

# Low-Level Light Therapy as a Potential Adjunctive Approach in Mucus Fishing Syndrome: Report of Two Clinical Cases

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**Abstract:** Mucus Fishing Syndrome (MFS) is a chronic inflammatory condition of the ocular surface characterized by repeated mechanical removal of mucus strands, leading to a cycle of irritation and excess mucus production. MFS is often associated with dry eye disease, meibomian gland dysfunction, blepharitis, and allergic conjunctivitis. Patients typically present with conjunctival hyperemia, irritation, and mucus accumulation. We describe two clinical cases of MFS in which low-level light therapy (LLLT) was used as part of a multimodal management approach. The first case involved a 32-year-old woman with a 2-year history of persistent symptoms despite previous treatments. The second case was a 50-year-old woman with severe discomfort and chronic mucus secretion unresponsive to tear substitutes alone. Both patients underwent conservative therapy including topical corticosteroids, acetylcysteine 5%, eyelid hygiene, and adjunctive LLLT (4 sessions in case #1 and 5 in case #2). MFS remains a challenging ocular surface condition requiring combined management of inflammation, mucin hypersecretion, and behavioral factors. In the cases presented, LLLT was incorporated as an adjunctive intervention within a broader therapeutic plan. Although improvement was observed, the contribution of LLLT cannot be determined based on these findings alone and further studies are needed to clarify its potential role in MFS management.

**Keywords:** ocular surface disease, dry eye disease, mucus fishing syndrome, blepharitis, conjunctival epithelium, keratoconjunctivitis sicca, LLLT

## Introduction

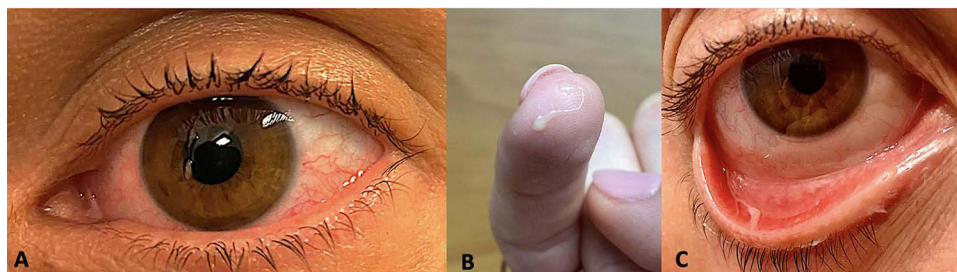
Mucus Fishing Syndrome (MFS) is a rare chronic inflammatory disorder of the ocular surface, characterized by compulsive and repetitive mechanical removal of mucus strands from the eye.<sup>1,2</sup> According to commonly accepted criteria, a disease is considered rare when it affects fewer than 1 in 2000 individuals, which applies to MFS. Patients with MFS often report persistent ocular discomfort, foreign body sensation, and excessive mucus production, which leads to habitual eye rubbing or manual mucus extraction. This behavior perpetuates a vicious cycle of mechanical trauma, epithelial injury, inflammation, and further mucus secretion. The term "mucus fishing" specifically refers to this compulsive act of extracting mucus from the tear film, which exacerbates ocular surface instability.<sup>1</sup> MFS is commonly associated with underlying ocular surface diseases such as dry eye disease (DED), meibomian gland dysfunction (MGD), allergic conjunctivitis, blepharitis, and conjunctivochalasis.<sup>3-6</sup> These comorbidities contribute to hypersecretion of mucus and compromise tear film homeostasis, prompting patients to engage in further extraction behavior. The repeated trauma

