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Dry eye: shining a light on IPL (intense pulsed light) treatment

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Meibomian gland dysfunction (MGD) is the most common aetiology of dry eye syndromes. IPL (intense pulsed light) is a promising new treatment for MGD.

But how does it work? What are its indications? How is it used in routine clinical practice? The symposium organised by Quantel Medical as part of the SFO [French Society of Ophthalmology] conference aimed to answer these questions and "shine a light" on this new treatment.

IPL: operating principles

Based on the presentation
by Dr S. Doan (Paris)

IPL has been used in dermatology since 1994 to treat various skin conditions (rosacea, acne, age-related vascular and pigmented lesions) and in cosmetic medicine (skin rejuvenation and permanent hair removal). Back then, it was noticed that patients with rosacea who received IPL treatment experienced an improvement in their dry eye. IPL began to be used in ophthalmology in 2002.

IPL emits high intensity flashes of polychromatic white light. In the treatment of MGD, the emission spectrum is between 400–610 and 1200 nm, with a fluence of between 8–12 J/cm^2 and 10–56 J/cm^2. To limit heating of the skin, the pulses are calibrated to be of very short duration (pulsed light).

There appear to be multiple mechanisms of action, which are yet to be fully elucidated. Unlike in dermatology, IPL does not cause vascular thrombosis when used in ophthalmology. Instead, it causes moderate skin heating leading to a reduction in palpebral telangiectasia. The thermal effect is significant and liquefies the meibum. The microstructure of the meibomian glands is improved after treatment. There is also a change in tear lipids and proteins after IPL. The observed anti-inflammatory effect is ocular (biochemistry of tears) and cutaneous. Photobiomodulation resulting in increased fibroblast proliferation and collagen synthesis may occur. A neuronal effect has also been suggested, whereby IPL has an impact on the sympathetic/parasympathetic systems involved in regulating the meibomian glands. Its effect on certain types of neuropathic pain points to possible "neuronal resynchronisation". Finally, it is anti-infectious, eradicating Demodex.

All of these mechanisms most likely have a synergistic and complementary effect in the treatment of MGD [1-4].

IPL's role in the treatment of MGD and combination therapies to optimise results

Based on the presentation
by Dr S. Lazreg (Blida, Algeria)

MGD has been better described and studied in recent years, following the creation of a working group (MGD Workshop, TFOS) in 2011. Improved knowledge of the mechanisms involved in MGD means it is easier to develop treatment approaches (***Fig. 1***).

Several treatments can be initiated alone or in combination. Drug-based treatment comprises preservative-free artificial tears, lipid emulsions, local anti-inflammatory drugs and local or oral antibiotics (azithromycin and cyclins). In addition to corticosteroid eye drops, which are most often prescribed in the event of an inflammatory flare-up, immunomodulatory eye drops such as ciclosporin or tacrolimus are also used in the treatment of MGD. The eradication of *Demodex* involves the prescription of wipes impregnated with tea tree oil and, more rarely, ivermectin. Eyelid hygiene is essential.

