The exclusion criteria did not specifically mention refractive status or contact lens wear, which could impact the relevance and application of these results. It is important to recognize that, according to the definition of DED, it is a chronic, multifactorial condition. This study performed three treatments over 12 weeks, whereas the Toyos protocol typically involves four sessions separated by 2 to 4 weeks. It is possible that additional treatment sessions could lead to an improvement in CS. Lastly, treatment benefits extended three weeks after the last session. Is there an ideal re-treatment window for these patients? With the growing popularity of this technology, it is important to establish realistic expectations and specific follow-up protocols.

Intense pulsed light treatment improved tear film quality and reduced ocular surface inflammation in dry eye patients[2]

Authors: Jiayan Chen, Ying Zhang, Sile Yu, et al

***Scientific Report* (2025)**

Inflammation has been well established as a hallmark of DED, and anti-inflammatory medications ranging from short term corticosteroids to long-term cyclosporine are routinely prescribed over the course of treatment. Depending on clinical signs, not every patient will be an ideal candidate for these medications, and novel and effective alternatives have not been fully established. The mechanism of action of IPL treatment for DED remains incomplete but it has been proposed that treatment may result in the obliteration of superficial blood vessels, subsequently reducing local inflammation and has antibacterial and anti-inflammatory effects. This study aims to identify and investigate the therapeutic efficacy and underlying mechanisms of IPL, establishing a foundation for its application in the treatment of DED.

Twenty-eight participants were enrolled in this study and randomly assigned to one of two groups. Group A consisted of 30 eyes with a mean age of 34.47±6.58 years and received three IPL sessions separated by 3 weeks. Group B consisted of 26 eyes with a mean age of 33.15±2.22 years, and received two IPL sessions separated over 3 weeks. All participants were examined at Baseline, 3, 6, 9 and 12 weeks for NITBUT, Lymphotoxin-alpha (LT-?), meibomian gland quality (MGQ), tear meniscus height (TMH), conjunctivocorneal staining score (CFS), meibomian gland expression (MGEx), tear-film lipid layer (TFLL), and OSDI. The IPL procedure included the appropriate Fitzpatrick score settings and 12 pulses of the IPL device spanning from tragus to tragus, with appropriate safety precautions. There is no mention of following a specific protocol (i.e. Toyos). Eligibility criteria include at least 18 years of age and having voluntarily participated in this trial, Fitzpatrick skin types I to IV and diagnosis of DED. DED diagnosis is established according to the TFOS DEWS II report by fulfilling a minimum of two of the following criteria: (i) the score range for OSDI questionnaire is from 13 to 100. (ii) CFS signifies the existence of over five spots on the cornea and more than nine spots on the conjunctiva. (iii) NITBUT is less than 10 seconds. Exclusion criteria include existing infectious diseases, pigmentation, skin defects, ocular trauma, moles, skin cancer, scars, recent surgical history, autoimmune diseases, skin allergies. and pregnancy or lactation. LT-? is a member of the tumor necrosis factor family, secreted by T cells, B cells and other immune cells and has recently emerged as an exploratory biomarker for diagnosing DED, although its mechanistic interpretation is still uncertain.

Seven parameters (NITBUT, TMH, TFLL, MGEx, MGQ, CFS, OSDI) showed improvement after two IPL sessions for both groups. Continued improvement in these parameters was seen at 3 weeks and 6 weeks post treatment. At 12 weeks, a comparison between the three IPL therapy group (Group A) and two IPL therapy group (Group B) found significant improvements in the NITBUT (p=0.002), TMH (p=0.011), TFLL (p=0.009), MGEx (p=0.011), MGQ (p=0.021), LT-? (p=0.034), while the CFS (p=0.104), OSDI (p=0.189) had no significant improvements. In Group A, LT-? was the only parameter that showed improvement after the third IPL session and continued to improve at the 12-week visit.

Based on the results of this study, the authors support a three-treatment protocol. However, as IPL appears to be a cumulative treatment, the question of whether additional treatments would enhance these outcomes is not answered in this study. As with the previous study, there was no mention of excluding contact lens wear and similarly, the mean age of participants makes this data more difficult to apply to the general dry eye population. Lastly, it is unclear if there was gland expression post-IPL sessions or only prior to treatment. The Toyos protocol implies gland expression after treatment, but this is not specified in the study. The results of this study support increased long-term benefits of multiple IPL treatment sessions. The next step would be to establish more data on the maximum ideal number of treatment sessions within a therapeutic window and the duration of effect on inflammatory markers.

