Treating Dry Eye Disease in an Orthoptic-Led Ophthalmology Clinic

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ABSTRACT

Dry eye disease is a complex and multifactorial disease of the ocular surface. The diagnosis and management options are being increasingly studied. The aim of this paper is to document an evolving orthoptic-led service delivery model that was implemented in an ophthalmic clinic to improve patient pathways for individuals with dry eye. The service delivery model is supplemented with a case vignette which further explores diagnosis, imaging and outcomes for a patient with dry eye.

Keywords: dry eye disease, meibomian gland, orthoptic-led clinic, keratography

INTRODUCTION

Dry eye disease is defined as 'a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface, increased osmolarity of the tear film and inflammation of the ocular surface'.[1] Within the last two decades, there has been an increased interest in both the diagnosis and treatment of dry eyes as it is becoming a prominent issue for many patients presenting to an eye care facility. Studies suggest a prevalence of dry eye disease between 5% and 35%, with women being affected more frequently than men, and those using visual display units throughout the day also more likely to be affected.[2,3] This has a negative impact on their physical, social and emotional wellbeing, as well as work productivity.[4-6]

In an aging population, ocular surface instability and dry eye are likely to become more prevalent.[7] While epidemiological studies confirm the causes and contributing factors of dry eye diseases to be multifactorial, global populations have increasing visual demands with the introduction of computers and mobile devices, coupled with a greater use of pharmaceuticals which carry their own side effects. Therefore, an effective approach is needed to manage dry eye while using appropriate service delivery models to provide timely care capable of meeting demand.[8-11]

The focus of this paper is to outline an evolving orthoptist-led service delivery model that was implemented in an ophthalmic clinic to improve patient pathways for individuals with dry eye.

Chronic dry eyes are associated with many factors. As such, it is important to understand that the tear film is sensitive and responsive to change. The pathophysiology reported by the Tear Film and Ocular Surface Society (TFOS) in 2017[1] described the vicious cycle of dry eye disease, which can be due to an aqueous deficient dry eye mechanism and evaporative dry eye mechanism. Figure 1 provides a simplified view of this cycle. It shows the interplay between the major pathophysiological processes that contribute to dry eye diseases and the multi-factorial nature of the disease process that can be triggered by several internal and external causes.

The onset of ocular surface damage initiates an inflammatory response which increases tear film hyper-osmolarity and disrupts a tenuous tear film stability.[12] There are many factors that maintain homeostasis on the ocular surface, each of which

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Accepted for publication: 3rd October 2021

contributes to the severity of symptoms and ocular surface pathology. Some factors that contribute to the cycle of dry eye disease include nerve blockades, including those occurring from the use of topical anaesthetics; trigeminal nerve damage or refractive surgery; obstruction of the lacrimal ducts from infection and inflammation; meibomian gland dysfunction and the effects of some systemic medications including beta blockers, antihistamines, anti-spasmodic drugs, diuretics and psychotropic drugs.[12] In addition, the body's hormone levels change with age and this contributes significantly to reducing aqueous production.[13] Trauma or injury from chemicals, environmental smoke, pollutants or pollens are also significant stressors.[14]

One important factor in the cycle of dry eye diseases is meibomian gland dysfunction (MGD). This is characterised by chronic, diffuse abnormalities of the meibomian glands (Figure 2) which affects the chemical composition of meibum secretions.[15] The TFOS illustrated that the meibomian glands can become clotted through hyperkeratinisation at the orifices and inflammation at the lid margins caused by inflammatory mediators on the ocular surface leading to corneal or conjunctival damage, as well as subsequent conjunctival scarring which displaces the meibomian gland openings posteriorly and further limits the meibum secretions.[16] Data from a recent meta-analysis reported the prevalence of MGD to be 35.8% globally. However, this rate differs dramatically depending on race. Reported prevalence is much higher in those of middle eastern descent (71%) and Hispanics (67.5%) as compared to Caucasians (29.5%) and African descent (21.2%). The prevalence of MGD in those with Pacific Island, Asian, and Indigenous Australian ancestory were not included.[17]

People affected by dry eye diseases often present complaining of stinging eyes, or a scratchy or burning sensation. As a result, they can have difficulty performing vision-dependent activities of daily living which may negatively affect physical, social and emotional well-being compared to those in the normal population.[4,5] Giampaolo et al[6] described a loss in work productivity by 2% for every 10 points gained on the ocular surface disease index questionnaire. The signs of dry eye disease include reduced tear film break-up time, decreased tear

