

Ocular Surface Optimization in Cataract & Refractive Surgery

Pre-operative Ocular Surface Optimization and Lacrimal Occlusion: A 3-Step Clinical Guide from the PEARL Working Group

PEARL Working Group (Pre-operative Expert Advisory group on the Role of Lacrimal occlusion)

The PEARL Working Group was convened with a clear objective: to produce a practical, implementable guide for pre-operative ocular surface optimization that clinicians can apply in routine practice. The group focused specifically on what the minimum necessary assessment looks like, how to structure the management approach, and where lacrimal occlusion can add meaningful clinical value. The PEARL Working Group is composed of:

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Executive summary

Introduction: Ocular surface disease (OSD) — predominantly dry eye disease (DED) — is highly prevalent in patients presenting for cataract or elective refractive surgery, yet remains under-recognized in clinical practice due to the high proportion of asymptomatic cases. Unmanaged OSD compromises biometric accuracy, impairs refractive predictability, and is a recognized driver of post-operative dissatisfaction, particularly in premium intraocular lens (IOL) candidates. Despite the availability of effective interventions, no universally adopted consensus framework exists for the systematic pre-operative management of OSD. Its integration into pre-operative care, however, remains limited and inconsistently applied.

Methods: A European international working group of four ophthalmologists with expertise in ocular surface disease, cornea, refractive surgery, and cataract surgery convened for a full-day face-to-face meeting. Through structured discussion grounded in clinical experience and familiarity with the current evidence base, the group developed a practical framework for pre-operative ocular surface optimization. Particular attention was given to defining the minimum assessment and workup required to identify OSD in surgical candidates, with the aim of producing a framework that is feasible to implement in routine clinical practice. The resulting guide was developed with financial and organisational support from Nordic Group.

Conclusion: Pre-operative ocular surface assessment is a clinical prerequisite in every surgical candidate, not a step reserved for symptomatic patients. Systematic screening consistently identifies subclinical OSD that would otherwise go undetected — and untreated. A structured 3-step approach covering risk assessment, diagnostic workup, and targeted optimization provides a reproducible and clinically feasible framework across practice settings. Lacrimal occlusion with Cross-linked hyaluronic acid (HA) canalicular gel (LacriFill®) provides a single administration non-pharmacological option that addresses tear deficiency directly and may be integrated into the pre-operative pathway for selected patients based on clinical profile and individual circumstance. Treatment decisions should always reflect the full patient picture and be guided by clinical judgement.

How to Use This Guide

01 Risk Assessment

Screen every surgical candidate systematically for OSD risk factors, even in the absence of symptoms.

02 Diagnostic Workup

Apply a tiered pre-operative screen:

- Minimum: staining + TBUT
- Valuable add-on: symptom assessment
- Informative: tear volume in at-risk patients.

03 Targeted Optimization

Initiate treatment based on findings. Lacrimal occlusion addresses tear deficiency directly and can be used together with, or without other therapies.

Declaration of interest: PEARL Working group members received honoraria from Nordic Group B.V. for their advisory contribution. Medical writing support was provided by Cencora. Content reflects the independent clinical judgement of the working group. This guide has been developed as external practical discussion guide to support screening, diagnosing and treating OSD in the pre-operative setting and the role of lacrimal occlusion in this setting. Prescribing decisions should follow clinical judgement and approved prescribing information.

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Ocular surface disease (OSD), particularly dry eye disease (DED), affects more than half of patients presenting for cataract surgery and many refractive surgery candidates, yet is frequently under-recognized without systematic screening — an “iceberg phenomenon” where only symptomatic cases are identified.^{1–3} Unmanaged OSD compromises biometric accuracy, impairs refractive predictability, and drives post-operative dissatisfaction, particularly in premium IOL and refractive surgery patients.^{2–7} TFOS DEWS III (2025) and others reaffirmed the need for pre-operative ocular surface optimization even in patients with minimal signs.^{5–9} This guide provides a concise, stepwise framework and evidence-based patient profiling to support clinical decision-making and the rational use of Lacrifill® as part of this strategy.