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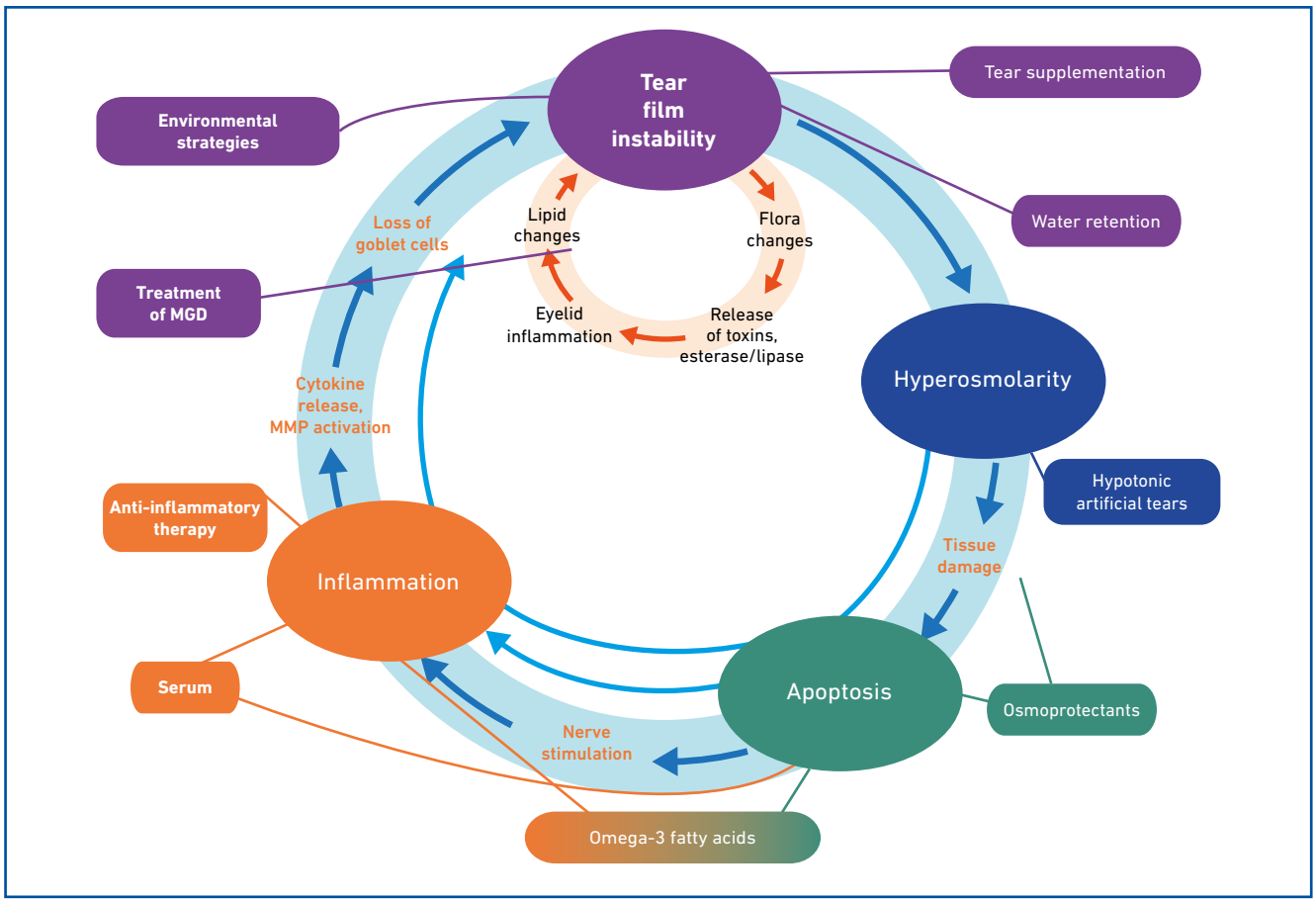

Fig. 1: Treatment options, vicious cycle based on [6].

Eyelid massaging can be time-consuming, which explains why long-term compliance is usually poor. Alternatives have been proposed in recent years that are aimed at enhancing meibum expression: manual expression with Collins forceps, Blephex, Lipiflow, Ilux, Activa, Rexon-Eye and IPL.

So is there a miracle treatment protocol? It is only possible to select the right option from among all these treatments once a precise diagnosis has been established. The treatment protocol should be systematised and targeted to each patient, always starting with the least invasive and least expensive option (***Fig. 2***).

There is no consensus on the prescription of physical treatments, including IPL. It is a case of drawing on common

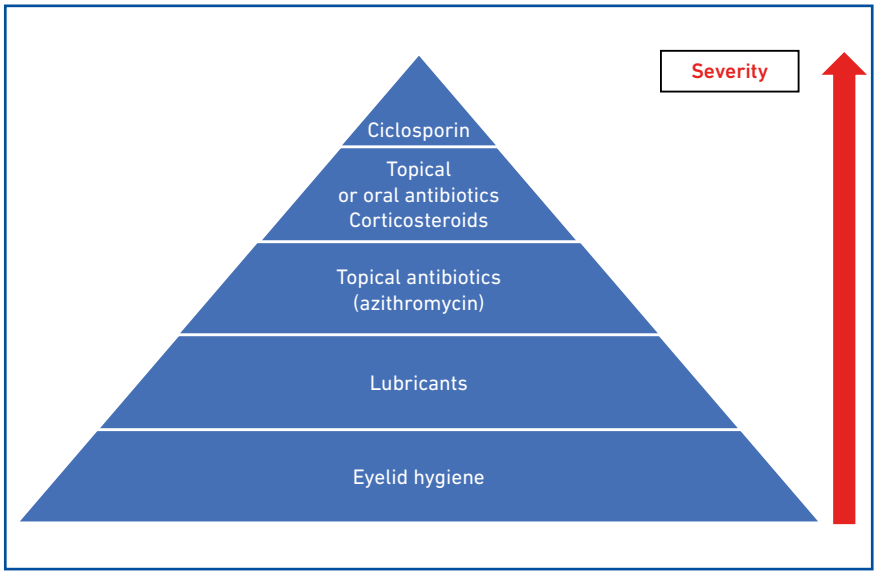

Fig. 2: Systematised and targeted treatment protocol, by Dr Lazreg. Each additional step is added to the previous step. Eyelid hygiene is therefore essential and needs to be prescribed at all times.