Figure 1. Simplified dry eye disease cycle. Adapted from Craig JP, Nichols KK, Akpek EK, et al.[1]

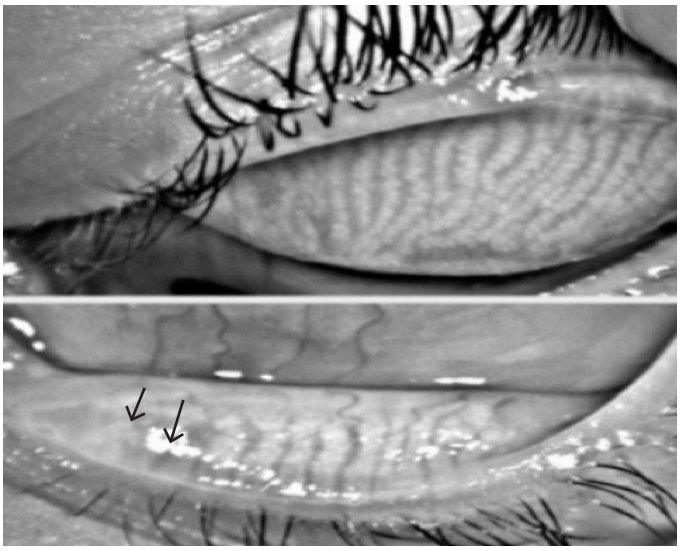

Figure 2. Appearance of the meibomian gland structure within the upper and lower lids with a very small degree of structural deficit present in the lower lid (shown by the two arrows).

meniscus height, tear film osmolarity and changes to corneal structure. Therefore, the diagnostic tests currently available for clinical investigation of dry eye use a comprehensive approach which accounts for these factors, to aid with diagnosis. Diagnostic tests include patient symptom questionnaire scores, Schirmer's tear testing, phenol red thread testing, tear meniscus height measurement, tear film osmolarity, tear film break-up time, corneal fluorescein staining patterns, bulbar redness and meibomian gland imaging techniques.[18-20]

Dry eye disease not only impacts quality of life, it can also affect the accuracy of diagnostic and screening tests performed in an ophthalmic clinic for other ocular conditions. For example, a dry cornea can affect the quality of an image obtained by optical coherence tomography scanning and this could consequently influence the timeliness and efficacy of clinical intervention.[21,22] While our understanding of dry eye disease has greatly improved over the last thirty years, there are still gaps in knowledge, and lack of standardised assessment and treatment leads to a delay in appropriate management and sub-optimal patient outcomes.[23]

There are several treatment modalities for dry eye syndrome and the respective utilisation of each is dependent on clinical signs secondary to a patient's underlying pathology and response to treatment. These can be classified as conventional self-care strategies or combined clinical intervention strategies.

TREATMENT OPTIONS

Conventional

Conventional evidence-based treatment involves the use of warm compresses, eyelid massage, lid hygiene, and artificial tears. The efficacy of this treatment, although promising with respect to new generation formulas for artificial topical tear therapy, is also limited, particularly in advanced dry eye disease where the management of dry eye disease with over-the-counter topical treatment alone may be inadequate for improving patient symptomology.[25,27] Other treatments include topical steroids, topical and oral antibiotics and omega-3 fatty acid supplementation. These treatments have demonstrated some effectiveness in reducing symptoms, however, they cannot be relied upon as stand-alone treatments, as some can be associated with adverse effects, drug resistance, cost issues or less evidence of long-term efficacy.[24-29]

The rationale for using a home-care routine that combines topical preparations, moist heat and eyelid cleansers, is because sole therapies work effectively to improve tear film stability in the short term, but dry eye disease is a multifactorial condition which can cause recurring ocular drying if other interplaying factors are not also treated.