Therapeutic effect of intense pulsed light in ocular demodicosis: A systematic review and meta-analysis[3]

Authors: Hsin-Ming Liu, Shannon Su, Cher-Ming Liou, Ann Yi-Chiun Chuang

***Contact Lens and Anterior Eye* (2025)**

Demodex is often an overlooked and underdiagnosed contributor to blepharitis in adults. As with other forms of dry eye disease, signs and symptoms can vary widely from the pathognomonic collarettes, to generalized lash debris, lid erythema and scalloped lid margins. The presence of demodex can alter sebaceous gland secretions, disrupt lash direction as well as disrupt meibomian gland openings and secretions. In addition to mechanical disruption, there is increased association with bacterial antigens on the lid surface, and the condition is associated with refractory keratoconjunctivitis and chalazion. Although pharmacological treatments have proven effective, it is possible that IPL could offer effective treatment and favorable safety profiles for ocular demodicosis. The exact mechanism of action is

unknown, but it is thought that IPL may alter the mite environment by disrupting abnormal vessels, modification of gland expression and photobiomodulation as well as provide a sustained temperature for mite elimination. This study assessed the impact of IPL on reducing the burden of ocular demodicosis.

A systematic literature search was conducted up to March 8, 2025, using the PubMed, Embase, Google Scholar and Cochrane Central Register of Controlled Trials databases. Eligible studies had to meet the following criteria: reported outcome measurements of Demodex mite infestation before and after IPL therapy and possessed study designs of controlled clinical trials with or without randomization. No restrictions were imposed regarding age, language or publication date. However, subjects with Demodex infestation unrelated to the eyelids or those undergoing light therapy other than IPL were excluded.

Six trials consisting of 329 patients in total were included in the analysis from dating from 2019 to 2024. They consisted of one retrospective controlled study and five randomized controlled trials. Three studies combined IPL with meibomian gland expression as an intervention, one treated with IPL and a tea tree oil product, and two were IPL alone. The predominant population studied was Asian and the gender distribution was noted as unequal in most studies, although never specified. In total, five studies involving 229 patients compared IPL therapy with control therapy in terms of demodex mite count per 100 eyelashes. The pooled mean difference (MD) was –7.80 (95% CI –16.36 to 0.76) when considering only randomized control studies. No significant difference was found in the IPL only group of participants, with a pooled MD of –2.08 (95% CI –9.69 to 5.54). Analysis revealed a greater therapeutic trend of IPL combined with meibomian gland expression or topical tea tree oil, with MDs of –69.25 (95% CI –158.55 to 20.06) and –15.20 (95% CI –21.43 to –8.97), respectively. The pooled risk ratio (RR) of Demodex mite eradication was 1.41 (95% CI –158.55 to 20.06) and –15.20 (95% CI –21.43 to 8.97), respectively. IPL with gland expression showed a greater therapeutic effect on mite eradication than IPL alone, with RRs of 1.49 (95% CI 1.17 to 1.91) and 1.32 (95% CI 1.02 to 1.72), respectively. No major adverse events were reported in any of the studies and no participants dropped out due to the side effects.

The authors conclude that IPL alone was effective for ocular Demodex eradication, while its combination with gland expression enhanced therapeutic outcomes. Further studies are needed to establish guidelines for the optimal IPL treatment regime. The authors note that a major limitation of IPL is its cost and the limited availability of insurance coverage, so financial barriers may impact accessibility and treatment adherence. Some limitations of this meta-analysis included the number of studies assessed, the varied disease severity and the lack of consistent and/or universal IPL parameters and follow up. It is interesting that there were studies that did not include meibomian gland expression as part of the IPL treatment given that the original FDA approval for IPL was based on studies of gland expression compared to IPL with gland expression. In addition, with the FDA approval of lotilaner ophthalmic solution (Xdemvy, Tarsus Pharmaceuticals, Inc.) for the treatment of Demodex blepharitis, IPL may not be the most ideal option for management, especially for those patients who fall to the higher numbers on the Fitzpatrick skin scale.

The growing body of literature evaluating IPL therapy suggests that it has become an important addition to the management of evaporative dry eye disease and other related ocular surface disorders. Recent studies continue to demonstrate improvements in a wide array of both subjective symptoms and objective clinical findings. While these findings are encouraging, several important questions remain unanswered. Variability in treatment protocols, patient populations, outcome measures and follow-up periods makes direct comparison between studies challenging. Most investigations have focused on relatively young patients and have not fully addressed factors commonly encountered in clinical practice, such as contact lens wear, concurrent therapies or long-term maintenance schedules. Additionally, the optimal number of treatment sessions, retreatment intervals and patient selection criteria have yet to be clearly established. As the use of IPL continues to expand into comprehensive dry eye management,

additional research will be essential to refine treatment protocols and targets. Until then, current evidence supports IPL as a safe and effective tool that can address several underlying contributors to ocular surface disease, offering clinicians another option to improve patient comfort, ocular surface health and quality of life.

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