3-Step Pre-operative Protocol

STEP 1 Medical history & risk assessment

Screen all surgical candidates systematically for OSD risk, even in the absence of symptoms. Key risk factors:

Key risk factors for OSD to screen for before cataract or refractive surgery

Patient-related risk factors	Ocular risk factors
Older age, female sex, hormone replacement therapy	Known DED or ocular allergy
Diabetes (especially with neuropathy or poor glycaemic control)	Meibomian gland dysfunction (MGD) or blepharitis
Autoimmune diseases (Sjögren’s syndrome, rheumatoid arthritis, thyroid disease)	History of contact lens intolerance
Oncology patients (chemotherapy, hormone therapy, immune checkpoint inhibitors, antigen drug conjugates (ADCs))	Prior corneal refractive surgery (LASIK / PRK / SMILE)
Systemic medications that reduce tear secretion: antihistamines, antidepressants, anticholinergics, β -blockers, isotretinoin, anti-glaucoma drops (especially preserved)	Long-term topical therapy, especially preserved drops
Mental health conditions, chronic pain syndromes, and sleep disorders (as these patients may report more severe subjective symptoms of DED).	Non-reproducible keratometry / biometry
Patient occupation: significant screen time, long flights and air conditioning	Self-funded / premium surgery with high patient expectations

STEP 2 Pre-operative ocular surface workup

Apply a minimum feasible screen to every surgical candidate. Escalate based on risk factors and initial findings:

MINIMUM — required in every patient

- Corneal staining (fluorescein $\pm$ lissamine green) — the single highest-yield baseline test in routine practice; should be performed in all patients without exception.
- Tear film break-up time (TBUT) — adds important information on tear stability; <10 s warrants attention, <5 s indicates marked instability. Interpret in context alongside other findings.

VALUABLE ADD-ON — recommended where feasible

- Symptom questionnaire (e.g. OSDI, OSDI-6 or SPEED II, VAS) — given the high prevalence of asymptomatic disease; identifies patients who need further evaluation

INFORMATIVE — useful in at-risk patients

- Tear volume (Schirmer test or tear meniscus height) — particularly informative in patients with suspected aqueous deficiency or high-risk profiles.
- Optional advanced diagnostics may include tear osmolality, MMP-9 testing, and meibography where available

Severity guide: timing of surgery relative to ocular surface status

MILD TO MODERATE	SEVERE / ACTIVE INFLAMMATION
<ul style="list-style-type: none"> ✓ Initiate targeted therapy ✓ Re-evaluate ocular surface (moderate or moderate+ disease) ✓ Proceed when surface is stable 	<ul style="list-style-type: none"> ⚠ Postpone surgery ⚠ Intensive ocular surface optimization ⚠ Proceed only when DED and inflammation are under control

STEP 3 Ocular surface optimization

When OSD or pre-surgical risk factors are identified, initiate targeted treatment before proceeding. A multifactorial approach is typically required:

- Lid hygiene / warm compresses for MGD; thermal pulsation when indicated.^{10–12}
- Preservative-free lubricants, initiated pre-operatively.^{13–15}
- Anti-inflammatory therapy (cyclosporine A, lifitegrast, topical steroids) — indicated when active ocular surface inflammation is present; not required in the absence of inflammation.^{2,8}
- Lacrimal occlusion (punctal plugs or cross-linked HA canalicular gel) targets tear deficiency directly.^{16–18} Ocular surface inflammation should be assessed and, where appropriate, managed, although it does not necessarily preclude treatment where tear deficiency is significant — the exception being severe or active inflammation, which should be controlled before proceeding.

Patient communication: Set realistic expectations pre-operatively. Many patients are unaware of underlying dry eye; proactive communication prevents post-operative dissatisfaction.