Matossian[30] demonstrated that a moist heat mask can be effective at improving tear film stability in the short term. The moist heat masks are specifically designed to retain a stable temperature of 35-45°C for at least 5 minutes and ideally 12-15 minutes however, heat profiles vary between masks and it is important to be aware of this.[31,32]

Tea tree lid washes may be recommended based on their anti-bacterial, anti-fungal, anti-parasitic, anti-inflammatory and wound healing properties. These are widely used in the treatment of demodex folliculorum (a type of mite which lives in the skin and hair follicles around the eyes), however there is still debate as to the quality of evidence regarding the efficacy of using tea tree lid washes. Hypotonic sodium hyaluronate was shown to be effective in treating the epithelium of the cornea and conjunctiva of severe dry eyes in patients affected with Sjogren's syndrome.[25,33-35]

The literature suggests that patients are unable to gain sustained success from conventional care alone or the effect is very minimal.[36-40] Early investigation into the possibility of contributing factors including telangiectatic lid margins, sleep apnoea or other dermatologic, endocrine, neurological or inflammatory conditions can be key to forewarning patients of the greater difficulty they may face in recovering from dry eye disease and empowering them with insight into the need to persevere with certain treatment strategies.[36-40]

Combined intense pulsed light and low-level light therapy

If results from conventional treatment are slow or ineffective for the patient, the next step of management is sought. This involves intense pulse light (IPL) therapy combined with a low-level light therapy (LLLT) in addition to manual expression of the meibomian glands and continued regular conventional care. The light emitting diodes (LEDs) of the IPL instrument initiate a

Figure 3. Oculus Keratograph 5M (Oculus Inc, Arlington).

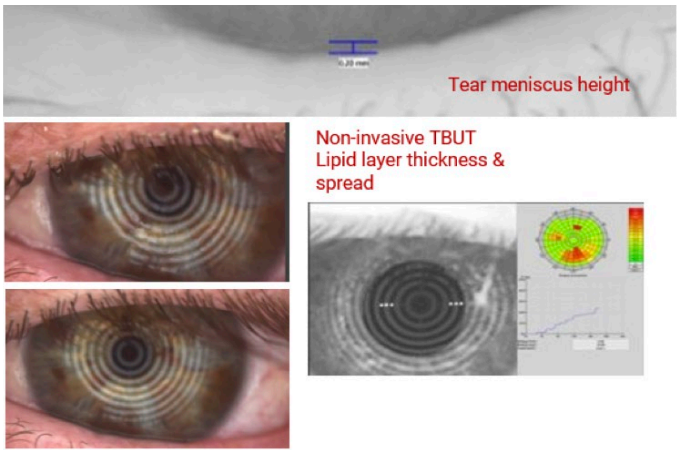

Figure 4. Assessment of tear film dynamics demonstrating the tear meniscus height, the non-invasive tear film break-up time (TBUT) (bottom left), and observation of the lid margins and interferometry showing the lipid layer concentration and spread (right).

photochemical cascade of events which causes non-traumatic cellular photoactivation to the meibomian glands. This activates several additional cells including fibroblasts and collagen cells. The warming effect of the instrument can also reduce demodex mites on the lid surface. Treatment with IPL and low-level light is shown to be effective in reducing patient symptoms and improving meibum quality. It assists in unclotting the meibomian glands and improving cellular function.[41]

Orthoptic-led dry eye clinic model

Dry Eye Victoria is a clinic that runs from the western suburbs of Melbourne. Patients are referred by their optometrist or local medical officer to the clinic for management of their dry eye disease.

Patients are commonly referred following observations of fast tear film break-up time of less than 10 seconds in addition to ocular hyperaemia, punctate epithelial erosions, blepharitis, telangiectatic lid margins, or meibomian gland dysfunction. The patients present with a variety of symptoms including grittiness, soreness, tired eyes, fluctuating vision and dependence on ocular lubricants. Other ocular surface and adnexal issues such as pterygium, conjunctivochalasis, Sjogren's syndrome, lid abnormalities, infection, surgical or traumatic injuries, are investigated and treated by the ophthalmologist. If the patient presents with vision and migraine symptoms, this is also investigated by the ophthalmologist prior to a patient being referred to the dry eye clinic.

The initial consultation with the ophthalmologist includes a comprehensive baseline ocular examination, including a dilated ocular exam performed by the ophthalmologist within the ophthalmic clinic. The ophthalmologist then refers patients who require dry eye management or comprehensive ocular surface review to the dry eye clinic. In effect, this serves as a triage for the dry eye clinic.