inflicted on the conjunctival epithelium aggravates inflammation and promotes goblet cell hyperactivity, leading to a worsening of clinical symptoms.<sup>3</sup> Therefore, effective management requires a multifactorial approach targeting both the underlying ocular surface pathology and the compulsive behavioral component. First-line treatment generally includes preservative-free tear substitutes, topical anti-inflammatory medications, mucolytic agents, and meticulous eyelid hygiene to restore ocular surface integrity. Addressing the behavioral aspect is also essential. Patient education aimed at discouraging mechanical mucus removal plays a pivotal role in clinical recovery and in preventing recurrence. In selected cases, psychological comorbidities such as anxiety or obsessive-compulsive disorder may be involved and require psychiatric evaluation or behavioral therapy. Due to its chronic, relapsing, and treatment-resistant nature, MFS remains a clinical challenge, necessitating individualized and integrative therapeutic strategies. Recently, adjunctive instrumental approaches such as low-level light therapy (LLLT) have gained attention for their potential in supporting ocular surface recovery by improving meibomian gland function and stabilizing the tear film.<sup>7,8</sup> In the present report, we describe two clinical cases of MFS treated with a multimodal regimen that included adjunctive LLLT, with the intention of sharing clinical observations rather than drawing conclusions regarding treatment efficacy. These cases may contribute to preliminary discussion and suggest that LLLT may warrant further investigation as a possible adjunctive option.

## Case Presentations

### Case #1

A 32-year-old female presented with a 2-year history of persistent foreign body sensation, ocular burning, mild conjunctival hyperemia and excessive mucus discharge in both eyes. The symptoms were chronic without seasonal or environmental variation. The patient reported a compulsive habit of mechanically extracting mucus strands from her eyes multiple times daily (Figure 1). Upon examination, uncorrected visual acuity was 20/20. Slit-lamp examination revealed mild conjunctival hyperemia with MGD. The cornea was clear in both eyes, but strands of mucus were adherent to the epithelial surface; conjunctival mucus filaments were particularly concentrated at the inferior fornix, and the tarsal conjunctiva appeared edematous. A comprehensive ocular surface assessment using fluorescein staining showed focal epithelial cell loss and mucus accumulation in the tear film, resulting in punctate conjunctival staining. Tear breakup time (TBUT), assessed with fluorescein, was significantly reduced to 5 seconds. Non-invasive workup using the Keratograph 5M (Oculus, Wetzlar, Germany) demonstrated reduced tear meniscus height (0.10 mm), and NIKBUT values (NIKBUT FIRST 5.22 seconds and NIKBUT AVG 7.30 seconds). The Ocular Surface Disease Index (OSDI) score was 45, indicating moderate-to-severe ocular discomfort symptoms. The patient had been previously managed with tear substitutes and continuous ocular surface irrigation, but these measures did not result in clinical improvement. Consequently, therapeutic strategy was implemented, including topical corticosteroids (hydrocortisone eye drops 3 times daily), mucolytic treatment (acetylcysteine 5% eye drops 4 times daily), and meticulous eyelid hygiene (twice daily). Additionally, the patient underwent LLLT sessions using an infrared light-emitting mask (My-mask<sup>®</sup>, Espansione Marketing S.p.A., Bologna, Italy), initially in the office and later at home. The patient received a total of 4 mask sessions, administered once per week for 4 consecutive weeks. After 2 months, a significant

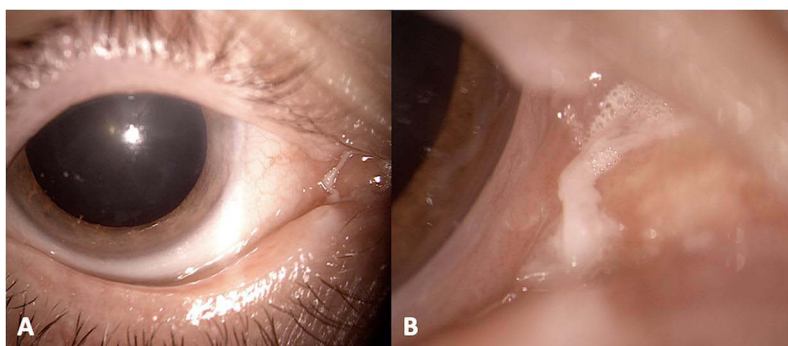


**Figure 1** Photographic documentation of a patient affected by Mucus Fishing Syndrome - Case #1. (A) Slit-lamp photographs of the ocular surface, revealing marked conjunctival hyperemia and the presence of mucous secretions on the corneal surface; (B) Smartphone-captured image submitted by the patient, documenting the manual removal of accumulated mucus from the eye, with the mucus clearly visible on the fingertip; (C) Smartphone-captured image submitted by the patient as evidence of an acute episode of her condition, illustrating how the compulsive mucus extraction behavior led to a temporary exacerbation.