sense and knowing how to blend treatments to minimise the iatrogenic effect. If the aqueous layer is affected, punctal plugs may be inserted. If the patient has evaporative dry eye syndrome due to decreased secretion, IPL will be effective. Where there is decreased secretion, the free margins should be cleaned prior to using IPL, e.g. with Blephex ± manual expression using forceps [5-7].

Dry eye: Quantel Medical IPL in routine clinical practice

Based on the presentation
by Dr M.-C. Trône (Saint-Étienne)

C.STIM IPL is a new device marketed by Quantel Medical (replacing LacryStim). It has the following characteristics: the light spectrum is between 610 and 1200 nm and the fluence is delivered by pulse train. There is a single handpiece with an integrated water-based cooling system. The touchscreen interface is easy to use. The cost of use is reduced, as no single-use consumables are needed. At present, it can treat phototypes 1 to 5.

Patients must be suitably informed before beginning IPL sessions. It is essential that eyelid hygiene and other prescribed treatments are continued.

The IPL treatment protocol comprises three sessions on D0, D15 and D45 (plus a fourth optional session) involving four shots under the lower eyelid (three vertical shots below and one horizontal shot at the temple). Fluence can vary from 8 to 14 J/cm^2. At the beginning of each session, the patient is positioned on a chair or bed. The skin is cleaned and any moles or tattoos are protected with white patches. A thin layer of clear gel is applied to the cheekbones. During the shots, the patient must wear protective goggles and the operator must wear protective glasses. The session is quick (lasting just a few minutes), simple and painless. After each session, the patient is advised to avoid sun exposure for 24/48 hours. The results can be improved by manual expression of meibum using forceps after each session (***Fig. 3***). An objective analysis of the ocular surface (e.g. using LacryDiag) before and after treatment can be performed to assess the results.