Subsequent consultations are managed by an orthoptist trained in the investigation and management of dry eye disease. The orthoptist conducts a thorough patient history. Patients are questioned about their diet and lifestyle factors which may affect their condition, such as occupation, caffeine intake, quality of sleep and potential stressors. Early identification of factors that will create a set-back to recovery, and appropriate patient counselling of the condition and expectations is very important in achieving long-term outcomes. When patients are aware of contributing factors, such as excessive computer work as part of their job or having rheumatoid arthritis for instance, they can have a better understanding of what impacts their condition during flare-ups, how to manage their dry eye daily, and what their prognosis is likely to be.

A questionnaire, the Ocular Surface Disease Index (OSDI), is administered to each patient at each visit. This a 12-item scale for the assessment of symptoms related to dry eye disease and its effect on the patient's comfort in windy or dry environments, while performing activities demanding visual attention. The OSDI is used as a rough estimate of a patient's progression of symptoms from their baseline examination.[42]

Imaging of the anterior segment and adnexa is performed using the Oculus Keratograph® 5M (Oculus Inc, Arlington) (Figure 3). This allows image and video capture of the tear film, lid margins, meibomian gland structure, cornea and conjunctiva.

Using the Oculus Keratograph, tear film dynamics are assessed by measuring: i, the tear meniscus height which indirectly assesses aqueous production; ii, the non-invasive tear film break-up time and rate of flow, indicating tear film stability; as well as interferometry to describe lipid layer thickness and spread over the corneal surface (Figure 4). Lid margin imaging and meibography as well as corneal and conjunctival integrity are assessed. An example of this is shown in Figure 5.

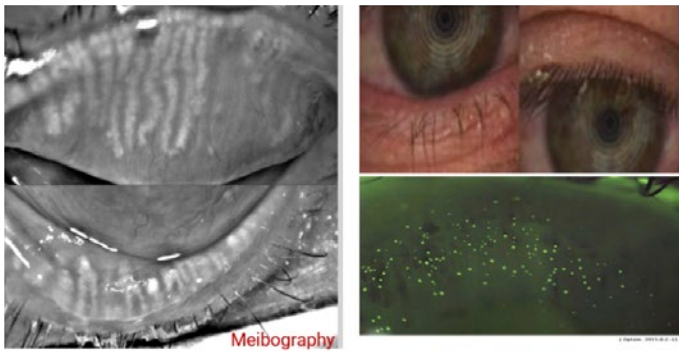

Figure 5. Meibography, lid margin assessment including observation of lash collarettes and telangiectasia, fluorescein staining of the cornea showing punctate epithelial erosions and areas of premature corneal surface drying.

Further to this, investigation of lid function, blinking, corneal sensitivity and testing for Bell's phenomenon are undertaken. The patient is informed about the clinical outcomes and treatment options.

INTERVENTION – DECISION MAKING MODEL

The orthoptist uses clinical judgement to counsel patients with regards to treatment options based on the clinic's Decision Making Protocol Tool (Figure 6). This allows the orthoptist to incorporate the multi-factorial understanding of dry eye disease and target the treatment based on the identified contributing factors for the individual.

A main function of the Dry Eye Victoria clinical model is in identifying the presence of meibomian gland dysfunction as this is a highly prevalent finding in dry eye disease pathophysiology and an effective target for interrupting the cycle of dry eye disease. Possible exacerbating factors are also investigated, such as anterior blepharitis or potential allergens. Once identified, conventional treatments are offered and explained. This may entail maintaining a twice-daily routine with application of a moist heat mask for 10 minutes, lid hygiene with warm water massages or a pre-formulated tea tree lid wash if required in the presence of demodex and collarettes, and instillation of topical lubricants such as sodium hyaluronate 2mg/ml during the day, as well as 138µg/g retinol-palmitate/lanolin/paraffin ointment at night. The twice-daily routine is conducted over six weeks initially, and the ocular surface signs and symptoms are re-evaluated by the orthoptist at the end of six weeks.

From experience there is some success with these conventional outcomes at the first patient review, which is usually at six weeks post initial assessment. If success continues and the patient is happy and able to pre-emptively manage their symptoms before severe aggravation, then this is a successful outcome. However, some patients do require direct expression of their meibomian glands to open the meibomian gland orifices and allow free secretion of meibum. Patients need to be advised that it is uncomfortable and will result in some lid swelling with some secretions over the next day, though many patients, both in our clinic and in the literature, benefit from this in the longer term.