improvement of both signs and symptoms was observed. After completing the LLLT cycle, the patient continued hydrocortisone and acetylcysteine eye drops along with regular eyelid hygiene, with no further treatment changes. Post-treatment assessment revealed a TBUT of 8.0 seconds. Non-invasive Keratograph 5M-assisted workup showed a tear meniscus height of 0.22 mm, NIKBUT FIRST of 9.45 seconds and NIKBUT AVG of 10.12 seconds. The OSDI score decreased to 35.

## Case #2

A 50-year-old female presented with severe ocular discomfort symptoms, persistent foreign body sensation, intense burning, conjunctival hyperemia, and pruritus, accompanied by profuse mucus discharge in both eyes for approximately 3 years. The symptoms were refractory, with progressive worsening, causing marked photophobia and difficulty opening the eyes upon waking. The patient described a compulsive behavior of manually removing mucus filaments multiple times a day. Ophthalmological examination revealed a best-corrected visual acuity of 20/25 in both eyes. Mild periocular erythema was noted, but no significant dermatologic abnormalities were observed on the eyelids. Slit-lamp biomicroscopy demonstrated diffuse conjunctival hyperemia, tarsal edema, and abundant mucus filaments adherent to the conjunctival surfaces. The cornea was clear, though epithelial irregularities were evident due to mucus accumulation, associated with filamentary keratopathy. Fluorescein staining revealed diffused epithelial disruption, with punctate keratopathy affecting both the cornea and conjunctiva. TBUT was markedly reduced to 2 seconds. Non-invasive ocular surface evaluation with Keratograph 5M showed reduced tear meniscus height (0.08 mm), NIKBUT FIRST (1.98 seconds) and NIKBUT AVG (3.25 seconds). The OSDI score was 58. The diagnosis of MFS associated with severe DED and filamentary keratopathy was reached. Prior management with tear substitutes and ocular surface irrigation failed to provide clinical improvement. Therefore, therapeutic approach was implemented with topical corticosteroids (fluorometholone 0.1% 4 times daily), mucolytic therapy (acetylcysteine 5% 4 times daily), autologous serum eye drops 20% 6 times daily, intensive eyelid hygiene with warm compresses and lid cleansing (twice daily) and photoprotection with specialized eyewear to alleviate photophobia. Additionally, the patient underwent LLLT using an infrared-emitting mask to restore lipid layer homeostasis and improve meibomian gland function, initially performed in the clinic and subsequently at home. After approximately 4 months of therapy (mask session once per week for 5 weeks), significant clinical improvement was observed, with marked reduction in mucus hypersecretion, ocular discomfort, and photophobia (Figure 2). Post-treatment evaluation measured a TBUT of 6.0 seconds; non-invasive-assisted Keratograph 5M revealed a tear meniscus height of 0.18 mm, NIKBUT FIRST of 6.0 seconds, NIKBUT AVG of 7.50 seconds. The OSDI score decreased to 38. The patient's compulsive mucus removal behavior was reduced through patient education, leading to a progressive improvement in both symptoms and clinical signs. After completing the LLLT treatment cycle, the patient continued corticosteroids, acetylcysteine, autologous serum eye drops, and eyelid hygiene with warm compresses, with no further changes to the therapeutic regimen.