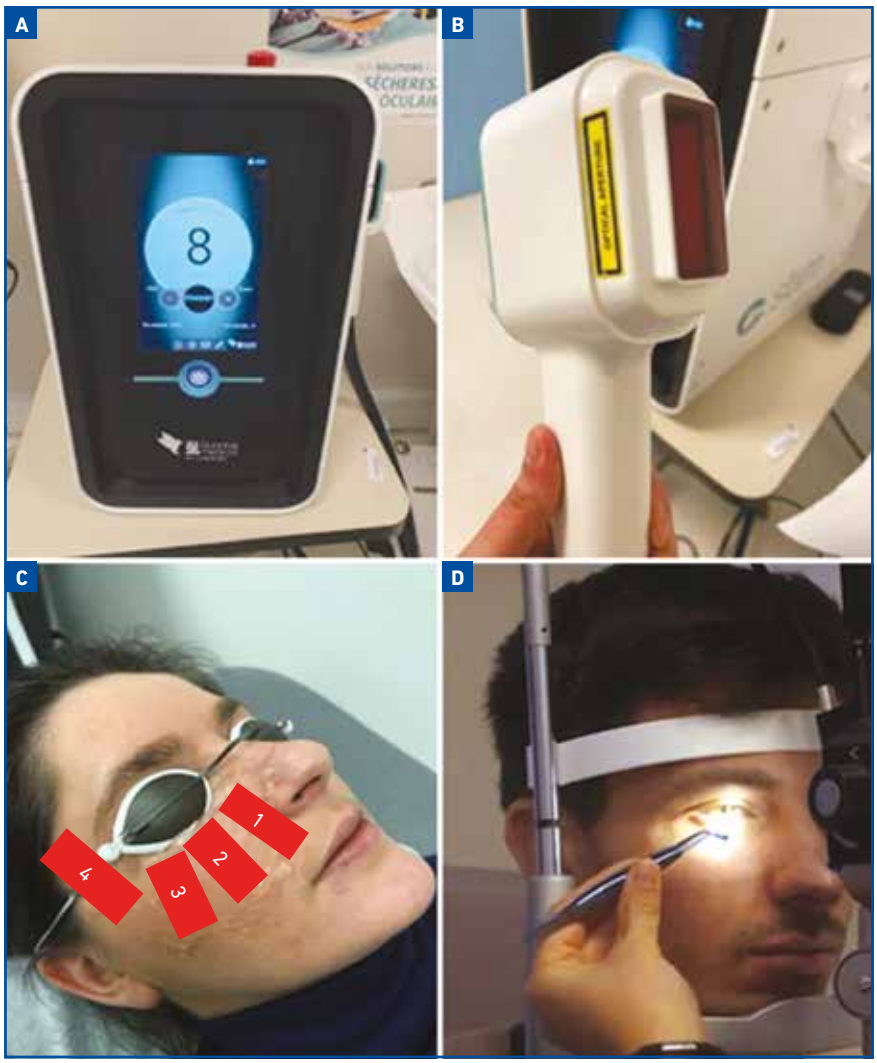

Fig. 3: C.STIM IPL by Quantel Medical. **A:** touchscreen interface. **B:** ergonomic handpiece with integrated water-based cooling system and tip with optimal optical features (Stim-ULI technology). **C:** at each session, four shots per side (three on the cheekbone and one at the temple). **D:** manual meibum expression can be performed with forceps at the end of the session to optimise the IPL results.

Two studies have been conducted at Saint-Étienne University Hospital to assess the efficacy and safety of the Quantel Medical IPL system. A first retrospective study of LacryStim IPL was performed on 45 patients treated consecutively between 2019 and 2020. The primary endpoint was the change in non-invasive tear break-up time (NIBUT) between D0 and 3 months. At 3 months, there was a significant improvement in NIBUT, of 1.6 seconds (95% CI: 0.5–2.6; p = 0.03), as well as in the Ocular Surface Disease Index (OSDI), Oxford score and interferometry. BUT, tear meniscus height and Schirmer's test remained unchanged. These results were maintained at 6 months. This shows the beneficial impact of IPL on the meibomian glands and therefore on the lipid layer. Safety was excellent: no adverse effects were observed.

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A second study involving C.STIM IPL is ongoing. Thirty-five patients with moderate MGD were treated with IPL (8 J/cm^2 on the right and 14 J/cm^2). Interim results show an improvement in NIBUT correlated with an improvement in OSDI at 3 months.

To confirm these results and the efficacy of IPL, a randomised controlled clinical trial needs to be conducted [8].

How to recognise and treat chronic ocular surface pain in 2022

Based on the presentation by Prof. M. Labetoulle (Kremlin-Bicêtre)

Cold thermoreceptors are particularly involved in the pathogenesis of symptoms of dry eye and corneal hyperalgesia. Evaporation of the tear film is the stimulus that triggers the neuronal response. The afferent pathway begins in the cornea, then travels through the trigeminal ganglion and brainstem, ending in the thalamus and the anterior cingulate and prefrontal cortex.

Chronic ocular surface pain is defined as a sensation of pain or extreme discomfort emanating from the ocular surface that lasts for more than three months. Nociceptive pain (due to nociceptor activation and resulting from actual or imminent damage to non-neuronal tissue) must be distinguished from neuropathic pain (caused by damage to or disease of the somatosensory, central or peripheral nervous system). Tear hyperevaporation is therefore an aetiology of nociceptive pain and MGD is a cause of neuropathic pain.

The treatment of central and peripheral neuropathic pain involves the use of drugs that regulate pain messages (calcium/sodium channel blockers, tricyclic antidepressants, serotonin reuptake inhibitors, opioids, etc.). In the case of peripheral neuropathic pain, local homoeostasis needs to be restored. This involves the use of growth factors (autologous serum, plasma rich in growth factors, amniotic membrane) and/or mechanical protections (amniotic membrane, soft or scleral lenses), and IPL. IPL has a local anti-inflammatory effect and reduces the concentration of certain mediators (PGE2, interleukins 6 and 17) that increase the release of substance P, a source of hyperalgesia, allodynia and synalgia.

It is in this context that Bicêtre University Hospital has begun work to assess the efficacy of IPL in MGD with a neuropathic component. The preliminary results are encouraging and promising: after IPL treatment, patients show an improvement in OSDI score and their keratopathy (Oxford score) [9-12].

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