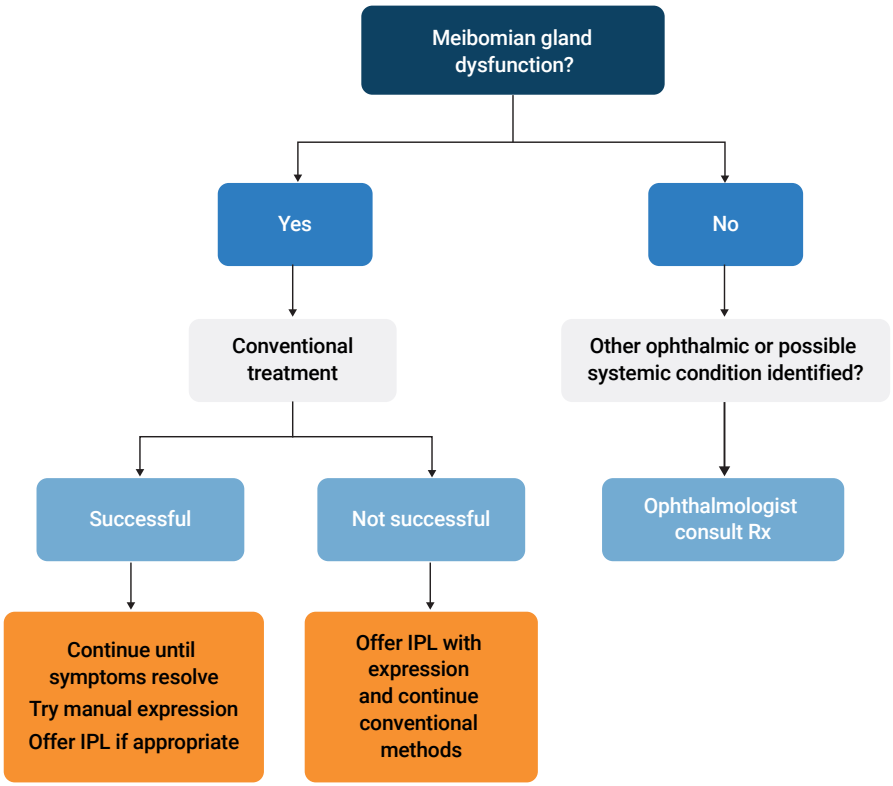

Figure 6. Decision Making Protocol Tool at the Dry Eye Victoria orthoptic-led clinic.

In the event that conventional treatment is not successful, the patient is offered IPL with low-level light treatment. There are several models of IPL available. The Espansione Eye-Light IPL (Espansione Marketing SPA, Bologna, Italy) is used in the clinic.

To determine the energy required by the IPL, the grade/severity of meibomian gland dysfunction is selected based on the meibomian gland structural drop-out seen on meibography with the Keratograph. This is measured between 1 and 4, with 1 being less than or equal to 25% drop-out, 2 being between 26 and 50% drop-out, 3 being between 51 and 75% drop-out, and 4 being greater than 76% drop-out. The clinician also needs to identify the amount of patient skin pigment according to the Fitzpatrick scale to allow the device to operate within safe limits for the individual's specific pigmentation levels.[43] These selections will set the device automatically to a pre-calibrated energy level which can be adjusted at the orthoptist's discretion.

Once the energy level has been set, facial oils and make-up are removed with a moist towelette and the eyes are covered with dark goggles. Five pulses of light are then applied along each cheekbone. Following this, the dark goggles are removed and the IPL mask with LEDs emitting low level light between 590 and 630nm are placed over the patient's face and kept on for 15 minutes.[44] After the IPL application, the lids are again gently cleaned, topical proparacaine is instilled to each eye and the patient's meibomian glands are expressed between two sterile cotton tip applicators while the quality of meibum is noted. Chlorsig is then applied in both eyes and sunscreen is applied over the face.

Patients return in two weeks for a second session and then re-attend at three to four-weekly intervals for additional treatments with a minimum of three and a maximum of six treatments suggested.