**Figure 2** Photographic documentation of a patient affected by Mucus Fishing Syndrome - Case #2. (A) Slit-lamp photographs obtained during the follow-up visit after 3 sessions of treatment with Low-Level Light Therapy, showing an improvement in the ocular surface with mild conjunctival hyperemia and the presence of mucous secretions; (B) Slit-lamp image captured with 14x magnification, highlighting the excessive mucus accumulation at the inner canthus.

**Table 1** Demographic and Clinical Outcomes of Patients with Mucus Fishing Syndrome Treated with a Multimodal Approach Including Low-Level Light Therapy (LLLT)

Parameter	Case #1 Pre	Case #1 Post	Case #2 Pre	Case #2 Post
TBUT (s)	5	8	2	6
OSDI score	45	35	58	38
TMH (mm)	0.10	0.22	0.08	0.18
NIKIBUT First/Avg	5.2 / 7.3	9.4 / 10.1	2.0 / 3.3	6.0 / 7.5

**Notes:** Data represent instrumental measurements and clinical outcomes of the two patients.

**Abbreviations:** TBUT, tear breakup time; OSDI, Ocular Surface Disease Index; TMH, tear meniscus height; NIKIBUT, non-invasive Keratograph tear breakup time; Avg, average.

## Methods and LLLT Protocol

LLLT was administered using an infrared-emitting mask (My-mask<sup>®</sup>, Espansione Marketing S.p.A., Bologna, Italy), integrating LED diodes that emit red light at a wavelength of  $633 \pm 10$  nm with an irradiance of approximately 15 mW/cm<sup>2</sup>. Each session lasted 15 minutes and was administered once per week. Initial treatments were conducted under standardized clinical conditions, followed by continued application at home according to manufacturer's instructions. All LLLT procedures were performed by the same physician (A.M). The device employs photobiomodulation through targeted emission of light and heat to the periorbital area. This stimulation of local circulation and glandular metabolism is designed to promote meibomian gland function, enhance lipid layer secretion, and reduce evaporative tear loss. Importantly, the device does not emit direct light toward the ocular surface. No adverse effects were reported during or after treatment. The parameters were based on LM<sup>®</sup> LLLT technology provided by the manufacturer,<sup>7</sup> in line with recent clinical evidence.<sup>8</sup> In both cases, LLLT was integrated into a broader regimen including corticosteroids (hydrocortisone in case #1 and fluorometholone in case #2), acetylcysteine 5% eye drops, artificial tears, and eyelid hygiene. In case #2, autologous serum and photoprotective eyewear were also included. LLLT commenced following a stabilization phase of at least 2 weeks on conventional therapy. Corticosteroids were tapered during the LLLT period. Topical acetylcysteine 5% eye drops were continued during the LLLT treatment phase in both cases. To provide a concise visual overview of the clinical evolution in both patients, key pre- and post-treatment parameters are summarized in the table below (Table 1).

## Discussion

MFS requires a comprehensive and individualized therapeutic strategy rather than a single-modal approach. In the cases presented herein, first-line treatment focused on optimizing ocular surface health through the use of tear substitutes, anti-inflammatory eye drops, mucolytic agents, and meticulous eyelid hygiene. Additionally, addressing the behavioral component of MFS was essential to facilitate healing and prevent recurrence. Patient education played a crucial role in discouraging excessive eye rubbing and mucus extraction, which significantly contributed to symptom improvement. Tear supplementation plays a critical role in stabilizing the tear film and diluting inflammatory mediators, while mucolytic agents, such as acetylcysteine, assist in disrupting excessive mucus aggregation and improving tear film clarity. In patients with concomitant MGD or blepharitis, adjunctive therapies including eyelid hygiene regimens, warm compresses, and lipid-based artificial tears are vital for improving meibomian gland function and reducing evaporative tear loss.<sup>6</sup> In cases of persistent ocular surface inflammation, short-term topical corticosteroid therapy (e.g., fluorometholone or hydrocortisone) may be useful to suppress inflammatory cytokine activity and facilitate epithelial recovery. In more severe or refractory presentations of the disease, autologous serum eye drops have a regenerative treatment function, exploiting anti-inflammatory and epitheliotropic factors to promote corneal and conjunctival repair.<sup>4,5</sup>