Lacrimal occlusion with Lacrifill® in Ocular Surface Optimization

Lacrifill® (cross-linked hyaluronic acid canalicular gel) offers a minimally invasive, office-based approach to tear conservation. In a prospective, multicentre, randomised, double-masked RCT, Lacrifill® demonstrated non-inferiority to a commercially available canalicular plug on Schirmer score improvement and OSDI responder rate at 3 months, with clinically and statistically significant improvements in OSDI, Schirmer score, corneal staining, and TBUT sustained through 6 months.¹⁷ A single administration lasts up to 6 months, removing the need for daily adherence. As a cross-linked HA canalicular gel, Lacrifill® differs from solid punctal plugs and may reduce plug-related mechanical complications and in the pivotal RCT, no cases of plug expulsion, migration, or granuloma formation were reported with Lacrifill®. Current evidence supports its role as a tear conservation strategy, particularly in patients with tear deficiency, poor adherence to topical therapy, or peri-operative ocular surface instability.¹⁹

Pre-operative patient profiling and practical considerations for lacrimal occlusion with Lacrifill®

Based on published evidence, instruction for use (IFU), and clinical rationale. Statements reflect observed effects on signs and symptoms of dry eye and do not imply direct impact on surgical outcomes. Clinical judgement and the full patient profile including comorbidities, concomitant medications, and individual circumstances should guide treatment decisions.

Clinical trigger	Why ocular surface optimization is needed	Ocular surface optimization strategy and the potential role of lacrimal occlusion with Lacrifill®
CLINICAL TRIGGERS — OCULAR SURFACE SIGNS		
Corneal staining (fluorescein / lissamine green)	Marker of epithelial compromise and ocular surface disease; associated with suboptimal visual quality and slower post-operative recovery. ^{20,21}	Address epithelial compromise before surgery. Consider lacrimal occlusion to support surface healing and stability as part of a broader optimization strategy.
Low tear volume (↓ tear meniscus height; Schirmer test)	Associated with increased risk of post-operative dry eye, discomfort, and delayed epithelial healing. ^{22,23}	Tear conservation is the primary goal. In patients with objectively low tear volume, lacrimal occlusion is a rational first-line adjunct. Cross-linked HA canalicular gel may be particularly suitable for those in whom sustained support is needed and daily adherence to lubricants is a concern.
Tear film instability (TBUT <10 s; <5 s when evaporative subtype predominates)	Tear film instability causes fluctuating vision and symptoms, and — particularly when TBUT is markedly reduced — can contribute to variability in topography, keratometry, and biometry measurements. This finding should be interpreted together with other signs and symptoms. ^{24,25}	Surface stabilization before biometry is essential. In patients where tear instability is moderate-to-severe or associated with other signs of OSD, lacrimal occlusion may be considered as part of the optimization strategy. Mild isolated TBUT reduction alone does not necessarily warrant occlusion.
Non-reproducible keratometry / biometry	Tear film instability may contribute to variability and poor reproducibility in topography, keratometry, and biometry measurements, with potential downstream impact on refractive outcomes and patient satisfaction. ²⁶	Do not proceed to surgery with unreliable measurements. Consider optimizing tear stability with lacrimal occlusion as part of a broader management strategy; repeat biometry once the surface is stable.

Based on published evidence, IFU, and clinical rationale. Statements reflect observed effects on signs and symptoms of dry eye and do not imply direct impact on surgical outcomes. Prepared with financial support from Nordic Pharma.