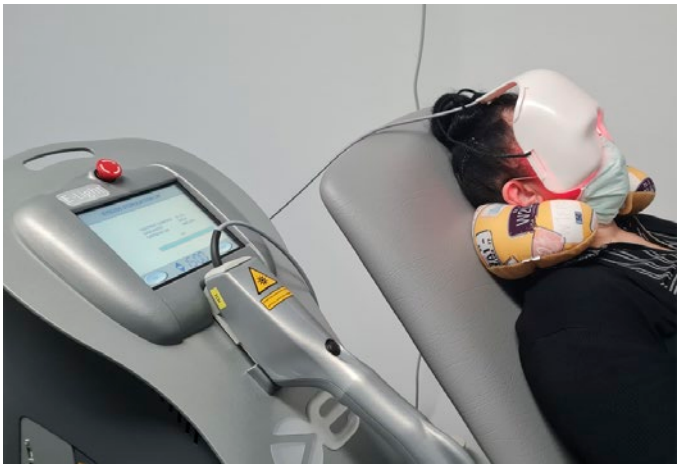

Figure 7. The Espansione Eye-Light IPL and low-level light therapy mask in use (Espansione Marketing SPA, Bologna, Italy).

CASE VIGNETTE

This case vignette describes a typical example of a patient attending Dry Eye Victoria.

The patient is a primary school teacher having significant soreness affecting her left eye more than her right. Yard duty was particularly difficult, she had trouble with bright lights, and was experiencing watery eyes. She had been using a warm towel to wash her eyes at night which she found soothing, and she used a range of ocular lubricants several times a day in addition to a warm compress. She was previously diagnosed 13 years ago with diverticulitis and Sjogren's syndrome. She drinks over two litres of water daily and consumes fish twice-weekly.

Her OSDI score was 56% (>32% indicates severe symptoms according to the OSDI classification).[42] She had a significant tear film lipid deficit with a fast watery film on the left and the lid margins appeared to have some crusting.

The patient followed the conventional care routine for six weeks before undertaking three sessions of IPL and low-level light therapy. With a conservative routine alone, she had a reduction in pain but still experienced dryness in both eyes at night.

After treatment with IPL and low-level light, her tear break-up time improved slightly in the right eye. Her significant lipid deficit also improved in both eyes and a thicker lipid layer was seen. The crusting on her lid margins also improved by the third session. In addition, she had meibomian gland dysfunction of 33-47% at presentation, which improved to between 20 and 30%. She had started to secrete smooth oily meibum and the meibomian gland orifices were open and clear. This indicates

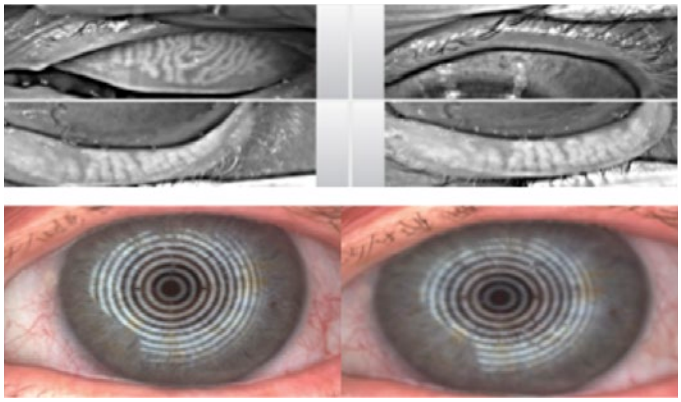

Figure 8. Patient's meibomian gland structure (top) and tear film imaging (below) showing before (left) and after (right) IPL and low-level light therapy. The meibomian glands appear fuller in the lower lids following treatment. Interferometry shows a pearly hue on the ocular surface following treatment compared with a pale hue prior to treatment suggesting an improvement in the spread of meibum through the tear film after treatment.

a positive response to treatment. Her score on the OSDI also improved to 11%, indicating a significant subjective reduction in symptoms.

Figure 8 shows imaging of her meibomian glands and lipid layer by interferometry in the left eye, before and after treatment.

CONCLUSION

Dry eye disease is a common and chronic condition that can have a significant impact on an individual's quality of life. The use of IPL therapy and meibomian gland expression to treat dry eye disease effectively when conventional treatment fails shows promise. We have seen significant improvement in patient signs and symptoms using this treatment method.

Innovative service delivery models where the orthoptist is more involved in the clinical care of patients with dry eye disease show potential to improve patient treatment pathways. Future studies should investigate orthoptists' accuracy in the diagnosis and management of dry eye disease and explore the efficacy of such a service delivery model in terms of cost-effectiveness, impact on patient wait times and the effect on patient outcomes, including satisfaction.

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