In both cases, LLLT was introduced as a potential adjunctive treatment rather than as a primary therapy. Although the use of LLLT may have contributed to support tear film stability and meibomian gland function, its specific contribution cannot be determined based on these observations. This is in line with preliminary findings in the literature, where LLLT has shown promising results in patients with MGD and DED.<sup>8</sup> The application of the mask, which generates localized

heat and stimulates lipid secretion, may reduce evaporation and improve ocular surface lubrication, factors particularly relevant in MFS management. It should be highlighted that the contribution of LLLT remains speculative due to the absence of objective biomarkers and the concomitant use of multiple treatments. While both patients experienced a reduction in mucus accumulation and foreign body sensation following treatment, these improvements cannot be attributed solely to LLLT. Moreover, the absence of a control group limits the ability to determine the specific contribution of LLLT, and future comparative studies are warranted to validate its efficacy. Whether repeated or maintenance LLLT sessions may be needed remains unknown and should be evaluated in future research. Additionally, as noted in previous reports, the effects of LLLT may be transient, and repeated sessions could be necessary to sustain clinical benefits.<sup>8</sup> In our study, the first case responded favorably to a combination of mucolytic agents, corticosteroids, and tear film stabilization; in contrast, the second case, characterized by filamentary keratopathy and severe photophobia, required a more intensive therapeutic regimen, including autologous serum therapy and psychological support to address the compulsive behavior of mucus extraction. This case highlights the importance of a comprehensive treatment strategy that integrates medical therapy with behavioral interventions. Psychological factors such as anxiety or obsessive-compulsive tendencies may contribute to the persistence of MFS and should be considered when developing a treatment plan. In fact, McCulley et al discussed the possibility that MFS could be associated with underlying psychological issues such as obsessive-compulsive disorder, which could complicate treatment and necessitate behavioral therapy.<sup>1</sup> This underscores the need for an individualized approach to therapy in MFS patients, where both ocular surface health and behavioral factors are addressed. The clinical cases described in this paper illustrate two distinct severities of MFS, emphasizing the necessity of personalized therapeutic strategies. These findings highlight the importance of tailoring management approaches based on disease severity and the individual patient's needs. Furthermore, greater awareness of MFS among clinicians is essential to ensure early diagnosis and intervention, preventing long-term ocular surface damage and improving patient outcomes. Although no definitive conclusions regarding efficacy can be drawn from these two cases, LLLT may represent a promising adjunctive approach particularly in patients with meibomian gland involvement or refractory disease, and further controlled studies are needed to clarify its potential role in MFS management.

## Conclusion

MFS is a complex and multifactorial disorder that requires a multidimensional therapeutic approach. Recognizing and addressing the underlying ocular surface pathology, while simultaneously modifying patient behavior, is critical to interrupting the pathological cycle and preventing long-term ocular surface damage. Future research should focus on controlled studies assessing the long-term efficacy of LLLT, its potential role as an adjunctive option within multimodal regimens, and on the development of pharmacologic agents targeting goblet cell regulation and mucus hypersecretion.

MFS remains a rare but clinically significant condition that demands an integrative strategy combining medical, instrumental, and behavioral interventions. Increasing awareness, improving diagnosis, and tailoring management to disease severity are key to optimizing patient outcomes. Based on the present findings, no conclusions regarding the clinical efficacy of LLLT can be drawn; however, these observations suggest that further research is warranted to determine whether LLLT may contribute as a complementary therapeutic tool in selected cases.

## Research Ethics

This study followed the tenets of the 2013 Declaration of Helsinki.

## Data Sharing Statement

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Informed Consent Statement

Institutional review board approval was not required for the publication of anonymized case reports according to local regulations. Written informed consent for publication of clinical details and accompanying images was obtained from both patients included in this case series. A copy of the consent is available for review by the Editor of this journal.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this paper.

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