Clinical trigger	Why ocular surface optimization is needed	Ocular surface optimization strategy and the potential role of lacrimal occlusion with Lacrifill®
PATIENT COMORBIDITIES INCREASING OSD RISK		
Diabetes (elevated HbA1c, poor glycaemic control, neuropathy)	Diabetes is associated with epithelial fragility, reduced corneal sensitivity, and delayed wound healing, all of which increase peri-operative OSD risk. ^{27–29}	Proactive surface management is warranted in diabetic patients with signs of epithelial compromise or reduced corneal sensitivity.³⁰ Where tear deficiency coexists with polypharmacy, lacrimal occlusion addresses surface instability without introducing additional pharmacological treatment.
Autoimmune / systemic inflammatory disease (Sjögren's, GVHD, rheumatoid arthritis)	Higher baseline inflammation and tear deficiency markedly increase post-operative dry eye severity. ^{31–35}	Manage active inflammation first. Once inflammation is managed, patients with residual aqueous deficiency are appropriate candidates for lacrimal occlusion. This group often requires both anti-inflammatory treatment and tear conservation to achieve adequate surface stabilization.
Oncology patients (chemotherapy, hormone therapy, checkpoint inhibitors / ADCs)	These therapies can induce epithelial compromise and inflammation, substantially increasing OSD risk. ^{36–38}	In patients with persistent tear deficiency after inflammation is controlled, and where ongoing systemic therapy limits other management options, lacrimal occlusion may be a practical, non-pharmacological and low-burden intervention.
LIFESTYLE & TREATMENT FACTORS INCREASING OSD RISK		
Glaucoma / chronic topical therapy burden	Long-term topical glaucoma drops — especially those containing preservatives such as benzalkonium chloride — directly cause ocular surface toxicity, inflammation, and tear film disruption, frequently resulting in dry eye disease. ^{39–42}	These patients carry a high cumulative surface burden from preserved topical therapy. Lacrimal occlusion may offer meaningful benefit without adding to an already complex regimen. <i>Clinicians should be aware that occlusion may increase ocular surface transit time of topical medication, including IOP-lowering drops, and monitor accordingly.</i>
Mental health conditions (anxiety, depression)	Associated with heightened symptom perception, reduced treatment tolerance, and adherence challenges. ^{43,44}	In patients where poor adherence is the primary barrier to effective surface management, a single-administration of cross-linked HA canalicular gel shifts treatment control from patient to clinician for 6 months. This may be particularly beneficial in selected patients with anxiety or depression where a simplified regimen supports both adherence and engagement with surgical planning.
Systemic medications reducing tear secretion (antidepressants, anticholinergics / antispasmodics, antihypertensives / β-blockers, antihistamines)	These drug classes reduce tear production and/or alter tear composition, contributing to tear deficiency and dry eye symptoms that can compromise biometric accuracy and post-operative recovery. ^{45–47}	When medication cannot be altered and tear deficiency is clinically significant, lacrimal occlusion may be considered to compensate for reduced secretion without adding to the topical drop burden.
Preserved topical drops (any indication)	Preservatives — particularly benzalkonium chloride — are associated with surface toxicity, inflammation, and discomfort. ^{48–50}	Reducing cumulative preservative burden is part of surface optimization. Lacrimal occlusion can serve as a medication and preservative-free complement where surface compromise persists despite preservative-free therapy. <i>Clinicians should be aware that occlusion may increase ocular surface transit time of topical medication, dosage may need to be adjusted accordingly.</i>
Drop-averse, elderly, or patients with physical barriers to self-administration (tremor, Parkinson's, limited dexterity)	Physical barriers and age-related challenges lead to poor adherence, unstable ocular surface, and fluctuating symptoms. ^{51–54}	For patients in whom reliable self-administration of drops is not achievable, office-based lacrimal occlusion is the reliable route to consistent surface management. A single administration of cross-linked HA canalicular gel provides up to 6 months of tear support without any requirement for patient adherence.
High screen time / adverse environmental exposure (air conditioning, pollution)	Environmental stressors contribute to tear film instability and symptom variability. ^{55,56}	Behavioural modification and environmental adjustments are the recommended first approach. In patients with persistent tear instability or symptomatic OSD despite these measures, lacrimal occlusion may be considered as an adjunct, particularly in those who are also surgical candidates.
SURGICAL CONTEXT WITH HIGH EXPECTATIONS		
Premium IOL implantation / elective refractive surgery (LASIK, SMILE, PRK) with high patient expectations	Premium IOLs are inherently sensitive to corneal irregularities: higher-order aberrations, abnormal corneal shape, and tear film instability degrade visual quality specifically with these lenses. ⁵⁷ Dry eye symptoms are consistently reported as a leading contributor to patient dissatisfaction following refractive and premium cataract procedures. ^{58–60}	Ocular Surface quality is non-negotiable in this group. In patients with identified tear deficiency, instability or corneal staining, lacrimal occlusion before surgery supports ocular surface health through the peri-operative period. Patient selection and shared decision-making are essential given the elective nature of these procedures.

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